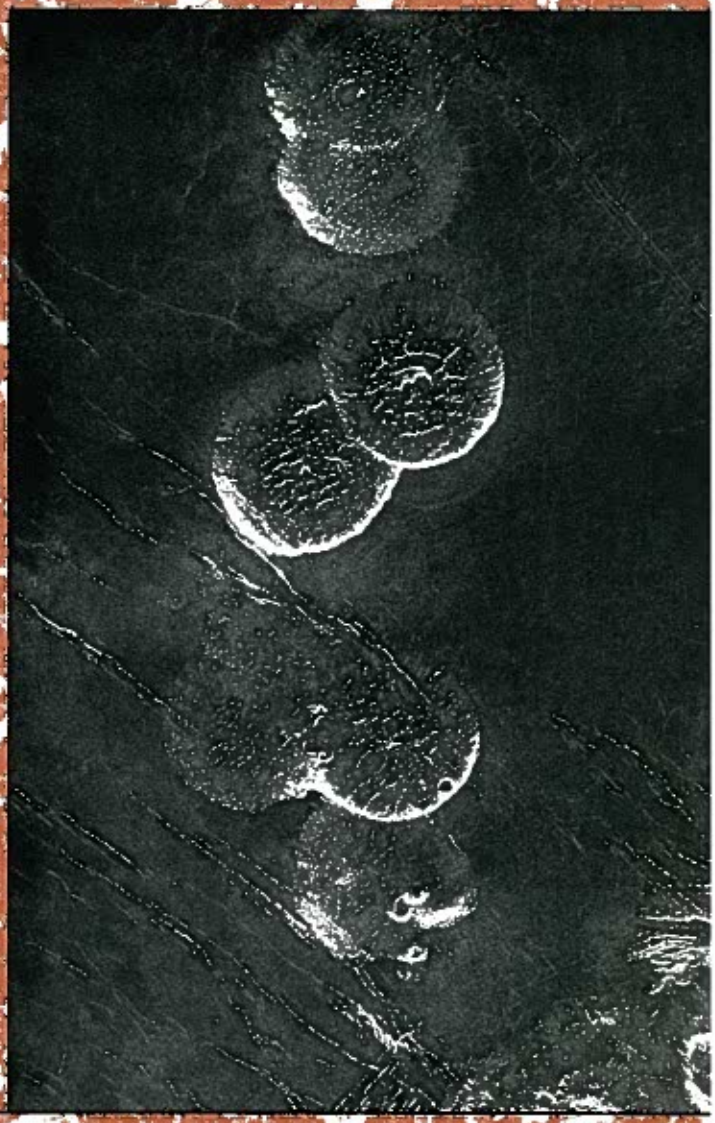
Second National Space Grant Conference Report 91



NATIONAL SPACE GRANT COLLEGE AND FELLOWSHIP PROGRAM

NASA

Second National Space Grant Conference

Cohosted by:
Alabama Space Grant Consortium
and NASA Marshall Space Flight Center
March 11-15, 1991

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NASA
Office of Human Resources and Education,
Education Division,
Higher Education Branch

Cover: "Venus by Magellan," courtesy of the NASA Jet Propulsion Laboratory, 1990.

The background is an area of the Lakshmi region that is located at 30 degrees north latitude and 333 degrees east longitude. The fainter lineations are spaced at regular intervals of about one kilometer, and extend beyond the boundary of the image. The brighter, more dominant lineations are less regular and, in places, appear to begin and end where they intersect the fainter lineations. This type of terrain has not been seen previously on Venus, nor on other planets.

The insert is the eastern edge of Alpha Regio, at 30 degrees south latitude and 12 degrees east longitude. Seven circular, dome-like hills, averaging 25 kilometers in diameter with maximum heights of 750 meters, dominate the scene. These features are interpreted as very thick lava flows that came from an opening on the relatively level ground, which allowed the lava to flow outward from the opening. The domes may be similar to volcanic domes on Earth.

A large mosaic of Alpha Regio, also courtesy of the NASA Jet Propulsion Laboratory, formed the backdrop for the Second National Space Grant Conference in the auditorium of the Administrative Science Building, University of Alabama in Huntsville.

The Second National Space Grant Conference is dedicated to the memory of Dr. Harold J. Wilson, Program Director of the Alabama Space Grant Consortium.

Chairman of the Department of Biological Sciences at University of Alabama in Huntsville, Dr. Wilson played an integral role in the establishment of the Alabama Space Grant Consortium. Described as a leader, Dr. Wilson attained a national reputation in science, and was quite active in academia as well as in his community. He is survived by his wife, Victoria, and his daughter, Ina.

Dr. Harold J. Wilson

1939 - 1991

Planning Committee

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Jeanette Jones
Karen Mack
Frank Six
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Anthony K. Hyder
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Richard Mould
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Michael Wiskerchen
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Industry Displays

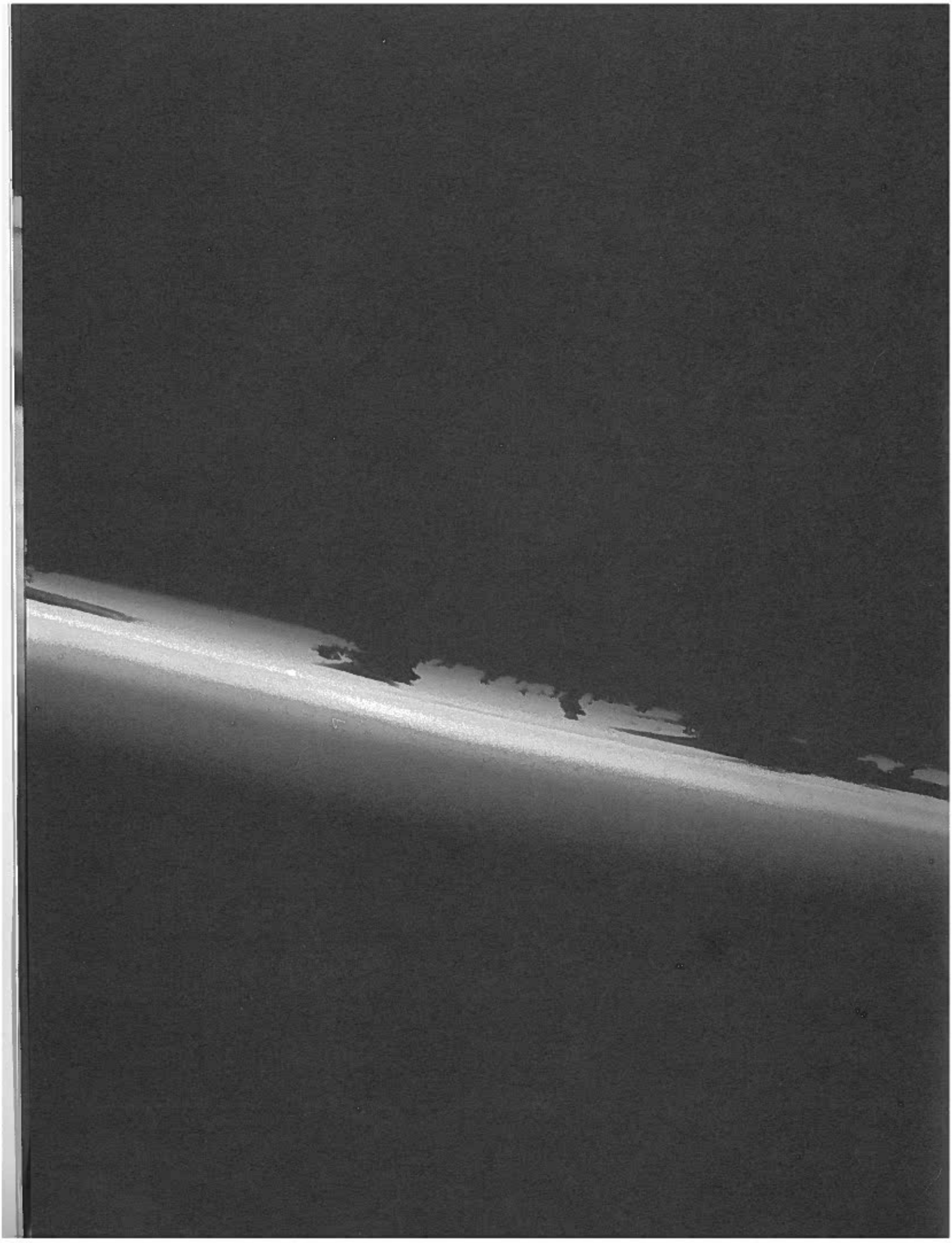
Boeing Aerospace & Electronics
Martin Marietta
McDonnell Douglas Space Systems
SCI Systems, Inc.
Sverdrup Technology, Inc.
Wyle Labs

At the Marshall Space Flight Center

Boeing Camera Crew
Terry Leibold
Tour Guides

The Alabama A&M University Staff and Space Grant Fellows

The U.S. Space and Rocket Center Staff



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Summary, First National Space Grant Conference

The First National Space Grant Conference was held January 17-19, 1990, at the Kossiakoff Center on the grounds of the Johns Hopkins University Applied Physics Laboratory in Columbia, Maryland. It marked the beginning of the Space Grant Program for the 21 Designated Space Grant Colleges and Consortia.

The conference was organized by the NASA Educational Affairs Division/University Programs Branch in conjunction with the Johns Hopkins Space Grant Consortium — the Johns Hopkins University, Morgan State University and the Space Telescope Science Institute — and the NASA Goddard Space Flight Center, which cohosted the meeting.

One hundred forty-eight representatives from the 21 designees met with Headquarters personnel from Educational Affairs and with University Affairs Officers from NASA Field Centers, including Ames Research Center, Goddard Space Flight Center, Jet Propulsion Laboratory, Lyndon B. Johnson Space Center, Kennedy Space Center, Langley Research Center, Lewis Research Center and Stennis Space Center. Space Grant recipients and Field Center personnel were encouraged to establish associations and share resources where feasible.

Conference goals were: (1.) to provide a setting for Space Grant College/Consortia leaders to meet and discuss program plans; (2.) to provide participants with updates on major NASA science and engineering programs and Educational Affairs activities; and (3.) to hold workshops on themes of critical importance to the program.

The conference agenda focused primarily on a series of 15 workshops in which program directors or their designees discussed components of the Space Grant Program. These components — outreach, pre-college education, publicity and organization, for example — were earlier incorporated in very specific ways within individual program plans. The conference thus afforded those attending an opportunity to exchange information and concerns regarding program elements while exploring ways to structure, enhance and perhaps broaden their program plans. Space Grant representatives also discussed with Headquarters officials ways in which the Space Grant Program itself should be evaluated.

Evening activities during the conference included a reception at the Maryland Science Center at Baltimore's Inner Harbor district and a banquet hosted by Morgan State University. The banquet speaker was Dr. Franklin D. Martin, Assistant Administrator, NASA Office of Exploration. Conference attendees were also treated to tours of the APL facilities, the Space Telescope Science Center on the Johns Hopkins Homewood Campus and the NASA Goddard Space Flight Center in Greenbelt, Maryland.

A report, "The First National Space Grant Conference Report", is available (NASA Publication EP-275, 128 pages).

During the First National Space Grant Conference (January 16-19, 1990), invitations were received to host succeeding Space Grant conferences in Huntsville, Alabama (Alabama Space Grant Consortium and the NASA Marshall Space Flight Center) and in Houston, Texas (Texas Space Grant Consortium and the NASA Johnson Space Flight Center). The first-received invitation was accepted for the Second Space Grant Conference to be held in Huntsville. The Third Space Grant Conference will be held in Houston, tentatively in late 1992 or early 1993.

The timing for the Second Space Grant Conference was delayed about two months to allov selection of Phase II — State Consortia and their subsequent participation in the conferenc Owing to the much broader range of participating institutions and programs, the conference agenda was modified from that of the first conference. Additionally, several suggestions resulting from the first conference were incorporated, such as, to hold all content workshops as meetings-of-the-whole, so that all could attend, and to allow time fo presentation by all Phase I programs. Conference goals, however, remained much the sam as those for the first conference:

1. To provide a setting for Space Grant College/Consortia leaders to meet, learn about other participant groups, and discuss program plans;

2. To provide participants with updates on major NASA science and engineering program and Educational Affairs activities;

3. To hold discussions on themes of critical importance to the program; and

4. To provide tours of NASA Marshall Space Flight Center, the University of Alabama in Huntsville, and Alabama A&M University.

Dr. Frank Six, NASA/Marshall Space Flight Center

Dr. Wayne Littles, NASA/Marshall Space Flight Center

Dr. John Yost, University of Alabama in Huntsville

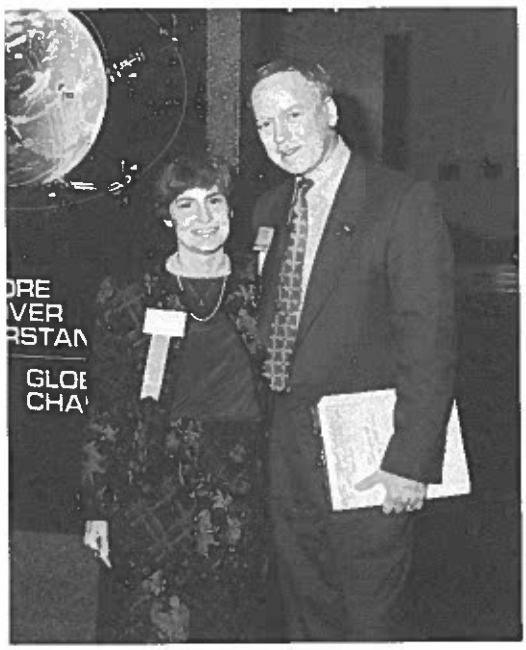
Dr. Frank Six, University Affairs Officer for the Marshall Space Flight Center (MSFC), introduced Dr. Wayne Littles, MSFC Deputy Director, and Dr. John Yost, Provost and Vice President for Academic Affairs for the University of Alabama in Huntsville, both of whom addressed Phase I and II attendees the first full day of the conference.

Dr. Littles attended the Georgia Institute of Technology, the University of Southern California and Harvard, and has been with MSFC since 1967. He has been deputy director for two years.

Dr. Littles welcomed the attendees, applauding the high number of universities and affiliates presently taking part in the Space Grant Program. He stressed the importance of maintaining U.S. technological competitiveness internationally and praised the establishment of university/industry/Government relations which have come about as a result of the Space Grant program. Unions such as these can play an important role in furthering American technology.

Dr. Yost attended Washington State University, Stanford University, Duke University and Cambridge University, and has held posts at the University of Arizona and the University of Nebraska-Lincoln.

Conference Chair Julius Dasch.



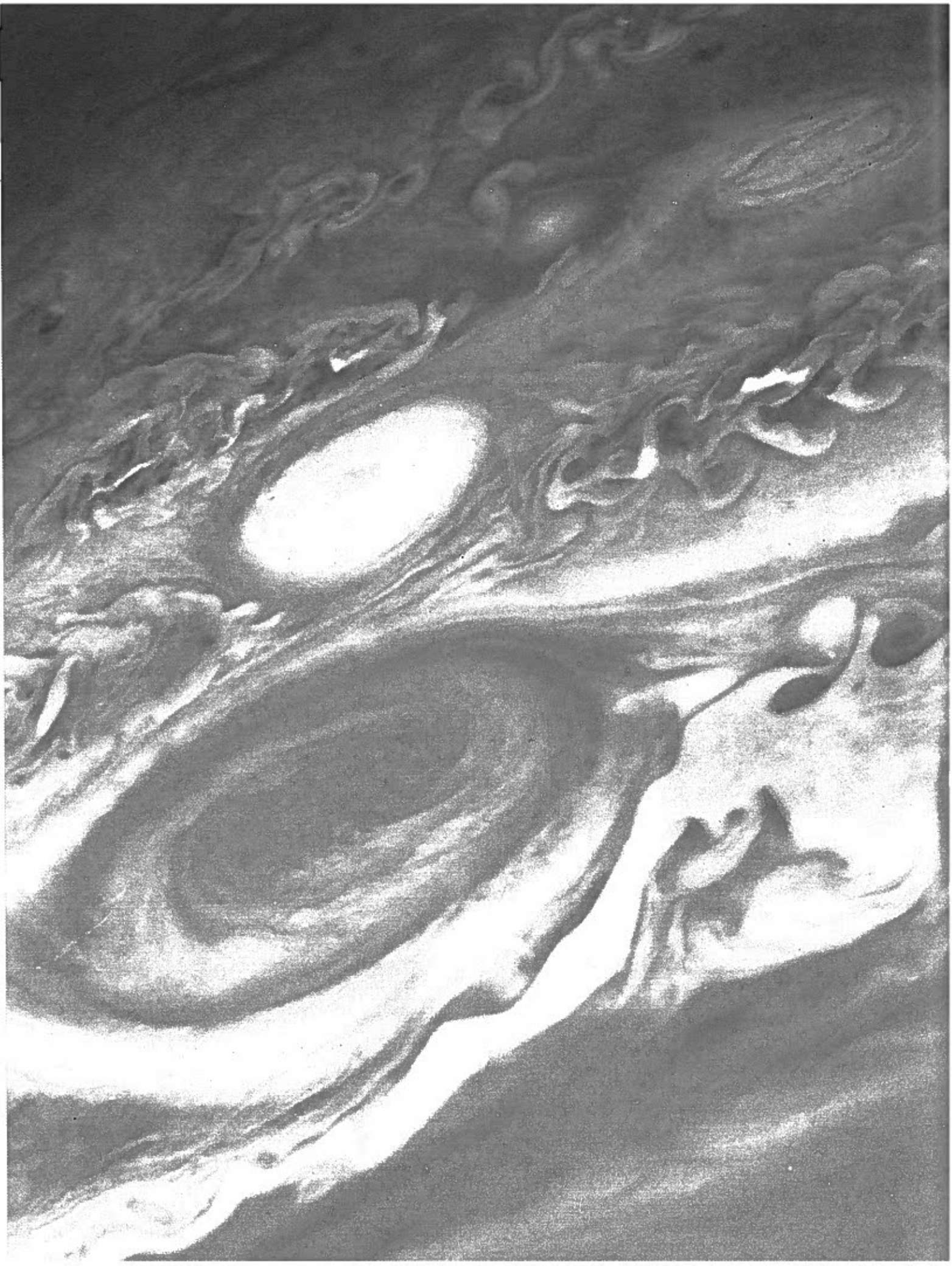
Conference Planning Committee members Jackie Reasoner and Frank Six.

"The science and technology work force is a critical national need that impacts all of us," Dr. Yost said, referring to the Space Grant Program as providing a "unique national network" which, while promoting future scientific and technological endeavors, addresses too, the issue of how to attract greater numbers of women and minorities to science and engineering fields.

Dr. Yost compared the Space Grant Program with the Land- and Sea-Grant Programs, observing that Space Grant achieves a better balance with its emphasis on education. "The Space Grant Program can address science and technological work force needs in a more creative and forceful way, perhaps, than any other program," he said.

Dr. Yost asserted that societal needs are changing and that research and education must meet those needs in creative and innovative ways while continuing to focus on the pressing issues of national security and economic competitiveness. The commercialization of space is one objective of the Space Grant Program, he noted, and an increasingly important goal i the U.S. is to maintain world leadership in space science and technology.

Featured Speakers



NASA Educational Affairs and the Space Grant Program

Dr. Robert W. Brown and Mr. Frank C. Owens, NASA Headquarters

"Kids are excited by space," Frank Owens, Deputy Director of Educational Affairs, told the audience attending the second National Space Grant conference, explaining why NASA supports educational initiatives designed to attract future scientists, engineers and technicians to aerospace and space-related fields. Furthermore, NASA is in a unique position to support education, he said, due to the number of technicians employed by the agency along with its technical capabilities, both of which are important to capturing the interest of young students who will ultimately fill the pipeline.

Owens and Dr. Robert W. Brown, Director of Educational Affairs, stressed that the participation of women and minorities in science and engineering fields must be encouraged since demographics indicate that these groups are underrepresented in the science and engineering fields.

Another issue in the pipeline problem is what Brown and Owens termed "high-tech anxiety" on the part of elementary and secondary teachers. Statistics from the National Science Foundation (NSF) show that of four million students entering elementary school in 1967, only 9,700 (0.2 %) received Ph.D. degrees in 1992, indicating a science and engineering "dropout" rate which could be curtailed by teachers who are well informed and better equipped to teach science.

Owens discussed the "National Goals for Education by the Year 2000" and touched on the Federal Coordinating Council on Science/Engineering/Technology (FCCSET) Committee on Education and Human Resources. NASA's education goals stem from the FCCSET Committee report and include among others a focus on teacher enhancement and curriculum development at the pre-college and undergraduate levels.

Owens summed up NASA's education goals as a three-tiered approach: (1.) capture the student's interest in space at an early age; (2.) channel that interest with programs designed to encourage the student to maintain that interest throughout elementary and secondary school; and (3.) enhance the student's learning experiences with programs to enrich faculty skills at the pre-college and college/university levels.

Brown and Owens cited numerous NASA programs corresponding to the national education goals and the objectives of the FCCSET committee, including the Space Exposed Experiment Developed for Students (SEEDS); the Urban Community Enrichment Program (UCEP); the Advanced Design Program; the Space Grant College and Fellowship Program; Teacher in Space; the Summer Faculty Fellowship Program; and the NASA Teacher Resource Center Network.

Decoding NASA

Ms. Elaine T. Schwartz,
NASA Headquarters

Ms. Schwartz, Chief of Higher Education (FEH) at NASA Headquarters, explained NASA's organizational structure, its commitment to the universities, and the ways to obtain and use knowledge of NASA to increase collaboration and funding.

NASA spends 13-15% of its R&D budget on approximately 5,000 scientists and engineers at 250 institutions of higher education. This occurs mainly through the Office of Space Science and Applications (OSSA, or code S), which receives about 40% of NASA's R&D budget ($2,429.6 million in FY 1991), and the Office of Aeronautics, Exploration and Technology (OAET, or code R), which receives about 15% of NASA's R&D budget ($897.4 million in FY 1991). OSSA funding puts NASA Field Centers in competition with universities and industry. OAET program funding is a contractual arrangement between NASA Headquarters and the NASA Field Centers. Between 1985 and 1990, NASA's obligations to universities doubled in nonadjusted dollars to $513.6 million. OSSA alone funds 5,000 scientists at 250 academic institutions.

The three main ways to gain knowledge of NASA are:

Publications
RTOP reports of the NASA Field Centers.
FEDIX - an electronic data base which has program information for NASA, DOE, NSF, and ultimately all Federal agencies.
Long range/strategic plans for programs and divisions.
Program literature.
NRC post-doctoral program (FEH).
GSRP Graduate Students Researchers Program (FEH).

People
University Affairs Officers at NASA Field Centers.
Professional conferences.
Peer review panels.
Mentoring GSRP students.
NASA phonebooks for HQ and the Field Centers.

Places

NASA Centers	Faculty fellowships. Research institutes. IPA assignments. Graduate student mentors.
Universities	Space Grant network. Joint research/faculty exchanges. NASA Centers of Excellence and Space Engineering Research Centers.

The three main ways of using knowledge about NASA are:

NASA Research Announcements (NRA)
Widely circulated.
Peer reviewed proposals.

Announcements of Opportunity (AO)
Limited opportunities.
Contracts up to several million dollars.
Intensely reviewed (peers, committee, division).
Associate Administrator selection.

Unsolicited Proposals (UP).
Versatile mechanism.
Highly responsive to innovative concepts.
Best to have a technical discussion with NASA before submission.
$25K-300K for individuals, up to $2M/year for institutions.

International Space Year

Mr. Frank C. Owens,
NASA Headquarters

Mr. Frank Owens, Deputy Director for NASA Educational Affairs, began his presentation on International Space Year (ISY) by noting that it was intended to coincide with the 500th anniversary of Columbus' New World discovery, 1992. He stressed the scientific and international thrusts of the ISY effort, which has the primary theme "Mission to Planet Earth."

ISY is coordinated by the Space Agency Forum on International Space Year (SAFISY) through three subgroups, which are Earth Science, Space Sciences, and Education & Applications.

The Earth Science subgroup, led by Dr. Shelby Tilford, will focus on greenhouse effect detections, the oceans, and monitoring of tropical rainforests. The subgroup will ultimately produce a software-based global change encyclopedia and a hardcover atlas.

The Education and Applications subgroup, led by Mr. Owens, is in the process of generating and selecting various training, educational, and outreach projects, and are soliciting support from a number of space agencies.

In closing, Mr. Owens encouraged those in the audience to "put the ISY banner" on their existing programs to help raise the consciousness of what space initiatives have done for mankind.

A Proposal for an International Space Year Partnership with the Challenger Center

Mr. Richard Methia,
The Challenger Center for Space Science Education

Mr. Richard Methia, Vice President of Educational Programs at the Challenger Center, opened his presentation with an illustrated account of past and present educational thinking, asserting that our society needs to break nineteenth-century traditions. The mission of the Challenger Center, accordingly, is to "move teachers and students into the twenty-first century, using experiential learning."

The Challenger Center makes direct contact with students through their Challenger Learning Centers. At these centers, middle-school students take participatory roles in simulated shuttle missions. The idea is to get these students interested in space and science, at an age where they might otherwise tend to develop negative attitudes. A key aspect is that 'science is brought to the students', allowing them opportunities they would not have otherwise. Six centers are currently in operation, and the current goal is to establish a total of 30 to 50 centers within five years.

To reach the educators, the Challenger Center conducts all-day workshops for middle-school teachers. In these, the teachers perform mission-oriented tasks while they are taught to relay the experience to their students. They are also given guidebooks and NASA slides to augment a program for their students.

Mr. Methia's first proposal is to form a viable educational network to foster classroom ideas and modifications, which would be based on associations with Space Grant schools. Essentially, four Saturday workshops per year would be held at each participating school. Each school would be asked

to provide a comfortable room, audio-visual equipment, and if appropriate, access to an interesting space-related attraction on campus.

Mr. Methia's second proposal is for Space Grant schools to host 'Marsville,' the Challenger Center's signature event for 1991-92. The center would initially provide students with four sets of problem activities related to the future settlement of Mars. Later, at the sponsoring school, groups of these students will construct a Martian habitat based on the completed problem sets. The students will be encouraged to work together to solve the various problems related to the colonization of a new planet.

Mr. Methia concluded with an invitation tc contact him regarding interest in these partnerships. For more information, call o write:

Challenger Center for Space
Science Education
Suite 190, 1101 King Street
Alexandria, VA 22314
(703) 683-7546

The Second Golden Age of Exploration

Dr. Charles R. Chappell, NASA Office of Space Science Applications

Mr. Alphonso V. Diaz, Deputy Associate Administrator, NASA Office of Space Science and Applications (OSSA), was unable to attend the Conference, owing to a last-minute congressional committee presentation. In his place, representing the science sector of NASA (OSSA) was Dr. Rick Chappell, Chief Scientist, NASA Marshall Space Flight Center and currently acting at NASA Headquarters for Dr. Joseph K. Alexander, Assistant Associate Administrator for OSSA (see Biography section).

Dr. Chappell defined the First Golden Age of Space Exploration as beginning with Sputnik and ending with the conclusion of the Apollo flight program. He pin-pointed the Second Golden Age as beginning with the return to flight of the STS (shuttle) and presently continuing. Interestingly, the first decade of the Second Golden Age has seen more flights (65) than did the decade of the First Golden Age.

"We really need your help," is the message that Dr. Chappell had for the university audience. Whereas NASA has about 4,000 scientists at Headquarters and in the Field Centers, university investigators on NASA programs, from about 200 institutions, total about 5,000. Only this partnership can make the Second Golden Age of Space Exploration a successful reality.

The NASA OSSA present budget ($2.6B) affects operations in three major areas: (1.) space missions, ranging in scope from majc flight programs to low-cost balloon payloads; (2.) analysis of data returned from these space missions; and (3.) continuing research and analysis, including plans for new missions. A given year in the present OSSA era might see 14 major science exper ments, 10 mid-level programs, 20 manned (STS and Spacelab) missions, 20 operating satellites, more than 300 aircraft flights, 35-45 balloon flights, and 45 sounding rocket experiments. All told, OSSA and universities may have 3,000 experiments in progres at any one time.

Commenting that he would probably be shortchanging someone's favorite project, Dr. Chappell described major ongoing initiatives and flight programs at NASA. He grouped these initiatives loosely into four themes: the Great Observatories; the Secon Wave of Planetary Exploration (Mission from Planet Earth); the Sun, its environment, and its interaction with that of Earth, and Humankind in the Environment of Space (Mission to Planet Earth).

The two Great Observatories are, of course, the Hubble Space Telescope (HST) and the imminent (successively deployed shortly after the conference) Gamma-Ray Observatory (GRO). In an illustrated passage, Chappell described HST, despite its too often negative characterization in the popular press, as the premier instrument of its kind, capable of greater resolution than existing telescopes by factors of from 3 to 10. The GRO, a first of its kind, will provide pictures of the universe through the "eyes" of its most violent form of radiation, gamma-rays.

The magnificent planetary explorers, again illustrated with spectacular images, were described briefly: Magellan, with its beautifully clear radar topography that is astounding the geosciences community; Galileo, en route to Jupiter after exciting flybys of Earth and the Moon; and Ulysses, in quest of data from the largely unexplored poles of our own star, the sun.

The very successful Cosmic Background Explorer (COBE) was described, especially in the context of its revelations on the exceptionally constant background radiation, thought by many to result from the origin of the universe, the Big Bang. Chappell pointed out that, along with HST, COBE may bring about radical surgery on our current cosmological theories.

Finally, NASA's part in the exceptionally popular Mission to Planet Earth concept was discussed, from the ongoing and proposed Earth Observing Satellite (EOS) and the more general themes of Global Change, to projects concerned with materials research on, for example, new alloys and complex organic molecules.

Teacher Education at the Research University

Dr. Richard J. Greenberg, University of Arizona in Tucson

Dr. Richard J. Greenberg holds a joint appointment at the University of Arizona in Tucson. He is a Professor of Planetary Sciences and, more recently, a Professor of Education; one of his missions is to bring these academic units into a more productive relationship. Owing to these unique credentials, Dr. Greenberg was asked to address the Space Grant audience on his perspectives concerning the training of science teachers at research-oriented universities.

Dr. Greenberg's talk covered three topics: (1.) A description of science and education at the University of Arizona; (2.) Things he has learned as a consequence of his dual role at the University; and (3.) The description of a specific, NSF and Space Grant-related program, using planetary and other digital imaging-processing as a tool in science teacher training.

The University of Arizona serves as an archetypal institution for problems and potential in science teacher training. There is distrust, poor communication, lack of knowledge, and structural/administrative (including turf) problems between the schools of science and education. There is a vagueness in the mandate to teach science education. A perception exists with science

faculty that involvement in science education is not a significant factor in tenure and promotion decisions. The science teaching curriculum is unrealistic and uncoordinated. Greenberg's involvement in addressing these problems (review of promotion and tenure procedures, review of curriculum, improvement of the advising function, correcting of administrative roadblocks, and development of closer ties with local science teachers) has benefitted mainly as a result of better communication and a willingness to address each issue, head-on.

Conference participants were delighted to hear Dr. Greenberg's comments concerning what he has learned in dealing with the science education issue, and his candor in delivering some of these anecdotal comments. Despite the hurdles mentioned, most science and education faculty are sincerely and alarmingly concerned with the problems of science and technical illiteracy and the "pipeline". The pipeline issue is not the "catastrophic", "hemorrhaging" problem depicted in the press, so much as a normal selection of other fields for careers. The problem, according to Greenberg, is better technical education for the 50 million entering students, not an over concern with the too-few (10,000) science and technical PhDs awarded each year. Poor preschool preparation and new definitions of "family" must be addressed more effectively. Advancement in pre-college teaching is too much tied to seniority, too little to performance. Teachers have more and more demands for classroom time and resources; a request to add a "few minutes" on AIDS education, for example, takes away from the time allowed for fundamentals. As teaching conditions, including tiny budgets ($50 per year for an entire science class, in one case), may worsen, teachers tend to "take it", owing to thei love of the profession, reinforcing the problems.

The final part of Greenberg's presentation consisted of the description of an NSF-funded, Space Grant supported science teacher project headed by Greenberg and Dr. Robert Strom, also at the University of Arizona. The program is a workshop for science teachers which utilizes the processing of digital imagery, especially the amazing, high resolution images from the Voyager missions, to teach mathematical, scientific, and technical concepts in the classroom. The instruments available in processing—i.e. enhancement, stretching, coding, filtering, and scanning—lend themselves admirably to the learning of mathematical technique, in many cases without the participant's realization. Greenberg pointed out that visual cognitive learning is many orders of magnitude faster than other forms of learning such as lecturing. He closed by suggesting that the Space Grant program might benefit greatly by supporting this kind of workshop.

Dr. Greenberg's talk provoked lively and extended discussion. In response to a question concerning the omission of engineering from the common, illiteracy-in-the-schools complaint, Greenberg agreed, stating that, "Science and mathematics connects to the real world through engineering," and that engineering, indeed, was poorly understood by school children and teachers alike.

The NASA Space Exploration Initiative

Dr. Wendell W. Mendell,
NASA Johnson Space Center

To the delight of space enthusiasts President Bush enunciated a sweeping vision of human exploration of the solar system in his speech commemorating the 20th anniversary of the landing of Apollo 11 on the Moon. Under the name, the Space Exploration Initiative (SEI), the President identified Space Station Freedom, a lunar base, and a landing on Mars as goals for the next three decades.

To long-time observers of the space program, these ideas do not seem new. In 1970, the Space Task Group presented a plan to President Nixon which also included a low Earth orbit (LEO) space station, a base on the Moon, and a base on Mars. In 1958 the Army produced a classified study of a lunar base under the name Project Horizon. Earlier, Wernher von Braun (1953) had published in English a plan called the Mars Project.

The plan of the Space Task Group in 1969 was in essence an extrapolation of the Apollo program and its technology. That plan was rejected by President Nixon, who also truncated the number of manned missions to the Moon. Faced with competition for funds from the Vietnam War and the Great Society programs, the Nation's space effort found itself in the hitherto unknown position of being considered an expendable luxury. An implacable Office of Management and Budget forces NASA to reduce its goal from a base on Mars to a station in LEO and then again to simply a reusable launch vehicle to LEO that we now call the Space Shuttle. Thus, the ambitions of the '70's and '80's were very different from those of the 60's.

A search of the NASA "gray" literature (for example, contractor reports) yields no studies of lunar base issues after 1973. By 1981, when I became interested in bases on the Moon, a NASA "advanced planner" would be working on concepts for a manned space station to follow (hopefully) the end of Shuttle development. Certainly, no element of national space policy, which was defined at the Presidential level, was concerned with the long-term evolution of the space program.

The situation changed substantially with the issuance of the Reagan space policy of February 1988. Although little noted by the public, this policy incorporated for the first time the statement of "a long-range goal to expand human presence and activity beyond Earth orbit into the Solar System." This element provides a basis for constructing a strategy for the manned space program, similar to the well-developed strategies now in place for the scientific part of the program. Bush's declaration of the SEI essentially defines such a strategy in broad concept at a high political level.

If the plans of the early NASA were aborted in 1970 and if there was a void in planning after that point, where did President Bush get his cues? In the most immediate sense, the President and the Vice-President were briefed by NASA personnel with a suggested approach. However, the basic ideas in that briefing can be traced back to a small, unofficial effort within NASA with which I have been associated.

Speaker Wendell Mendell (left) conversing with conference attendees James Vedda and David Webb.

The Future of Space Transportation (as seen from 1982)

The Space Shuttle

The Space Shuttle represents a radical departure from the Apollo system as an approach to space transportation. While the Apollo spacecraft and the Saturn launch vehicle were designed to carry out lunar landings, the Shuttle was intended to provide routine Earth-to-orbit transportation. As a reusable vehicle, the Shuttle was to operate in analogy to an airline. Investment in capital equipment is amortized by multiple use and frequent operation.

Unfortunately, we now know that the promise of low launch costs through frequent utilization was not to be. Problems with technology, financing, and politics have combined to make the shuttle less than it was meant to be. Nevertheless, routine operation of 24 flights per year was assumed in the early '80's.

As Shuttle operations increased, they altered the public perception of space flight. No longer were astronauts demigods whose accomplishments seemed far beyond those of ordinary humans. In fact, traveling to space seemed to be a regular job done by people not unlike ourselves whose names were not necessarily etched into our memories (unlike John Glenn or Neil Armstrong). The mission, which salvaged the Westar and Palapa communications satellites under contract with Lloyd's of London, places space operations square in the world of business. The public began to accept space flight as a familiar part of our social and economic activities.

The Space Station

In 1982 a LEO space station was on NASA's drawing boards, and various design concepts were under study. NASA management was pressing very hard to make it the next approved manned space-flight project. A Presidential commitment to the space station was viewed as critical to maintain the continuity and viability of the U.S. space program.

From my own point of view, the space station had two important aspects, one symbolic and one functional. On the functiona side, it was the second element in a growing space transportation system designed deliver people and cargo to space routinel Shuttle operation was managed by the Office of the National Space Transportatio System, implying a larger scope than only Earth-to-Orbit operations.

On the symbolic side, the space station would be our first permanent foothold for human beings in the space environment. The daily reports of astronaut activities in LEO would reinforce the public view that space activities formed a natural part of ou society's endeavors. No longer would it seem to be an esoteric luxury for a few test pilots.

As we mastered operations in LEO on the space station, we could anticipate more ambitious goals for the space program. Whatever those future objectives would be I believed that the aspect of permanent human presence would be a component. No longer would we be satisfied with simple demonstrations of capability such as Apollo, but rather we would choose to pro mote permanent human presence as demonstrated in LEO by the space station. A few years later the NASA Office of Exploration would contrast evolutionary programmatic objectives with expeditionary ones. The latter were colloquially called "flags and footprints".

The Orbital Transfer Vehicle

The Space Shuttle and the proposed space station were familiar to most observers of the space program in 1982, but the Orbital Transfer Vehicle (OTV) was less well known. The purpose of the OTV would be the delivery of payloads from the space sta tion to higher orbits and return to the station. There it would be refueled and refurbished for its next mission. In the minds o

NASA designers, the main purpose of the OTV was placement of payloads into geostationary orbit (GEO) above the Earth. According to NASA projections, the Shuttle, the Space Station, and the OTV would comprise a reusable transportation system capable of routinely taking payloads from the surface of the Earth and delivering them to high orbits.

I reached the conclusion that NASA planned to have in place, by the year 2000, a reusable space transportation system capable of routine flights to lunar space. Yet no one seemed to notice this or even care about it. To my mind, the next goal for the manned program after the LEO space station would almost certainly be a base on the Moon because the rudimentary capability would already exist and the idea of establishing permanent footholds in space would be ingrained in the thinking of the public.

Although I and my colleagues found these arguments compelling, we encountered disinterest or even hostility within NASA to these ideas. Working engineers were very busy with day-to-day problems and opined that lunar bases were too "far out". Managers were concerned with supporting ongoing programs and did not want to get involved with proposing new initiatives. Planners were highly focused on the space station and viewed with misgivings any new idea that might divert attention or resources from the effort to sell a program. The Apollo program was remembered primarily as being very expensive, and the assumption was that a lunar base would be out of the question.

It was our position that a connective thread runs through the concept of the National Space Transportation System and that thread leads directly to a base on the Moon in the first decade of the 21st Century. We realized that such an opinion was arguable, but we strongly believed that the debate ought to take place. If we were right and if no heed was paid to future objectives, then the U.S. might end up with expensive manned elements in space that were designed for the wrong purposes. In fact, this is part of the turmoil over Space Station Freedom today.

Architecture of the Lunar Initiative

Legitimacy

A persistent problem in initiating discussion or study of a lunar base within NASA was the legitimacy of the issue. What were the credentials of the people urging discussion of a lunar base? What technical or programmatic requirements led to a study of a lunar base? While individuals might be interested, it was very difficult to generate interest in the organization without couching the arguments in terms of approved programs or from the recommendations of recognized authority.

Starting early in 1983, we worked to convene a "blue ribbon" committee to consider the issues involved with a lunar base as a long-range strategic element in space policy. Finally, at the end of that year, the NASA Deputy Administrator, Dr. Hans Mark, asked us to hold a workshop on the subject and helped us to find funding for it. (Obtaining funding was not trivial, even for Dr. Mark, because none of the major divisions of NASA would claim responsibility for a lunar base program.)

With the funding, Dr. Michael Duke (NASA/JSC) and Dr. P. W. Keaton (LANL) organized a small workshop in April 1984, at Los Alamos National Laboratory for a selected group of senior scientists, technologists, and policy analysts. Their deliberations and conclusions were published as the Report of the Lunar Base Working Group (Duke, et al, 1984).

The workshop's first recommendation was that "[a] permanent lunar base should be adopted by NASA as a long-term goal for the early 21st century." The report made other recommendations and then went on to define the major issues associated with lunar base planning. Those topics were

used to structure the agenda for a Symposium on Lunar Bases and Space Activities of the 21st Century, which was convened at the National Academy of Sciences in Washington, D. C., in October, 1984. The symposium featured both invited and contributed papers, most of which were published the next year as Lunar Bases and Space Activities of the 21st Century (Mendell, 1985).

In addition to technical and scientific contributions to the meeting, the book also features keynote addresses by James Beggs (then Administrator of NASA), Dr. George Keyworth (then Science Advisor of the President), Dr. Edward Teller, Dr. Harrison Schmitt, and others. These speakers, all of whom endorsed the basic concepts of the symposium, served to establish finally the validity of the subject for discussion. Eighteen months later, the National Commission on Space (1985) presented its report, *Pioneering the Space Frontier*, to President Reagan; and the view of the future in space presented there validated the Report of the Lunar Base Working Group but also went beyond it in scope.

Scientific Uses of the Moon

"In any scenario of lunar activity, much of the effort at the lunar surface is devoted to the expansion of scientific knowledge. Priority should go to investigations for which the Moon is uniquely suited or which are particularly easy to do on the Moon." (Duke, et al, 1984)

Science played a secondary or subsidiary role in the large manned programs such as Apollo and Space Shuttle. Although marvelous and unique scientific discoveries were made by the Apollo program, the imprimatur was to "land a man on the Moon and return him safely by the end of the decade." Scientific activities began to grow after NASA engineers became confident of the capabilities of the Apollo system. Similarly, good scientific research has been enabled by the Shuttle, but potential scientific uses were not major requirements in the design of the spacecraft.

In fact, the scientific community has a strong feeling that the large manned programs deflect agency resources that might otherwise go to support scientific research. When asked by NASA to endorse the space station, the Space Science Board of the National Research Council penned a carefully worded letter in which it claimed to have "no position with regard to a space station..." and was "apprehensive about the possible adverse consequences of the cost of a space station on the national capability for conducting a vigorous scientific program during the next two decades," (Donahue, 1982).

Given such reservations, the scientific community would join a national consensus for a lunar base program only if it had a vested interest in the success of the endeavor. Therefore, we tried to discover any scientific experiments, uniquely enabled by a lunar base, what would be considered not only desirable but indispensable by scientists. Obviously, nothing could improve planetary scientists' understanding of planets and solar system evolution like a geologist doing field work on the Moon (Taylor and Spudis, 1990). However, our greatest success has been in the astronomical community (Smith, 1986; Mumma, 1990; Burke, 1990), where the lunar surface is now widely understood to be an unparalleled observing platform. Whether similar revolutionary experimental concepts can be found in other disciplines remains to be seen.

More importantly, these scientific experiments are actively integrated into the lunar base concepts being developed in NASA planning.

Industrialization on the Moon

"Using lunar resources adds an important economic element to a manned base program. Because transportation costs will constrain establishing the base more than

any other factor, the first industrial processes probably will be aimed at making lunar materials available to the space transportation system," (Duke, et al, 1984).

If a lunar base is viewed as an early stage in a process of humanity moving off the Earth into space, then the Moon provides the first opportunity to learn to utilize resources that are found there. A planetary surface is fundamentally different for an orbital facility such as Space Station Freedom. On planetary surfaces materials exist which can be used to support operation there, whereas an orbital station must always be supplied from a planet.

Within the reusable space transportation system described here, it takes six tonnes of fuel in LEO to deliver one tonne of cargo to the surface of the Moon (Duke, et al, 1985). Thus, we can make a rough estimate that transporting material to the Moon is seven times more expensive than transporting material to Space Station Freedom. If we assume a Shuttle launch cost $100 million (a low estimate), then a vehicle loaded to maximum capacity delivers cargo to LEO at a cost of $4 million per tonne. Estimated cost to the Moon is then $28 million per tonne, i.e., approximately twice the price of refined gold.

In our reference transportation system, some of the fuel (in our case, liquid hydrogen and liquid oxygen) is carried all the way to the surface of the Moon to be used to lift off and transfer back to Earth. Since lunar rocks are silicates and contain 40% oxygen by mass, we can actually produce fuel on the Moon with a proper processing plant. Let's suppose that we can produce lunar liquid oxygen in quantities sufficient to fuel a reusable lunar lander that carries cargo back and forth between lunar orbit and the lunar surface. In that situation, the launch system on the Earth is required to launch only 3.5 tonnes to LEO for every tonne of cargo delivered to the Moon, In other words, the launch mass to Leo is cut in half, and the cost of delivering mass to the Moon falls in half according to the rough calculation made earlier.

Lunar resources could possibly be utilized in markets in space. For example, the mass of the Space Shuttle payload destined for LEO is only 1.5% of the total mass of the vehicle on the launch pad at Cape Canaveral. By comparison, a payload being launched from the Moon bound for LEO will constitute 50% of the vehicle. The low lunar gravity and the absence of an atmosphere make it energetically favorable to launch off of the Moon. However, the lunar products will not make true economic sense until activities in space are of a scale large enough to require constant and substantial supplies.

Permanent Lunar Settlement

"Severing the umbilicus between the Moon and Earth is an event that will transform the lunar settlement from a technological feat to a cultural watershed. . . Using tools at first imported, [lunar settlers] must construct whatever they need to deal with the lunar environment and to live there with minimal resupply. The whole spectrum of biological processes associated with the growth of food and closed ecological life-support system (CELSS) is important,..." (Duke, et al, 1984).

The Lunar Base Working Group concluded that the true long-range goal of a lunar base was permanent settlement of the Moon. The key to that goal is the achievement of lunar self-sufficiency, or at least lunar autarchy. Whereas transportation systems dominate discussions of early lunar landings, permanence requires a closed life support system with biological elements. Technologies associated with closed life support had not been a high priority in NASA funding. Therefore, one consequence of a lunar base program would be an increased emphasis on space life science research. Today, in the context of the Space Exploration Initiative, life support technologies do indeed appear high on priority lists

although large funding increases have not necessarily appeared. Also, the recent Augustine Report emphasizes life science objectives on Space Station Freedom.

Talk of permanent settlement of the Moon found little favor in the NASA of 1984. Even though I understood the reasoning of the working group and agreed with it, I never emphasized that conclusion in my official presentations. However, the report of the National Commission on Space (1986) declared "[t]he Solar System is [humanity's] extended home" and legitimized permanent human presence as an asymptote for future planning.

Implications for the U.S. Space Program

The Value of a Strategic Plan

The space program has a particular attraction for lovers of high technology, who find great delight in speculating about the designs of lunar bases and martian outposts. Some observers might see a lunar base proposal simply as the expression of indulgent fantasies from technofreaks with little basis in political or fiscal reality. However, as the preceding discussion illustrates, a lunar transportation system is a simple and obvious extrapolation of current technology. Landing on the Moon can be accomplished with straightforward adaptation of an OTV using techniques demonstrated repeatedly by Apollo. The Lunar Base itself is something rather new for NASA, but its design and construction can draw upon terrestrial construction technology in extreme environments. The life support systems for the Moon and the operational procedures for surface activities must be developed but also can be applied to problems on the Earth. All in all, the lunar base is not really an overwhelming leap in technology.

The real utility of planning a lunar base is that identification of a long-range goal establishes contexts for mid-range objectives and for defining a sequence of programs. For example, within the context of a futur lunar base, Space Station Freedom takes o special importance as a transportation node, a life science research facility, and a test bed for streamlining space operations. These objectives contrast with the NASA rationale of 1984 emphasizing micrograph ic processes, astronomy, and Earth observ tion. None of these uses are uniquely enabled by a manned orbiting facility. By the time of the Third Space Station Evolution Workshop (NASA, 1986), it was becoming clear that microgravity scientist did not want humans shaking their labora tories, that astronomers did not want thei optics degraded by deposits from thruster firings and urine dumps, and that earth sc entists wanted to be in polar orbit.

Implications of Lunar Oxygen Production

Over the Christmas holidays of 1982, Hu Davis (then with Eagle Engineering, Inc.) used his Apple II Computer to model the impact of lunar liquid oxygen (LLOX) pro duction on the performance of our reference lunar transportation system (Davis, 1983). As a surrogate parameter for dollars, we use initial mass to low Earth orbit (IMLEO) because the majority of the cost c a lunar base is in launch costs from Earth. In addition, other costs such as operations approximately scale in proportion to the mass launched from Earth. Such estimate: are crude but are used to determine whether a mission architecture is worth investigating further.

For this work it was assumed that a lunar production facility was supplying LLOX t Space Station Freedom in sufficient quanti ties so that no liquid oxygen needed to be launched from Earth to supply the space transportation system. The question addressed by the study was whether the mass of LLOX delivered to LEO exceeded the mass required to be launched from LE to support the lunar operations. The ratio of mass delivered from the Moon to the

mass sent to the Moon was called the Mass Payback Ratio. Was the MPR greater than unity, and if so, by how much?

The Eagle Engineering study produced an MPR of 3:1. Surprised at this result, NASA/JSC engineers did their own calculation and arrived at a value closer to 1:1. In resolving the difference, NASA engineers found that Eagle has assumed an advanced hydrogen/oxygen engine for the OTV. They also assumed that the oxygen to hydrogen ratio burned in the engine was higher than the standard ratio. There exists an optimum ratio of oxygen to hydrogen (approximately 6:1) that will yield maximum performance. Changing the ratio degrades the engine performance somewhat, but in this case using more oxygen in the engine has the next effect of making lunar oxygen more "profitable".

The significance of this discovery was that a design for a subsystem will be utilized within a complete transportation system. Without a lunar base transportation model and a long-range strategy, any number of subsystems would be designed in ways that were not necessarily optimized for the context in which they would be used.

There exist a number of possible chemical processes that could be used on the lunar surface to extract the oxygen. Since almost no funding had ever been invested in research on this problem, very little experimental data existed that could be used to choose among them.

In most lunar minerals, the oxygen atoms are bound tightly in the crystal lattice. Removing them would require strong reagents or a great deal of energy. In an iron-titanium oxide called ilmenite, one of the oxygen atoms in the crystal structure is not strongly bound and will combine with hydrogen under pressure to form water at a temperature around 1000C. Experimental data confirms that the reaction takes place at reasonable rates.

Ilmenite is a common mineral in several lunar maria, the lava-filled dark basins on the near side of the Moon. Since hydrogen is used as a propellant in the lunar landing spacecraft, no special reagents must be imported to the Moon to make the process work. In addition, the required temperature can be achieved without the use of complex equipment. For these reasons, the ilmenite process for producing lunar oxygen was chosen as a baseline to model lunar base requirements such as mass, power, crew size, and transportation The technical capability in place must include mining, process engineering, chemical engineering, power generation at a small industrial scale, crew support, equipment maintenance, logistics, and transportation. These skills and types of experience are more familiar to the constructor-engineer companies (e.g., those engaged in rebuilding Kuwait) then to the aerospace companies. The space program and space operations in the 21st century will require participation from sectors of the economy which have almost no role in current space activities.

Implications of Self-Sufficiency

If permanent human presence in space is to remain a policy objective, then the programs must include elements of technology development directed toward the use of resources in space to support that presence. As mentioned above, a planetary surface installation does have the potential for producing some of its material needs from the planet if appropriate technology is developed or adapted to access the resources. However, the most critical as well as the most challenging technology to be mastered, is closed and self-regenerating life support systems.

American space missions to date have been short enough to allow consumables to be stored on board the spacecraft. The cost of launching consumables to Space Station Freedom has caused planners to consider closure of the water and the air loops in the Environmental Control and Life Support System (ECLSS). However, proceeding

further to close the food and waste processing loops would require a system with biological elements. The mass associated with regenerative biological systems makes them prohibitive for all but very long duration missions. Studies indicate that mission durations of one to two years justify the development of Controlled Ecological Life Support Systems (CELSS). A permanent lunar base is such a mission.

No life support system is ever completely closed. In addition, a growing lunar population requires an ever-growing biomass, which in turn requires a supply of water, carbon, and nitrogen. Lunar rocks contain abundant oxygen, but carbon, nitrogen, and hydrogen are found only as solar wind gases implanted in lunar surface grains over geologic time. Even though the total amount of these elements on the Moon is quite large, the concentrations tend to be quite low (<100 ppm).

Until recently little consideration had been given to extracting solar wind volatiles for life support. However, a NASA task force (Kearney, 1989), has endorsed a proposal to consider lunar mining of 3He, an isotope rare on Earth and potentially valuable as a fuel for commercial nuclear fusion reactors in the middle of the next century. Helium mining is a controversial subject, but it is important to note that such a mining operation would capture a mass of solar wind volatiles so great that the whole question of life-support consumables on the Moon would become moot.

Some NASA planners are attracted to the helium mining proposal because plausible projections indicate that the 3He could be marketed on the Earth at a price high enough to pay for the lunar mining operation. This point brings us to another kind of self-sufficiency — autarchy or economic self-sufficiency.

A lunar-surface facility has a better chance of permanence if it generates some kind of tangible return to society beyond scientific knowledge. The most immediate and recognizable kind of return is economic, but our simple models of an initial lunar base seem to present little opportunity for economic return. Markets exist on the Earth, but cost of transportation to them is so high that it is hard to imagine what kind of lunar product (other than 3He) could be sold there at a profit. On the other hand, orbital facilities may need bulk materials that could be supplied from the Moon, taking advantage of the low-launch energy required. For example, bulk lunar soil could be used as radiation shielding on an orbiting station at geosynchronous orbit around the Earth.

Although enthusiasts have claimed that lunar materials are economical in a number of space applications, detailed and reliable cost analyses are difficult. It can be said, however, that the level of orbital activity must be much larger than it is today before capital investment in lunar surface facilities can be amortized through sales of products to space markets. Nevertheless, the principle of potential self-sufficiency is beginning to be understood in NASA as a rationale for choosing certain kinds of technology investments.

Why not Mars?

In principle, the simple transportation system that I have outlined can be structured to take humans to Mars. In general, the increased energy demands of a landing translate into approximately 15 tonnes to LEO for every tonne on the martian surface. Therefore, the ships to be launched from LEO are larger than the lunar vehicles and require assembly on orbit. A design published in *FY 1989 Annual Report of the Office of Exploration* (NASA, 1989), has an IMLEO of 776 tonnes, of which 615 tonnes is propellant. Since that much propellant would require 25 Shuttle launches just for the delivery to the space station, a heavy lift vehicle on the scale of the Soviet Energia or the U.S. Saturn V is needed to conduct the mission.

The Earth and Mars reach favorable alignments for launch once every 26 months. Launch opportunities must be met because the missions are tailored for the parameters of a specific planetary alignment. Keeping the schedule for on-orbit assembly and launch of such a large craft implies that our launch operations and our future in-space operational capability must be much more reliable than is currently the case.

A typical mission to Mars with chemical propulsion (NASA, 1989), lasts about 500 days. Stay time on the surface for one class of mission is about 30 days, and the time spent in transit both ways is about 500 days with one-way times from as short as 170 days to as long as 327 days. The crew must take high g-loads in entry to the Martian atmosphere after a long-duration transit time and then perform challenging tasks on the surface. These durations spent by the crew in zero-g and in isolation far exceed current operational experience in the U.S. Although the Soviets have flown for durations up to a year in their space stations, U.S. life scientists believe very strongly that they would like to do their own experiments.

Life scientists have taken strong stands against planning piloted Mars missions until the human physiological and psychological response to extended space flight is more completely understood. Mission designers have tried to finesse the objection by proposing shorter flight times with nuclear powered spacecraft. The former strategy has not been demonstrated to solve the deconditioning problems or to be without side effects on performance. The latter strategy invokes a radical departure from recent propulsion design philosophy together with possible political complications.

An issue which has not been addressed in detail is the problem of reliability and maintenance of these complex systems during a two-year voyage. Strategies to ensure against system failure include usage of (expensive) high-reliability components, extensive preflight testing of subsystems, duplication of functions with backup systems, and stocking of spare parts. Since the mission is constrained in terms of payloads mass, any strategy emphasizing repair from a stock of spares becomes untenable. End-to-end verification of the transportation system must include flight testing in space, preferably for durations similar to the actual mission. Particularly mettlesome is the problem of exercising the complex software on board.

In every technical arena — crew performance, system reliability, in-space operations — a piloted mission to Mars exceeds our experience base. More long-duration flight experience must be accumulated before even basic design choices can be made. Actual long-term planetary surface operations would add immeasurably to confidence in the performance of systems critical to crew survival and mission success.

"Mars now" advocates argue that a lunar base program wastes time and scarce fiscal resources. I believe the operational parameters of manned lunar exploration fall within our current experience base and represent a modest as well as prudent extrapolation of our capability. Long-term lunar operations will lead naturally to the design of the Mars system as an evolutionary design. It is critical to have in place the strategic plan to go to Mars so that the lunar system will be developed with commonality in mind.

Conclusions

President Bush's Space Exploration Initiative represents a long-range Presidential commitment unparalleled in the history of the space program. The space policy declarations associated with it enable, for the first time, the formulation of a strategic plan for human exploration of space extending into the next century.

Over the past decade the various communities in space science (e.g., astrophysics, life science, Earth observation, planetary

science) have spelled out thoughtful strategic research objectives that have allowed NASA managers to structure to justify the space science programs. At the same time, the manned programs have been planned on the basis of tactical considerations such as maintaining continuity of technical resources and meeting budgetary constraints. As a result, the justification and goals of manned programs seemed protean to Congress and NASA technical constituencies. The SEI presents an opportunity for participants in the space program to reach common understanding on ultimate goals.

The *NASA 90-Day Report* (Cohen, 1989), prepared in response to the President's declaration, largely consists of a proposed implementation of the lunar base and landings on Mars, including descriptions of spacecraft, surface facilities, and schedules. The program architecture looks very similar to the systems outlined in 1984 under certain assumptions about the space transportation system. This system included routine access to low Earth orbit with the Space Shuttle. Space Station Freedom was included in 1984 concepts because no NASA engineer would consider a future system without it. The requirement for a space station to support human exploration was not derived from an analysis of strategic objectives; it simply was given boundary condition.

The NASA response to the President (Cohen, 1989), was quite logical and competent from an engineering point of view. However, the report treats SEI as a lunar-base program followed by a Mars-base program complete with conceptual designs and schedules. Programs defined to this level can be given cost estimates, and NASA did such estimates honestly and conservatively. The total expenditure through the year 2025 was high, and when spread over the schedule implied a doubling of NASA's budget. Congress may or may not want to double NASA's budget, but it certainly does not want to make a promise covering the next 35 years.

NASA faces credibility problems in the political arena. The highly publicized flaw in the Hubble Space Telescope, the vexing problems delaying Shuttle launches, and the continuing turmoil in an expensive space station program reinforce the reluctance to make long-term fiscal commitments. A sense of concern within the political establishment was a factor in the formation of the Advisory Committee on the Future of the U.S. Space Program (also known as the Augustine Committee).

In their report (Augustine, 1990), the committee recommends that NASA's "Mission from Planet Earth [i.e., SEI] be configured to an open-ended schedule, tailored to match the availability of funds." "Living within your means" is certainly sage advice, but making available resources for bold new programs necessarily implies a serious realignment of function and corporate culture. Right now, the Agency expends the bulk of its resources - technical, managerial, and fiscal - on repeated launches of a vehicle which uses 1970 technology. Meanwhile, the programs continue to exhibit cost growth rather than productivity increases which free resources for the future.

Obviously, NASA is in need of a strategic plan, but it must be more than a list of programs. Taking the President's vision of human exploration of space, policy analysts must first understand the societal and cultural processes embodied in that vision and then determine what kind of space program is implied. Such an analysis may have a form more similar to the report of National Commission on Space (1986), than to the *NASA 90-Day Report*. The result will contain commercial and scientific components as well as traditional federally funded technology development. Most importantly, the role of NASA must be redefined within a pluralistic environment with participation by academia, industry, and other Federal agencies such as the Departments of Energy, Defense, Commerce, and Transportation. Since a lunar-base program which has only political objectives and which has only political returns will even-

tually be cancelled for political reasons, the new national space initiative must have economic, educational, and technical attributes which address our national needs.

In purely technological terms, a lunar outpost is within our grasp. However, as we continue on a permanent presence, what many people see to be a program actually becomes a watershed in human history, and we transform ourselves in the process. The Moon is the stepping stone on the path to the solar system and to a future humanity which is a spacefaring species.

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Dr. Mendell's presentation was concluded with an extended and lively discussion panel.

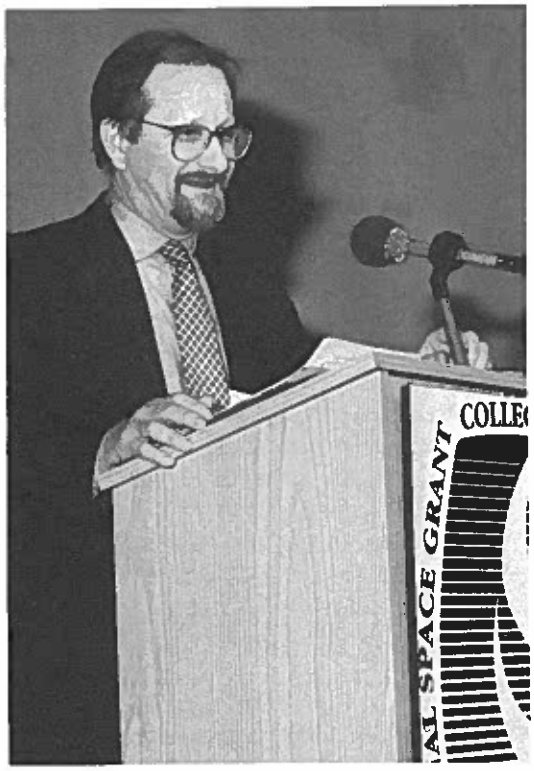
The National Science Foundation EPSCoR Program

Dr. Joseph G. Danek, The National Science Foundation

Dr. Danek is Director of the Division of Research Initiation & Improvement and the Head of the Experimental Program to Stimulate Competitive Research (EPSCoR) at the National Science Foundation.

The Experimental Program to Stimulate Competitive Research (EPSCoR) is an expression of the National Science Foundation's desire to build research capability in all states. It has successfully linked two often antithetical constituencies, politics and high-quality science, by supporting merit-based research in those states with the weakest record of federally supported research in science and engineering in the country. Awards were made in 1980, 1986 and 1989, and there are now 16 states and Puerto Rico in the program. At present, there is an Advanced Development Competition underway which will result in continued funding for only 10 of the 17 programs. However, the value of the awards will be greater than previously. The increase is to $1.5 million a year for three years from a previous level of $600,000 a year. EPSCoR will work with the unsuccessful programs to make them more competitive for some future program.

Federal support for academic R&D in 1990 was $8.2 billion. Of this, the top ten states received 61% of the total, or $64 per capita, and the bottom states received 6% of the total, $10 per capita. This type of disparity occurs in all the Federal agencies that fund academic research and the top 20 states get over 80% of all Federal academic research and fellowships in science and engineering. However, NSF does not approach this disparity from the perspective of inequity. Rather, it is concerned about the loss of talent and the loss of diversity implied by these figures.



Speaker Joe Danek.

When only excellence is funded the very good is not. And, when this occurs in whole institutions and regions, it makes it hard even for excellent individuals to over-

come the accompanying institutional barriers that exist in incentive structures, material support, facilities and attitudes. The result is idle research talent, and generations of students receiving too few positive messages and experiences for careers that are critical to the intellectual and economic health of the Nation. There is also an absence of the types of economic consequences that research activities have locally in terms of a demand for goods and services, spinoffs, consulting and a positive ambience for industries and their employees. Unfortunately, the syndrome has reproductive qualities, and faculty, students, administrators and industries that might make a difference tend not to come.

The strategy of EPSCoR is to find and fund the "very good" in States that are receiving very low levels of Federal academic R&D funding. However, it takes the infrastructure problem as the critical issue and the funding only takes place for programs that engage in permanent improvements in their research infrastructure. In fact, in the funding process there is an infrastructure phase that is followed by a research phase. Further, EPSCoR has moved from its initial strategy of funding individuals to funding groups of researchers in centers and clusters.

A very significant aspect of EPSCoR's emphasis on building a permanent change in the academic research infrastructure is the extent to which it induces local support. In the early planning stages, a search is made for the "six" people in the State most likely to be able to make a difference in changing the academic research environment. Many more than six people end up being involved, but this search for the best change agents in industry, education and government is very important. And the resulting commitments in time and institutional change at the State and institutional level are very large. In addition, there is a very high level of matching. On average, EPSCoR recipients match at a rate of $3 locally for every Federal dollar received.

In addition to the strong local leadership and long-term approach, the success of EPSCoR also reflects the insistence on merit-based reviews and the maintenance of NSF standards for quality in research. There are many indications of success: individual S&E research accomplishments, department and institutional initiatives, State S&E research initiatives, and an improved S&E research environment. Measures used include proposals submitted, projects funded, and numbers of S&E faculty and degrees awarded. In Alabama for instance, the recipients of EPSCoR fun received $2 million in competitive Federal funds in 1986 - this had risen to $8 million by 1989. And some individual researcher who began their research careers with EPSCoR funding have become nationally prominent. Jack Horner is a prominent paleontologist who was recently featured Time magazine. He began with EPSCoR support, as did M. K. Wu (at UAH), who collaborated with Paul Chu in the well-known superconducting experiments.

The EPSCoR program has created many benefits. The most obvious is an improved quality of S&E research and education in the target states. Other benefits include increased public and Government support for S&E research, increased visibility for NSF goals and objectives, and, nationally, improved economic diversity and a greate S&E talent pool.

In terms of national policy, it should be noted that EPSCoR is a competitive program and not properly part of the $490 million that represents academic R&D programs that are earmarked by Congress for particular institutions. (If non-academic institutions are included, the figure is abou $800 million.) However, the $15 million ca of EPSCoR is now matched by about anoth er $16 million for EPSCoR-type programs a other Federal agencies such as NASA and DOE. The Capability Enhancement Program in Phase II of the Space Grant program is NASA's current EPSCoR endeavor This reflects Congressional urging and, in

some cases, appropriations for other Federal agencies to include EPSCoR types of programs. After looking at the EPSCoR program, the European Government is putting about $400 million into developing the 5 less-developed areas of Europe: Spain, Portugal, Greece, Ireland, and Southern Italy. However, their program is primarily focused on industrial development and technology parks, rather than on academic R&D.

The EPSCoR program is changing somewhat by adding new purposes. It now has a relatively modest component for human resource development, and there is a new commitment to technology development.

The staff at EPSCoR hope that the Space Grant programs in the EPSCoR states will be able to work well with the EPSCoR programs there, to the benefit of both.

Experience and Results from Centers for the Commercial Development of Space

Dr. Charles A. Lundquist, University of Alabama in Huntsville

Dr. Lundquist is Associate Vice-President for Research and Director, Consortium for Materials Development in Space, at the University of Alabama in Huntsville.

Legislation in 1985 established the NASA Centers for the Commercial Development of Space (CCDS). There are now 16 such centers, most if which are housed in universities. These centers have 184 industrial affiliates, 58 university affiliates and 53 government affiliates. The commercial foci of the centers are in material processing in space, space structures, remote sensing, life sciences, robotics, space power and space propulsion. Each center receives approximately $1 million a year from the NASA Office of Commercial Programs to run the base program. Other sources of revenue and in-kind support are industries, State governments, Federal government affiliates, universities, and shares in any royalties that emerge from the products and ideas developed.

The directors of the CCDSs meet quarterly. Although they originally viewed their mission in technical terms, they have come to find that social, political, legal and economic issues often take up most of their time. For example, the directors spend a portion of their time with their senators and congressional representatives.

With the exceptions of communications and space image processing, most commercial objectives in Space tend to be for knowledge for ground use or for some stage in a development process and not for the production of a commercial product. Many undergraduate and graduate students work on challenging projects in CCDSs.

Access to Space is by parabolic aircraft flights which provide less than 30 seconds of microgravity, and suborbital rockets with microgravity environments of up to about 14 minutes duration. The CCDSs currently use about 2 suborbital rockets a year. Starting around 1992-93, they expect to use about one orbit and recovery (COMET) a year, and a few Shuttle experiments using the Spacehab and Wakeshield facilities. The CCDSs are particularly interested in the opportunities provided by Space Station Freedom.

The evolution of equipment is very important. The various means of access to Space listed above involve very different costs. It is important that equipment be developed and tested on the less expensive means of access before it is deployed in something as expensive as the Space station.

The CCDSs are tests of the university-industry-government teamwork that is essential to the economic health of the country.

Problems and Solutions in the Recruitment and Retention of Blacks in Science and Engineering

Dr. Jeanette Jones,
Alabama A&M University

Speaker Jeanette Jones.

Dr. Jeanette Jones, Assistant Vice President for Research, Alabama A&M University and an Associate Director of the Alabama Space Grant Consortium, was introduced by Julius Dasch, Conference Chair. In his introduction, Dasch pointed out that at the next national conference, co-hosted by the Texas Space Grant Consortium and the NASA Johnson Space Center, a similar theme talk would be devoted to special problems in the recruitment and retention of Hispanic students.

Dr. Jones began with a brief sketch of the HBCU (Historically Black College and University) Alabama A&M University. A&M University, founded in 1875 by a former slave, became a Land Grant institution in 1890. It presently serves about 5,000 students with 70 degree programs, including three Ph.D. programs. University faculty have 26 NASA grants and contracts, many of them interactive with personnel at several NASA field centers.

Dr. Jones organized her talk around two main sets of viewgraphs: problems in the recruitment and retention of black students, and solutions in the recruitment and retention of black students. Her main topics for these categories are listed below.

Problems:

1. Minority enrollments (student pool low, competition intense).
2. Past practices in recruitment.
3. Campus climate unfriendly, hostile.
4. Impersonal recruitment effort.
5. Lack of mentors (black or white).
6. Lack of commitment by the chief executive officer and other leaders.
7. Image problems (noncaring, impersonal, just-a-number attitude).
8. Recruitment/retention commitment confined to the minority affairs office.
9. Little student/teacher interaction.
10. Limited relationships developed between university and black community.
11. Lack of career awareness and job availability.
12. Peer interaction limited.

Solutions:

1. High expectations/assumptions that all students can achieve.
2. Financial/tuition assistance.
3. Job counseling.
4. Summer job opportunities.
5. Social and cultural activities to increase sensitivity and cross-cultural awareness.
6. Institutionalization of retention efforts.
7. Frequent monitoring.
8. Academic advising of students.
9. Peer study groups.
10. Peer tutors.
11. Summer transition/orientation programs to focus on skills improvement and adjustment to college life.
12. Study skills workshops.
13. Student/faculty contact.

Dr. Jones stressed the importance of HBCUs—a third of the enrollment of black students in the U.S. is at HBCUs and a third

of degrees conferred are from HBCUs—but concluded that significant efforts for recruitment and retention must be made at historically white colleges and universities, as well. "The need for greater minority involvement in science and engineering is not just a social or aerospace problem but one of national security."

Dr. Jones punctuated her topics with attention-getting, anecdotal remarks. "Reach out, don't just have outreach programs." (For example, while most institutions have outreach programs, too often the attitude is "Every one knows we are here. Let 'em come. We are No. 1".) In response to a complaint that universities don't know where to go to recruit black students—"you know where to go to recruit black athletes!" The lecture stimulated a lively and lengthy period of discussion.

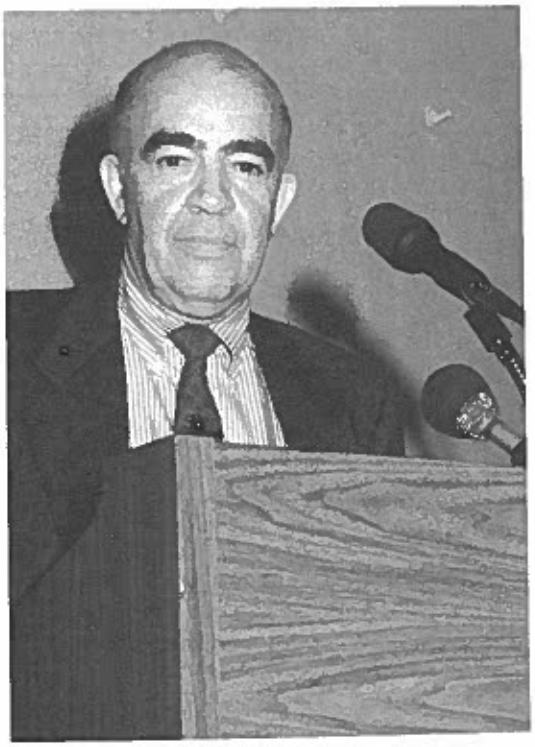
Earth Observing System: An Interdisciplinary Initiative

Dr. Shelby G. Tilford, NASA Earth Science and Applications Division

Wednesday evening provided an opportunity for conference participants and the public to hear Dr. Shelby G. Tilford, Director of NASA's Earth Science and Applications Division, Washington, D.C., speak on NASA's major and popular responses to the interagency, national, and international challenge of Global Change. The speech took place in the Bibb Graves Auditorium of Alabama A&M University, Normal, Alabama. Dr. Tilford was welcomed and introduced by Dr. Jay Carrington Chunn, Vice President for Academic Affairs and Research, Alabama A&M University.

Dr. Tilford's remarks fell among three themes: (1.) The Global Change Research Program; (2.) Earth Observing System (EOS) and Mission to Planet Earth; and (3.) The EOS Data and Information System.

The Global Change Research Program has three objectives, all of which are global in concept: (1.) To provide an integrated, extended document of global data relevant to global changes on time scales from decades to centuries; (2.) To carry out focused studies on certain aspects of this data base; and (3.) To provide predictive models useful for policy recommendations. Tilford pointed out that the study is global in nature and applicability and that many Nations are or will be involved; within the U. S., many Federal agencies are coordinating their activities (e.g. NASA, NOAA, USGS, EPA). However, "the project is not very far along", said Tilford.



Speaker Shelby Tilford.

In the historical past, Earth's major modifying events have been natural—for example volcanic eruptions, El Nino, solar flares, floods, and earthquakes—but, increasingly, anthropomorphic modification is becoming more effective. Changes by man pose extremely serious problems for our environment and represent a principal thrust

behind the Mission to Planet Earth. Examples of such changes abound: contamination of our major reservoirs—the air, the oceans, and our soils; large-scale changes in land use, resulting in a decrease in vegetative cover; and release of refrigerants and other industrial chemicals into the atmosphere are but a few examples. Dr. Tilford pointed out that many of the resulting problems are but poorly known. Such processes as desertification, ozone depletion, and greenhouse effects are brought about or influenced by natural as well as human inputs. Some examples are primarily man-made, some are natural, many are not understood, or understood very incompletely.

An example of the later category, one very much in the news, is the anthropomorphic introduction of greenhouse and other gases into the atmosphere. Dr. Tilford went into this subject in some detail, as an example of the complexity and threatening nature of our current policies and/or actions. Although many parts of the puzzle are missing, others are in hand and clear. Accurate measurements of CO_2 concentration in the atmosphere since the 1950s indicate that this gas, the best known of the greenhouse gases (which allow buildup of infrared radiation and therefore temperature), is significantly increasing in abundance (about 0.5%/year). The total amount of CO_2 involved in Earth's recycling reservoirs is huge; the added amounts added through the combustion of fossil fuels and modern vegetation, though small in comparison, nonetheless could tip greenhouse warming to greater intensities. Estimates of this increase range from 3-5 degrees F. As natural temperature fluctuation in the past 1,000 years (which span the "Little Ice Age") is only about 1.5 degrees, the implications for warming are extremely serious. Increases in other greenhouse gases are more serious and their origins less equivocal. Freon-12, for example, is growing in the atmosphere at a rate of about 5% per year.

Dr. Tilford repeatedly made the strong case that, although we desperately need more and better data, and better models for understanding these data, the facts are that we are significantly affecting our environment, with potentially disastrous consequences.

Global Change is an international study; examples of significant involvement, along with the US, are Japan, Canada, and the USSR. All satellites within Tilford's jurisdiction have international components. Educational opportunities available within the Global Change framework have significant potential.

As a final component of his presentation, Dr. Tilford discussed the centerpiece of the US Global Change program, the Earth Observing System (EOS) of satellite and integrated platform measurements. This ambitious program has as its goals: ongoing, integrated measurements of whole Earth, with respect to a series of critical measurements, primarily from satellites; focused studies on selected problems covered by these measurements; useful data acquisition and distribution of the enormous data set collected; and finally, formulation of predictive models for use in policy decisions and actions. With smaller satellite systems currently in place, major program advance will come in 1998 with the orbiting of larger satellite platforms capable of acquiring large sets of time-integrated data. Twenty-eight interdisciplinary teams have been selected, with about 10-25 investigators in each team; there will be a 15-year collection period and perhaps 25 years of analysis. The most difficult part of the project may well be the effective handling of the enormous amounts of data obtained.

Examples of integrated results from these experiments were illustrated by Dr. Tilford. The amounts of data, graphical and mathematical capabilities, and increasingly creative modeling of results will bring about "maps" of amazingly effective utilization.

For example, topography, temperature, and other factors can be combined in three-dimensional illustrations that can be grasped much quicker than mathematical or narrative accounts, thus increasing their utility as policy instruments.

Dr. Tilford's lecture brought about lively and informed discussion. In answer to a political question, Tilford said that "politicians do listen," and gave as an example the result form the Montreal Protocol, which came to grips with the global warming question. Dr. Tilford's response to the use of K-12 students and the collection of "ground truth" measurements for calibration of satellite-collected data, was welcome and interesting to the assembled group. Finally, Dr. Tilford, while finding the "Gaia Hypothesis," as discussed in popular media, a positive factor for the Mission to Planet Earth endeavor, he stopped well short of agreeing with some of the more extreme poles of Dr. Lovelock's thesis.

Space Research & Technology Overview

Gordon I. Johnston,
NASA Office of Aeronautics, Exploration and Technology

Gordon Johnston is Program Manager for the Space Technology University Programs and for the Global Change Technology Program.

This talk focused primarily on research activities in the Office of Aeronautics, Exploration and Technology (OAET, known as "Code R" at headquarters). OAET has key program areas in aeronautics, Space technology, exploration, high performance computing and communications, and the national aerospace plane. Much of OAET's R&T work is done through, or at, the three NASA Field Centers that report to OAET. These are the Ames Research Center, The Langley Research Center, and the Lewis Research Center.

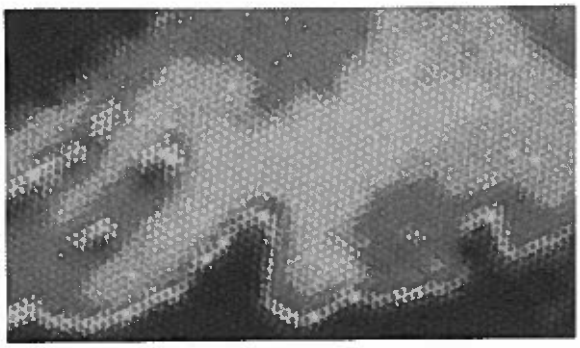
In constant 1991 dollars, the R&T funding level at OAET fell from about $1 billion in the mid-60s to about $200 million in the mid-70s. It stayed at that level until the late 1980s when it rose to about $300 million. The upward trend may continue since the Augustine Recommendation #8 calls for a two- to three-fold enhancement of funding for advanced technology development.

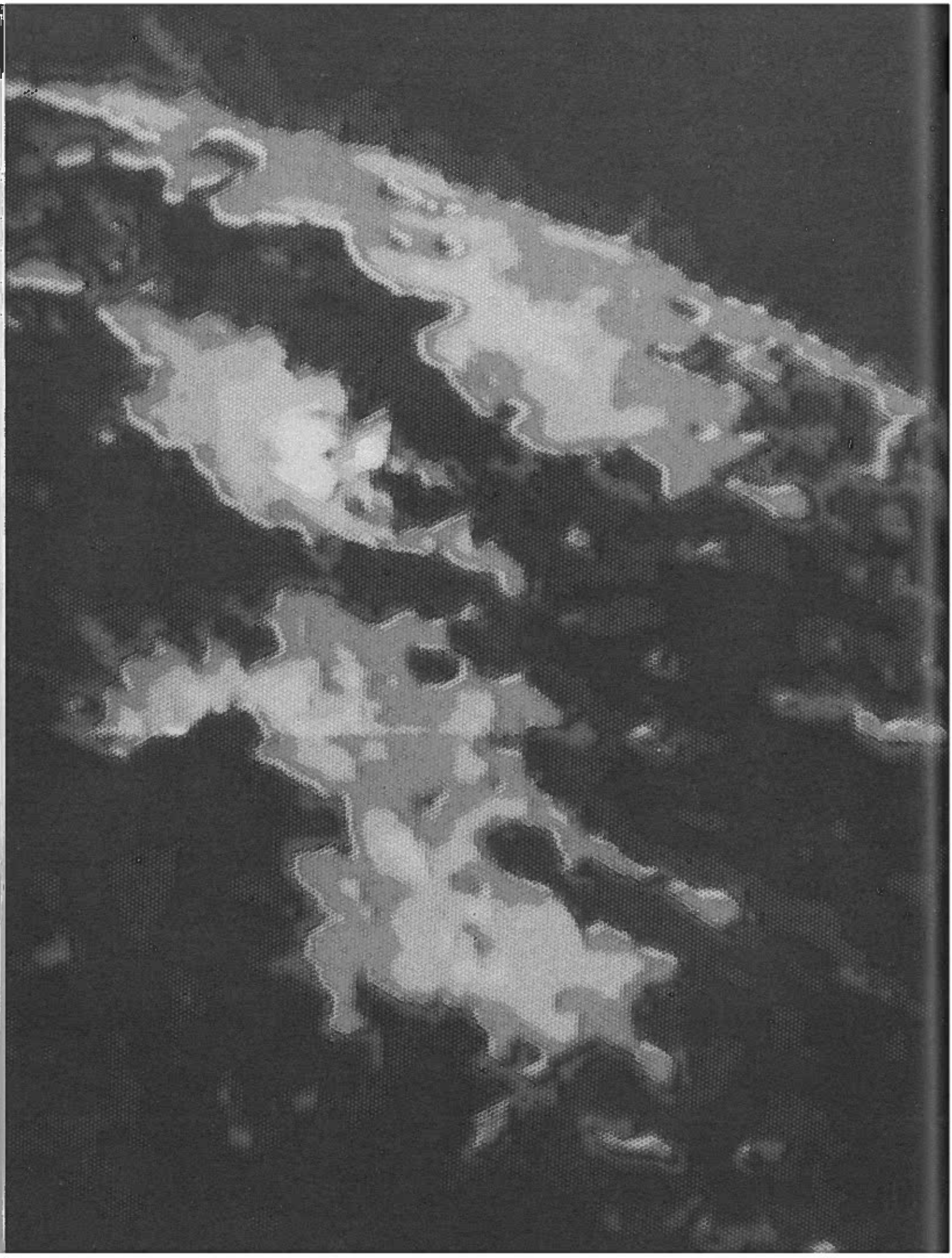
In FY1990, the OAET was spending $105.5 million to fund 1,097 projects at 184 universities with an average award size of $96,000. The awards were typically made through NASA Field Centers. Funding occurs through NASA Research Announcements (NRA), Announcement of Opportunities (AO), and unsolicited proposals. The latter are very versatile and most successful when technical discussions with NASA (HQ or Center) precede a submittal.

There are a number of OAET university programs. In university Space research there are nine University Space Engineering Research Centers, and Investigator Research and Advance Design Programs. Other programs are for basic research, hypersonic training and research, in-Space technology experiments (IN-STEP), and a graduate program in aeronautics.

In addition to the R&T activities, OAET does encourage educational outreach programs. At present there are programs (often funded from other sources) in minority outreach, summer faculty fellowships, at HBCUs, and for high schools.

Featured Topic Discussions





Computer Networking and the Space Grant Program

Ms. Molly Daniel,
Mississippi Space Grant Consortium

During the Second National Space Grant Conference, participants explored the possible advantages and disadvantages of utilizing electronic communication as a means of information exchange among Space Grant Program Directors, NASA personnel, and Space Grant program participants. Conference activities included informal and organized discussions, distribution of a survey, and recommendations presented at the Directors' Council meeting. The following information is a summary of these activities:

Questionnaire on Computer Networks

Each participant in the Second National Space Grant Conference was asked to complete a survey of interests in the development of an electronic network. The survey also requested the E-mail address for each person completing the form. Approximately 70 survey forms were gathered, and the results were overwhelmingly in support of the development of an electronic network.

Phase II Discussions, Monday, March 11 Electronic Networks

The topic of electronic networks was introduced and discussion groups were formed to represent the membership from both the Program Grant and Capability Enhancement Grant institutions of the Phase II Programs.

Mr. Richard Devon, Associate Program Manager, National Space Grant College and Fellowship Program, NASA Headquarters

Mr. Roy S. Torbert, University of New Hampshire, New Hampshire Space Grant Consortium

Mr. Joshua B. Halpern, Howard University, District of Columbia Space Grant Consortium

Ms. Molly Daniel, University of Mississippi, Mississippi Space Grant Consortium

Mr. John W. D. Connolly, Director, Center for Computational Sciences and Kentucky EPSCoR Program, University of Kentucky

Discussion group members solicited reactions informally during the week from conference participants. In addition, the discussion group organized a dinner meeting with the task leaders of the Networking Working Group and other interested persons.

Highlights of this information gathering:

- Space Grant Program directors in general have a high interest in establishing a mechanism of electronic communications.
- Initial efforts should focus on the development of a directory of electronic addresses of Space Grant Program Directors (or designated contact persons).
- Development of a bulletin board system should begin with an assessment of equipment and expertise available to the directors of the Space Grant Programs.
- If necessary, contingency plans should be made to provide support or alternative communications for those Space Grant Programs that may not be immediately accessible via an electronic link.
- Careful development of a bulletin board system (BBS) should include a determination of the purpose of the BBS and the audience to whom the information will be directed.
- Possible topics of interest for display on the BBS or in an electronic newsletter include the following:

  Lists of related electronic information sources, i.e., NASA databases, Space Link, FEDIX.

News briefs of ideas and innovations from Space Grant Programs across the Nation, including lists of publications, products, and other materials available.

A forum on selected topics, such as the issues introduced for discussion on day one of the 2nd Annual Space Grant Meeting (research infrastructure and faculty development; State and local government; underrepresented groups; evaluation of programs; university-industry interactions; and fellowships).

Notices of Space Grant-related national meetings, including information about NASA program personnel who will be available at those meetings.

Recommendations of the Networking Working Group

These recommendations were presented at the meeting of the Phase I Directors' Council on Tuesday, March 12, and the combined meeting of Phase I and Phase II Space Grant Program Directors on Thursday, March 14. The recommendations were endorsed and submitted to Dr. E. Julius Dasch, Program Manager of the National Space Grant College and Fellowship Program.

1. The establishment of a Networking Working group for the Space Grant Program, composed of two groups:

   a. User Interface Working Group with responsibilities for defining access modes and user services; surveys of existing capabilities and emerging capabilities on networks; development of necessary documentation and training manuals.

   b. Database Working Group with responsibilities for information capture, dissemination, storage, and archiving; database content, structure and evolution; development of documentation and training materials.

2. Funding of the working group to carry out assigned tasks. Initial task of the working group is to define the scope of the funding.

3. Submission of statements of interest and capabilities from those associated with the Space Grant Program to the ad hoc committee to facilitate the above.

4. Development of a Space Grant white page as an immediate, short-term goal.

Scheduled Conference Discussion on Tuesday, March 12: Electronic Integration: Can Computer Networking Help the Space Grant Program?

Moderated by Dr. Stephen Horan, New Mexico Space Grant Consortium, New Mexico State University, and Dr. Michael J. Wiskerchen, California Space Grant Consortium, University of California at San Diego, this portion of the meeting's program allowed for a presentation of the issues and an open-forum discussion.

Aerospace Curriculum Development

Dr. David R. Criswell,
Texas Space Grant Consortium

Dr. David C. Webb,
Florida Space Grant Consortium

In his introductory remarks to the March 14 session on aerospace curriculum development and the topic's first speaker, Dr. David R. Criswell, associate director of the Texas Space Grant Consortium, Dr. Julius Dasch noted that early in the Space Grant Program it was clear that curriculum development required close attention. He observed that while some courses were designed to "weed out" weaker students, such courses often ignored what he termed the need to educate all students in the quantitative aspects of science.

One such effort to confront the obstacles associated with curriculum development occurred when the California Space Grant Consortium under Criswell, then associate director, held a workshop in July 1990 on "Advanced Undergraduate and Graduate Curriculum in the Aerospace Sciences and Engineering." Criswell told the attendees that the workshop came about primarily as a result of the Space Grant Program and NASA Administrator Richard H. Truly's testimony before Congress in June 1990, where he supported strong educational programs to attract students into science and technology.

Criswell outlined the goals of the workshop, which were to:

1. Ascertain long-range opportunities that industry, government and academia could provide to a new generation of scientists and engineers;

2. Assist in designing undergraduate and graduate curriculum in aerospace sciences and engineering and courses in general education;

3. Develop new working relations among workshop participants and organizations in support of new curriculum;

4. Recommend courses of action to aid in the development and implementation of proposed curriculum by colleges and universities;

5. Encourage cooperation among government, industry and academia in these efforts;

6. Stimulate debate in the community concerning more constructive actions.

Criswell stressed the necessity for multidisciplinary courses. He cited, as an illustration of this need, the Jet Propulsion Lab, saying, "Even an institution which specializes in unmanned spacecraft requires a wide range of disciplines to operate."

Criswell discussed workshop recommendations to enhance the process of developing new curricula. They included:

1. Utilizing national R&D organizations to develop and evolve advanced curriculum in advanced aerospace studies;

2. Establishing three- to five-year coordinated summer programs at national laboratories with a team from university and industry to participate in developing curricula;

3. Establishing a coordinating panel and staff from Space Grant Consortia to encourage these summer programs and provide administrative ties from year to year;

4. Promoting the professional status of teachers within aerospace studies;

5. Establishing summer institutes for the development and testing of curricula;

6. Fully utilizing the Space Grant Colleges and Consortia on a local and national basis.

Criswell was director of the Institute of Space Systems Operations and attended the University of Northern Texas and Rice University. His education is in physics, space physics and astronomy.

Copies of the workshop report may be obtained from the California Space Grant Consortium.

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Dr. David C. Webb, University of Central Florida, is an international expert in the fields of Space Policy and Developments in Education. He is one of 15 appointed by former president Ronald Reagan to the congressionally-mandated National Commission on Space. He chaired the first and only interdisciplinary Space Studies Department at the University of North Dakota.

Dr. Webb discussed the need for an interdisciplinary approach to education. His remarks sparked considerable debate among conference attendees.

Societal makeup has changed from "rural agrarian" to "scientific/technological," Webb said, leaving "98 percent of the population behind."

"Education itself has been left behind," he continued. Where universities once controlled the rate of social change, Webb asserted, since 1945 — and for the first time in 800 years of university presence — change has come from outside the educational fabric. This was due, he said, to the massive centralization of manpower that occurred as a result of World War II.

Sudden change came about as the world entered the atomic age and continued into the space age resulting from driving economic, social and political factors distinct from education. Since then, he said, "the educational structure has been struggling to catch up, and it has failed." Webb further labeled the Nation's present educational system "irrelevant."

"We are sending people out into society unfit to live in an increasingly technological complex," he said. Webb blamed the Nation's "State-controlled, decentralized educational system," saying that societies with a centralized educational structure were more successful. In our society, education is directed "by the people," he said, "but the people don't know where they are going."

"In one person's lifetime," Webb continued, "our concept of reality has radically changed from static Keplerian/Copernican influence to the Einsteinian/relativistic, massively changing, violent universe we know today and caught society totally flat footed."

"No one can define a curriculum and set up an evaluation process," he continued, "when by the time you've got the curriculum in operation it is already out of date. That is not the way education should function."

Webb suggested that education should train people to be flexible, to understand, "and, above all, be multidisciplinary."

Webb stated that the manner in which education is structured in this country must be changed — to a Federal, centralized system — and predicted an uproar when and if it came about. He further suggested that such change will occur in a directed fashion "fundamentally, constitutionally," or it will come about unplanned, "changed for us by necessity" due to the needs of the scientific complex for manpower.

Webb accused the universities of becoming "irrelevant" and "part of the problem," saying that those who teach the teachers are at fault. He further asserted that the "total education problem rests at the university level." Yet, while K-12 teachers receive the most criticism, he said, "we have got off Scot-free and that is not fair."

Webb suggested that the universities must take responsibility and try to lead as they have in other countries. He urged the acceptance of programs whereby college students receive a broad understanding of "the societal forces at work: the technological, scientific, industrial, artistic, sociological, psychological, political."

He concluded by saying that he hoped that historians, looking back on the period 1950-2000 report that they saw "the beginning of the end of reductionism in knowledge and the start of the return to an holistic approach."

Webb's address stirred a number of audience members to comment.

Dr. Wallace T. Fowler of the University of Texas at Austin responded to Webb's remarks by saying that the problem in many cases lies not with the universities but with the State Boards of Education. Fowler labeled such bodies as often inflexible in their efforts to make teaching materials "teacher proof."

Webb agreed, saying that teachers are constrained by being told what to teach and how to teach it. Such an approach defeats the purpose of education, he said, further asking, "How can students maintain their interest [in a subject] when it's rote?"

Dr. Michael Wiskerchen of the University of California-San Diego agreed with Webb that the education system failed when change occurred too rapidly for the system to adjust.

"Technology and the space program created an environment where change occurs so fast the educational system cannot respond," he said.

Dr. Alvin M. Strauss of Vanderbilt University protested that the centralization of education would be "a disaster," asserting that technological advances spring from the universities. Webb challenged him by asking why the U.S. is in "a hell of a mess and why is it getting worse? Why do the universities see their function as becoming industrial research tanks?"

Strauss countered by asking why foreign students come to the U.S. for their education, to which Webb asked why American students do so much worse than those of almost all other nations.

Dr. Paul W. Weiblen of the University of Minnesota remarked, "I feel like someone who has been given some very bad medicine, and I didn't know I was sick." He suggested Webb visit some elementary schools to see the positive changes occurring and stated that in his view "a lot of good things are happening in education departments."

Dr. Willy S. Sadeh of Colorado State University accused Webb of presenting a "very gloomy picture," and disagreed, too, that centralization of education was the solution. He called the diversity of the American educational system its greatest feature. On Webb's multidisciplinary approach to education, Sadeh commented that, "We don't need Jacks-of-all-trades." He stressed the learning of fundamentals, saying that if students are properly taught basics, they will be independent thinkers. "We are in much better shape than we think," he asserted.

Webb countered by saying that multidisciplinarity and the teaching of fundamentals were not incompatible.

Dr. Julius Dasch, conference chairman, remarked that "professors can be turgid and constipated" when it comes to change. He recommended the attendees read the American Association for the Advancement of Science (AAAS) publication, *2061, Science for all Americans,* for evidence of a very different approach to education.

Dr. Terry Armstrong of the University of Idaho requested from the attendees what they consider to be the "central purpose of science education in today's public schools."

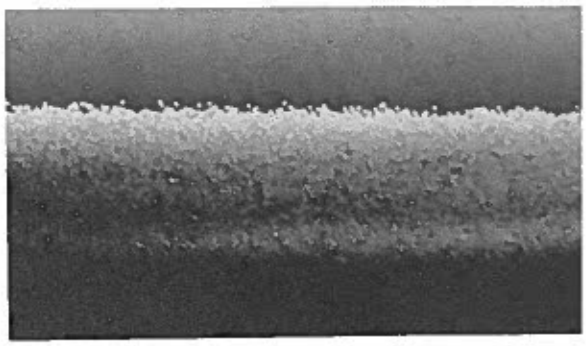
"I'm not sure we understand the purpose of science education. What are we really trying to do?" he asked. Armstrong suggested that identifying the purpose will enable educators to better focus on the "knowledge, skills and attitudes we want youngsters to know about."

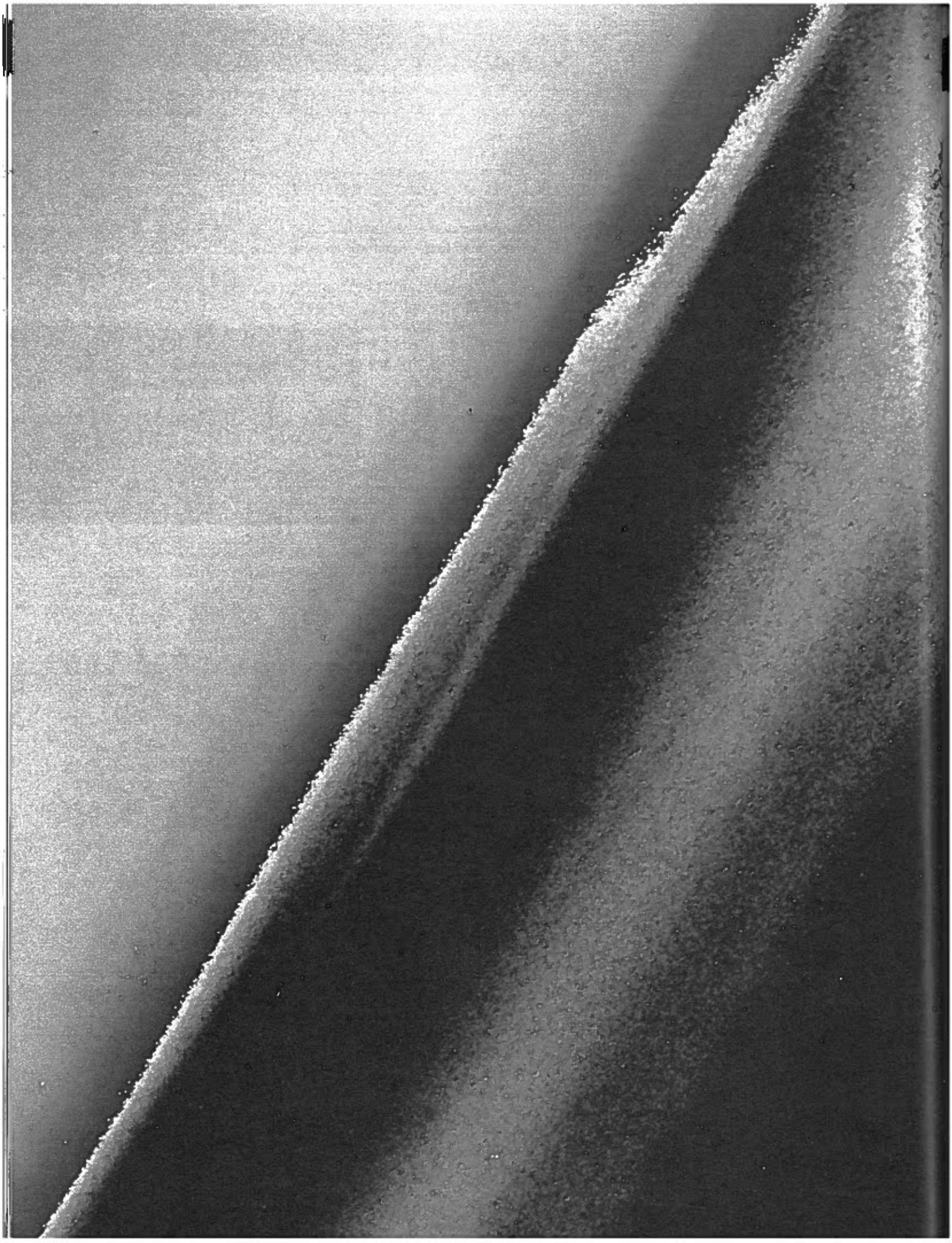
Dr. David Cudaback of the University of California-Berkeley related an anecdote which illustrated what he called "the problem we are facing [in science education]."

He recalled an incident in which he experienced the phenomenon of "highly educated... people [being] generally incapable of figuring out on their own when the Sun is going to set in a couple of days."

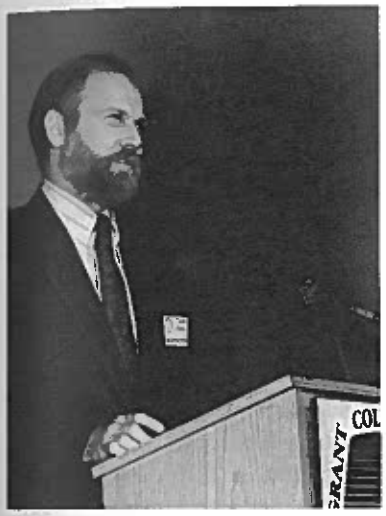
Cudaback urged educators to convey how "simple numerical matters apply to the real world." Students often come away from science courses unable to retain what they have learned "because we have not given attention to this matter of models that [the student] can test against reality."

Phase I Consortia Presentations





Summary of Phase I Results



David Peters gives the Georgia Institute of Technology Report.

Twenty-one individual institutions and Consortia, encompassing colleges, universities, nonprofit organizations, industry, national laboratories and State and local governments, were selected under Phase I of the National Space Grant College and Fellowship Program to provide the foundation for a network of universities with notable capabilities in aerospace research, education and public service.

The colleges and Consortia designated under Phase I have embarked on innovative programs of research, education and public service. Each of these programs has specific measurable objectives tailored to the program and derived from the Space Grant Program's overarching goals. These derived objectives will form the basis for evaluation of individual programs and subsequent expansion, modification or termination.

Examples of some of the activities put in place by the designees are:

- Undergraduate/graduate fellowship programs.
- New space science and engineering courses.
- Interdisciplinary aerospace science seminars.
- Faculty support programs.
- Summer workshops for pre-college teachers and students.
- Undergraduate/graduate student work experiences in aerospace-related industry.
- Speakers' Bureaus.
- Student/teacher conferences.
- Resources for teachers and students such as libraries, computer conferences, and "hands-on" laboratories.
- Public and cable television programs.
- Public education information brochures and exhibits.

Under the fellowship portion of the Space Grant program, designees have awarded thus far over 200 undergraduate and graduate fellowships, scholarships and internships. Special emphasis is placed on reaching women, underrepresented minorities, disabled and disadvantaged students. In addition, many endeavors upon which Space Grant schools have embarked involve cooperative efforts between science, engineering and education departments, industry, nonprofit organizations, national laboratories and State and local governments.

Space Grant schools have raised for their programs —in addition to the Space Grant award — over $16 million in cash and in-kind contributions to date. Moreover, Phase I participants have reached out to include over 30 new consortium members since the program began, bringing the total number of educational, nonprofit institutions, industrial and governmental agencies involved in Phase I alone to over 160.

In keeping with the Space Grant objective to form a national network of universities with interests and capabilities in aeronautics, space and related fields, several Space Grant designees have formed the Western Regional Space Grant Consortium. This body has met to discuss such issues as the development of sources of matching funds and the establishment of relations with industry affiliates. The consortium includes among its membership representatives from the Arizona Space Grant Consortium, the Colorado Space Grant Consortium, the New Mexico Space Grant Consortium, the Rocky Mountain Space Grant Consortium, and the Texas Space

Grant Consortium, as well as personnel and direction from the NASA/Johnson Space Center.

In addition, program directors from all 21 designated schools and Consortia early on formed the National Council of Space Grant Directors. The council meets periodically to discuss cooperative activities and share experiences.

Alabama Space Grant Consortium

Dr. J. Milton Harris, Acting Consortium Director

Activities and Accomplishments

The Alabama Space Grant Consortium (UAH, AAMU, AU, UAB, and UA) has been involved in a variety of activities designed to meet the objectives of the Space Grant Program as detailed by NASA Headquarters. The following is a brief listing of these objectives and accomplishments during the past year. A detailed description of these activities is contained in our Annual Report.

Objective 1: Establish a national network of universities with interests and capabilities in aeronautics, space and related fields.

The Alabama Space Grant Consortium (ASGC) assisted several other campuses in preparing Space Grant proposals. In particular, assistance was given to Vanderbilt University in organizing the successful Tennessee Valley Consortium proposal. The University of Arkansas, Clemson University and the University of Mississippi also assisted with Phase II proposals.

The Summer Faculty program is designed to aid faculty from nonresearch oriented campuses in spending the summer doing aerospace related research on ASGC member campuses. The brochure describing this program has been mailed to appropriate colleges throughout Alabama and surrounding States. Proposals for this program will be reviewed in February 1991; the first participants are expected to begin during the summer of 1991.

In collaboration with the Marshall Space Flight Center (MSFC) and the Alabama Space & Rocket Center, the Alabama Space Grant Consortium is hosting the Second National Space Grant Conference in Huntsville, March 11-15, 1991. This meeting has brought together a large number of individuals, representing many universities, industries, and NASA Centers, to hear about progress in the Space Grant Program and to discuss programs in aeronautics, space and related fields.

Objective 2: Encourage cooperative programs among universities, aerospace industry, and Federal, State and local governments.

Designated representatives of industry and university affiliates, and representatives of ASRC have been invited and have participated in Consortium Management Team meetings. A representative of MSFC is a nonvoting member of the Management Team and has participated regularly. Industrial and university affiliates, the ASRC and the MSFC have participated with member universities in the Consortium Policy Advisory Council according to the original plans outlined in the proposal.

The seven industrial affiliates and the ASRC have commitments to support the fellowship program and some resources have been received by the Consortium. The Governor' s representative on the Policy Advisory Council is assisting with negotiations to obtain fellowship/scholarship

funding from the State above the current educational commitments to the universities.

A major goal of the Alabama Consortium is to institute a NASA/University/Industry Personnel Exchange program between Consortium universities/industries and MSFC. A pilot activity was begun during the year involving the exchange of a professor from the College of Engineering (UAH) with a senior engineer from the Marshall Space Flight Center (MSFC). In addition, MSFC collaborated in hosting the Second National Space Grant Conference.

Objective 3: Encourage interdisciplinary training, research and public service programs related to aerospace.

The Consortium has made a major commitment to an extensive Conference and Seminar program (see attached brochure) designed to bring together people from a variety of disciplines in discussions of aerospace related matters. A successful proposal competition was held in the fall which drew 13 proposals from three member universities. Eight of these were funded for a total of $34,265.

Objective 4: Recruit and train professionals, especially women and underrepresented minorities, for careers in aerospace science, technology and allied fields.

The single largest financial commitment of the ASGC is to a Fellowship program for both graduate and undergraduate students. During the first program year, nine graduate fellowships were awarded for $20,000 each.

An undergraduate fellowship competition oriented to increasing the pool of minorities and females in aerospace fields was also successful. Ten undergraduate fellowships of $3,000 each (all to women or minorities) were awarded on four Consortium campuses and one affiliate campus, and one $5,000 fellowship was awarded on a Consortium campus to a handicapped (quadriplegic) minority undergraduate engineering student. Fellowship data sheets are attached.

Objective 5: Promote a strong science, mathematics and technology educational base from elementary through university levels.

The Alabama Space Grant Consortium has been involved in a large number of activities designed to promote science, mathematics and technology in elementary through university levels of education. In particular, the Fellowship, Conference and Seminar and Summer Faculty Programs (described above) are a major contribution to the promotion of science education. In addition to these programs which have received direct Space Grant funding, the ASGC campuses have facilitated, arranged, encouraged or committed funds to an additional large number of outreach activities on the various campuses including National Conference on Nursing in Space, Space Orientation for Professional Educators, Space Academy II, Kids College, Students for the Exploration and Development of Space, and Teacher Science Education Institute.

Management and Administration

During the past year, the Alabama Space Grant Consortium has fully implemented the management structure as described in the original proposal. The Management Team, composed of the campus directors, a nonvoting NASA representative, a Space & Rocket Center representative and a consultant from UAH, met eight times during the first year to deal with a broad range of business matters and to review fellowship, conference, and seminar proposals. The Policy Advisory Council has met twice.

Arizona Space Grant Consortium

Dr. Eugene H. Levy,
Consortium Director

Annual Report - 1990

The Arizona Space Grant Consortium encompasses the three State universities of Arizona: The University of Arizona (the consortium's lead institution), the Arizona State University, and the Northern Arizona University. The general concept implemented by the consortium is to have each of the campuses establish its own more or less independent Space Grant College activities, while the central consortium will play an integrating role across the three campuses.

Each of the three campuses has established a local steering committee, led by an associate director of the consortium. The associate directors are Prof. Christopher Impey (University of Arizona, Astronomy Department and Steward Observatory), Dr. Peter Wehinger (Arizona State University, Physics & Astronomy), and Drs. Thomas Harrison/Henry Hooper (Northern Arizona University). Prof. Eugene H. Levy (University of Arizona, Planetary Sciences Department and Lunar and Planetary Laboratory) is the director of the statewide consortium.

Each of the three universities has particular strengths, which form a complementary set for the consortium as a whole:

- **The University of Arizona** has very strong, broad, and deep programs in space science and engineering research and education in the context of a major undergraduate/graduate research university.
- **Arizona State University** is the State's largest urban university, located in its major population/technology center, with growing programs and increasing stature in space science and engineering.
- **Northern Arizona University** focuses principally on undergraduate education, and has the State's leading extant programs in outreach to precollege and minority groups.

Each of the universities focuses in those areas of strength where it can provide especially valuable experiences and opportunities for students in the areas of space science and engineering, as well as in related aspects of the national space program. In addition, each university seeks to use the Space Grant resources in areas where it can enhance its space-related programs. The program foci are:

The University of Arizona: Undergraduate education/career/ research/traineeship opportunities, outreach to public schools, support of university student-initiative projects, teacher training and materials development for pre-college science and space science education.

Arizona State University: Increased visibility and opportunity in graduate programs and through undergraduate traineeships.

Northern Arizona University: Primary emphasis on undergraduate research opportunities, outreach to pre-college and junior college students, exploitation of existing ties to minority student opportunity-enhancement (especially exploiting access to Native American population centers).

As the program develops, the central consortium will try to coordinate the three campus programs in areas where that might prove beneficial, especially with respect to joint activities and "student opportunity sharing." In addition, corporate participation and private-sector fund raising will be carried out by the three campuses jointly.

The Arizona Space Grant College program attempts to make best and complementary use of already existing activities at the three universities. This approach makes for the most efficient use of peoples' time and program resources. The approach has been to direct, to the greatest extent possible, program resources to student activities and student support. The Space Grant College

Program is still in its formative stages and efforts are being directed to find the most valuable mix of programmatic activities.

The following is a list of program components either underway, in the process of being implemented, or planned for the future. The "related programs" are listed to give a broader context of the overall environment of space science/engineering educational and outreach in which the Arizona Space Grant College Program exists. As can also be seen from the listed program elements, the present ambitions cannot be accommodated within present resources. We expect the program to grow as additional sources of support are found.

Related Program Components (Largely Supported from Other Sources):

1. High school teaching techniques workshop
2. Steward Observatory astronomy camp
3. Image processing space science teaching techniques
4. Teaching/research partnership
5. Astronomy summer master's degree program for teachers
6. Saturday science series at University Planetarium & Science Center
7. NASA Teaching Materials Resource Center
8. National undergraduate research observatory "Joint Ventures" (JOVE) program projects

Space-Grant-Consortium Specific Activities (Existing and Planned):

1. Undergraduate research/training work/study internships
2. Graduate fellowships in space science and engineering
3. Senior/Junior high school teacher research internships
4. Senior/Junior high school teacher space science teaching materials internships
5. Summer research intern program for high school students
6. Space science and engineering speakers/outreach program
7. Support of student-group initiated research

California Space Grant Consortium

Dr. Michael J. Wiskerchen, Program Director for UCSD

The Space Grant College and Fellowship (SGC&F) program in California is completing its first year. The combined efforts of the three University of California campuses at San Diego (UCSD), Los Angeles (UCLA) and Berkeley (UCB) of the California Space Grant Consortium have resulted in significant progress in enhancing space science and engineering education in the State of California and the Nation. This report will summarize both the administrative as well as the educational aspects of the initial year of the program.

The organizational and administrative structure of the California Space Grant Consortium (CSGC), with the Consortium Headquarters Office and Program Director at the California Space Institute (CalSpace) at UCSD, a curriculum development committee with key membership from UCSD, UCLA, and UCB, and an active working group on each of the three campuses, has proven successful and will continue. A change in the Consortium administration occurred in August with Dr. Michael Wiskerchen (formerly of Stanford

University) replacing Dr. David Criswell as Program Director. The principal investigators at UCSD (Dr. James Arnold), at UCLA (Dr. Christopher Russell), and at UCB (Dr. Christopher McKee) will continue in their respective leadership roles on the three UC campuses.

The initial year thrusts for the CSGC were to:

- Take a lead role in undergraduate interdisciplinary space science and engineering education;
- Take a supporting role in K-12 education;
- Take a lead role in creating a communications infrastructure for information exchange and curriculum development for the State and Nation;
- Provide an environment for encouraging underrepresented minorities and women into science and engineering careers;
- Build a hands-on environment for space science and engineering education;
- Form a university-Government-industry cooperative program.

In the area of interdisciplinary space science and engineering curriculum development, significant progress has been made on all three campuses. The primary emphasis was at the undergraduate level. At UCSD, under the leadership of Dr. Arnold and participation of a number of science and engineering faculty, a new undergraduate course in space science and engineering was introduced. At UCB, Dr. David Cudaback developed an undergraduate science and engineering course based on hands-on experimentation using an astronomical observatory and computerized learning tools. UCLA developed two new course offerings, one with an emphasis on space plasma physics and the other with the Global Change Initiative as the interdisciplinary driver. For all three campuses, the new course offerings have stimulated many thoughts and insights on directions for the future. The following are a few of the insights gained:

- There is a need to develop interdisciplinary undergraduate curriculum along with a mechanism to implement it within a classically structured department oriented university;
- There is a need to define, develop and establish multimedia (voice, video, graphics, animation, simulation, and digital data) capability as a tool for curriculum development;
- We must encourage industrial participation in the educational process such that there is joint use of facilities and personnel, joint space science and engineering projects, intern opportunities for faculty and students, and provision of scholarships;
- There is a need to establish a national communications network for the exchange of information between and within States and to provide an electronic link for the testing, evaluating, training, and implementation of multimedia curriculum tools.

Also key questions arose concerning the general issue of science and engineering education. These are summarized as follows:

- What are the relative roles of Government (Federal, State, local), industry, academia;
- How does the education process address and teach people how to deal with and manage a rapidly changing world;
- How do we incorporate modern communications and information system technology into the educational process;
- How do we create a new funding paradigm where academia, industry, and Government are equal cooperative partners;
- Can industrial partnerships be structured such that industry can participate in the educational process as a research partner as well as an important resource (financial and personnel).

Although, in the first year, primary emphasis was on establishing strong interdisciplinary science and engineering undergraduate curricula, considerable thought was given to community outreach efforts including science education for kindergarten through twelfth grade, for minority students and for women.

The Fellowship program, administered through the Calspace mini-grant program, provided research opportunities to space science and engineering students at the nine UC campuses. It acted as a catalyst to focus student attention on the science and engineering opportunities involved in the space program. The fellowship awards for 1990 had the following statistics:

- Graduate Level Fellowships Offered. — .38 Student Applications — 12 Selected;
- Ethnic Breakdown — 1 Black, 2 Hispanic, 1 Pacific Islander, 8 white of which 4 were female;
- Degree Fields — Physics-5, Earth Science-2, Astronomy-4, Applied Mech.-1.

In 1990, the Consortium conducted a workshop where leaders from academia, industry and government could jointly discuss and create an action plan for achieving excellence in science and engineering education. This, along with the curriculum developments on the three campuses, provides the following framework for the future efforts of the California Space Grant College and Fellowship Program:

- Continue to develop space science and engineering curriculum with an emphasis on the undergraduate level;
- Continue with graduate level research fellowships;
- Develop undergraduate scholarship program with hands-on experience emphasized;
- Encourage more mentor/student efforts where the mentoring comes from a triad arrangement involving industry, NASA Centers, and university faculty.

Colorado Space Grant Consortium

Ms. Elaine R. Hansen, Consortium Director

A NASA Program for Teaching, Public Service, and Student Research

The Colorado Space Grant Consortium (CSGC) was established by NASA in August 1989 as part of a national effort to help maintain America's pre-eminence in aerospace science and technology. One of 21 such programs in the country, CSGC links 14 member and affiliate institutions across Colorado. (CSGC was selected by NASA for a five-year grant and is funded on an annual basis by NASA and the University of Colorado at Boulder, Colorado State University, the Colorado Commission on Higher Education, and several Colorado space-related industries, which provide matching funds. The current budget is approximately $550,000 per year.)

Headquartered at the University of Colorado at Boulder, CSGC combines the resources of the University of Colorado (CU) campuses in Boulder and Colorado Springs; Colorado State University in Fort Collins; the University of Southern Colorado in Pueblo; Fort Lewis College in Durango; Mesa State College in Grand Junction; and the United States Space Foundation in Colorado Springs. Affiliates rounding out the statewide Consortium are the University of Northern Colorado in Greeley; the Colorado School of Mines in Golden; the United States Air Force Academy; Pikes Peak Community College; Colorado College in Colorado Springs; Western State College in Gunnison; and Adams State College in Alamosa. CSGC strengthens the educational base for

science, math and technology by extending space education and outreach to most of the students in the states, including Hispanic, Native American, Black, and rural populations. The Consortium provides opportunities for industrial partners, Federal, State, and local government personnel, and an outreach and community service program for primary and secondary schools and the public. An important feature of CSGC is the provision of special career opportunities for underrepresented minorities.

The Colorado Space Grant Consortium has three main focuses: research, teaching and outreach. The research and teaching programs build from the solid base of the established space program at the University of Colorado at Boulder, calling upon the resources of the growing space programs at Colorado State University, the University of Colorado at Colorado Springs, and the United States Air Force Academy. The outreach program develops and strengthens ties with the aerospace industry, reaching out to communities to encourage young students and underrepresented minority groups to continue math and sciences education. CSGC provides its students with hands-on experience in designing, building, flying, and operating real space experiments and in analyzing data from space engineering and scientific research efforts.

Research

NASA provides regular flight opportunities for small Space Grant experiments on the suborbital programs, Shuttle, and Space Station Freedom. About one flight per year is anticipated. There is a strong emphasis on student involvement throughout the entire range of space experiment phases, from initial concept through analysis of the data and publication of the scientific results and methodologies.

Teaching

A team-taught video course entitled "Gateway to Space" serves as the Gateway to student research opportunities. Space curriculum options are being developed for students in a variety of disciplines. Students participate in space mission operations modeled after the Solar Mesosphere Explorer's "Classroom in Space," which trained over 100 students as Command Controllers during its 7-years of operation. Students will staff the control centers of satellites and instruments on upcoming space missions, such as Upper Atmosphere Research Satellite, International Ultraviolet Explorer, Dynamics Explorer, and testbeds for the Space Station.

Outreach

Cooperative programs with industry include visiting faculty, sabbatical exchange programs, flight project collaborations and televised transmission of courses and lectures. Public service efforts center around a Speakers' Bureau for schools and interest groups, a Summer Honors Institute for outstanding high school juniors, summer certification programs for teachers, and tours of CSGC space-related facilities for primary and secondary students and the general public. A public space seminar series is offered each semester which provides basic introductions to the technical, social, and political aspects of space exploration.

The Colorado Space Grant Consortium Director is Elaine R. Hansen, of the Laboratory of Atmospheric and Space Physics at the University of Colorado. Trish Dunbar is the Program Coordinator. Both may be reached by telephone at (303) 492-3141, and by mail at Colorado Space Grant Consortium, Campus Box 10, University of Colorado, Boulder, CO 80309-0010.

Cornell Space Grant Consortium

Dr. Peter J. Gierasch,
Consortium Director

Highlights of 1990 Activities and Innovations

1. University Affiliates

Cornell and Clarkson are the university members of the Consortium. During 1990 City College of New York (Manhattan) and Polytechnic University (Brooklyn) were added as affiliates for special programs. These New York City schools bring our program to student populations with large numbers of minorities and underrepresented groups.

2. Industry, Federal, State and Local Governments

Industry members of the Cornell Space Grant Consortium are:

Grumman Aircraft
Hughes Aircraft
IBM
Ithaco
Rockwell International

These corporations are providing matching support. In addition, ALCOA has recently made contributions.

Our affiliated NASA Center is Goddard Space Flight Center.

3. Encouragement of Aerospace and Space Science Training

The Cornell Consortium sponsored eight public events during 1990. The most exciting and successful of these turned out to be a pair of talks by Dr. David Low, NASA astronaut (and Cornell graduate). He gave one presentation for high school students, who were invited to Cornell for a day of science and technology activities, and another talk for Cornell students. Both were tremendous successes. Contact the astronaut office in Houston to make arrangements if you are interested in an astronaut speaker.

We also support several community activities, such as the local Science Center, and several student activities at Cornell. Of the latter, the most exciting example during the past year was probably a glider project sponsored by an aeronautical engineering professor. A group of about 30 students are constructing a working glider from scratch, and are having a great time gaining real hands-on experience.

4. Recruitment and Training

The Cornell Consortium is supporting 10 full graduate student fellowships. Fellowship availability is widely advertised; about 900 announcements are sent throughout the United States. Special effort is made to reach colleges with high minority enrollments. These advertisements attract many applicants for graduate admission, and thus have an effect even larger than the fellowship program per se.

The Cornell Consortium runs a summer program for undergraduate interns. In 1990, 21 students were placed in research laboratories at Cornell and another 15 were placed at our industrial affiliates. For those at Cornell, a special lecture series was established, offering twice-weekly talks by faculty from a wide variety of space and aerospace fields. This program was a wonderful success. The students were, with only one or two exceptions, pleased and inspired by the opportunity to participate in real research. They spontaneously designed and produced a Space Grant tee shirt, which gave our program unexpected wide advertisement.

5. Promotion of an Educational Base

We offer speakers for high school teachers' conferences, and arranged several of these during 1990. Science teachers like this because it gives them current material to incorporate into their classes. We are receiving more requests for these presentations as our availability becomes known.

Polytechnic University in Brooklyn runs a pre-college summer program for high school students, particularly minorities. The program is operated by the University' s Center for Youth in Engineering and Science. Many students require fellowships to participate, because their family situation requires that they earn some money during the summer. The Cornell Space Grant Program provides fellowship funds to this program.

We offer tours and slide shows to groups of public school students of all ages, who visit the Space Grant Library and other facilities on the Cornell campus.

Florida Space Grant Consortium

Dr. Martin A. Eisenberg, Consortium Director

Program Highlights 90-91

The global objectives of the Consortium are to increase the flow of highly qualified and motivated personnel educated for and dedicated to aerospace-related careers and, in the process, to increase public awareness of and informed support for the development of and exploitation of aerospace-related science and technology. Toward these ends, the Consortium operates a number of programs:

- The *Interinstitutional Space Research Program (ISRP)* provides seed money for development of extramural funded cooperative research in aerospace-related areas to be conducted by colleagues drawn from different institutions. University, industry, and private/ Government laboratory interaction are fostered. Technical quality and promise of the proposed research, and potential for developing long-range cooperative efforts are two key criteria for funding. Under the aegis of the ISRP, research workshops are also sponsored. The emphasis is on grass-roots, researcher-to-researcher cooperative initiatives.

In 1990, under the ISRP five research projects involved faculty and graduate students from four universities and one corporation. These involved diverse topics in single crystal fiber growth, astrophysics, tracking of space objects, stability and control of large space structures, and applications of radiating gas flows to space propulsion. Each project involved multiple principal investigators bringing diverse expertise to the intrinsically interdisciplinary projects. In 1991 six new projects were funded.

- The *Space Grant Fellowship Program (SGFP)* in addition to recognizing, recruiting, and rewarding outstanding scholars, enhances interinstitutional cooperation by coupling academic year fellowships with summer internships in aerospace-related industries, Kennedy and other NASA Centers, and FSGC programs.

Since 1990, six fellows have been engaged in study of diverse topics from astronomy, computer sciences, engineering mechanics, neuroscience, meteorology, and aerospace engineering. Each will be engaging in an externship at a government or industry lab assuring diversity of perspective beyond that offered by the faculty of their home departments. Six new fellows will be funded for AY 91/92 while the first six continue under FSGC sponsorship.

- The *Space Assistantship Enhancement Program (SAEP)* provides supplemental funding for graduate assistants participating in aerospace-related programs, thereby improving retention rate in key academic programs and providing crucial support for research programs of particular promise.

In 1990, 19 graduate research assistants from four universities were funded to engage in research in astronomy, atmospheric sciences, climatology, geology, biology, computational fluid dynamics, materials processing and optics, space-

flight systems, and structural dynamics and control. Most projects have interdisciplinary aspects to them. Among the more intrinsically interdisciplinary projects are those associated with the NASA CELSS Project, biosphere atmospheric modeling astronomical effects on global sea levels, and materials processing in reduced gravity environments. Nineteen new projects will be funded in AY 91/92.

FSGC Program Highlights

- *The Undergraduate Space Research Participation Program (USRP)*, modeled after the highly successful NSF programs but restricted to aerospace-related research, provides superb opportunities for students from throughout Florida (and from historically black institutions in neighboring states) to become actively involved in ongoing research programs. It provides a vehicle for recruitment of underrepresented minorities and women into graduate study and careers in a wide variety of aerospace-related areas.

In 1990, 24 undergraduate students from six universities worked on USRP-sponsored research projects in an even more diverse range of subjects. For many students the research was carried on under the mentorship of faculty from departments other than their own. All students were forced to stretch their horizons, learn to work in ongoing team projects and integrate knowledge gained from numerous courses. In addition to their work on individual projects, each student was invited to attend the Florida Space Conference during which they were exposed to diverse issues on subjects related to the general theme of space commercialization. Twenty additional students will be funded for Summer 1991.

- The *Space Education Development Program (SEDP)* sponsors several complementary and innovative aerospace-related educational initiatives to: (a.) enhance curricular offerings in the above and related areas; (b.) develop programs to train a cadre of aerospace-literate K-12 teachers — via new graduates and continuing education; (c.) develop aerospace-related K-12 math and science curricula; (d.) develop broadly based multidisciplinary undergraduate aerospace-related general education courses; (e.) develop systems for communication, replication, and transfer of courses and curricula; and (f.) enhance systems for interinstitutional sharing of expertise and resources, and statewide coordination of aerospace curricular offerings.

In 1990, the SEDP sponsored four projects oriented toward development of K-12 teachers in aerospace-related subjects. For all such teachers the subject matter represented an extension of their competency in dealing with interdisciplinary applications of their subject specializations.

In 1991 we have shifted our focus to university education and are now developing plans for a national conference, *Meeting the Space Education Needs of the Future*, October 23-25, 1991, in Cocoa Beach, FL.

- The *Space Lectureship Program (SLP)* is designed to recruit lecturers from academia, industry and government labs; and to promote lectures appropriate to K-12 schools, undergraduate student technical societies, graduate seminars, and to civic groups throughout the State of Florida — thereby enhancing public understanding of and support for the Space program.

In 1990, the SLP under the leadership of Ron Thornton, Director of NASA's Southern Technology Applications Center, and relying on STAC's professional staff, delivered lectures to more than 3,000 K-12 students throughout Florida on interdisciplinary Space-related subjects. The program continues in 1991.

Georgia Institute of Technology Space Grant Consortium

Dr. David A. Peters,
Consortium Director

The Georgia Tech Space Grant Consortium has awarded 26 fellowships to date. Recipients of the fellowships are students currently enrolled at one of the member institutions. The major fellowship goal of the Consortium has been the recruitment of underrepresented groups — nine Black males, eight Black females, one Hispanic female, and eight White females were the recipients of the awards for 1990. Fellowships are for the duration of one year. During the 1991 program year, the GT Consortium looks forward to receiving matching fellowship funds from corporations and increasing the number of fellowships awarded.

The first several months of 1990 were spent determining which organizations on each campus within the Georgia Tech Consortium were involved in activities or programs with similar goals and objectives. Several established organizations were engaged in similar program activities and the Consortium utilized funding to add an aerospace component. One example of such a program is Summerscape, which is an academic enrichment program designed to challenge middle school students through a variety of course offerings in science, mathematics and technology. The Consortium added an aerospace component, and provided scholarships for five minority students.

Last year, the major activity sponsored by the Georgia Tech Consortium was the Space Camp. Ninety-three children from 14 Atlanta Public Schools were provided an exciting learning experience through the Space Camp. Of the 93 children who participated in the program, 90 were on full or partial scholarships. Eighty-nine of the campers (95%) were Black and 43 (47%) were female. Twenty-three Atlanta Public School teachers from nine public schools and one elementary school honed their science teaching skills through special in-service training for the camp. A team of eight multidisciplinary Georgia Tech staff worked with the Atlanta Public School staff to plan and implement the camp. Georgia Tech provided meeting and teacher training facilities, and Georgia State provided the lead trainers. Numerous scientific field trip experiences were provided including visits to Hartsfield International Airport, Zoo Atlanta, Fernbank Science Center, Alabama Space and Rocket Center and tours of the Georgia Tech Campus. The campers learned about Newton's law and Bernoulli's principles and participated in building model space stations, building and launching model rockets, setting up and launching a passenger balloon. At the kick-off session at the beginning of the camp, 12 campers said that they were interested in a career in science or technology. At the closing ceremony, one week later, 49 campers indicated an interest in exploring science/technology related career possibilities. For 1991, the number of kids involved in Space Camp will be doubled and last for two weeks. The camp at Georgia Tech is cosponsored by the Office of University Partnerships and will be held from July 22 to August 2. This year's Space Camp will be called Space 2010, because the kids involved in this Space Camp are the answer to the shortage of personnel in math and science expected in the year 2010. Activities during the two-week Space Camp include a trip to Tuskegee University to observe the NASA project with hydroponic vegetables, the George Washington Carver Museum, and the home of the Tuskegee Airman, an overnight trip to Huntsville, a tour of one of Atlanta's airports, rocket building, experiments with professors on Georgia Tech's Campus, a trip to an observatory, and a space shuttle design contest. Mentors will be used throughout the two weeks of Space Camp. The Ron McNair Foundation will provide a film and other materials on the life of the late astronaut, Ron McNair. This particular Space Camp will involve year-round planning and monthly meetings. Representatives from the City of Atlanta Schools, Georgia Tech faculty and staff, and private industry representatives are involved in monthly planning sessions.

On the high school level, the Consortium will sponsor numerous activities encouraging students, particularly students from underrepresented groups, to pursue science and engineering careers. This year several high school students will work with the Georgia Tech Space Grant Consortium doing research and working with program activities. Some of the activities the Consortium has already sponsored include two annual banquets on the Georgia Tech Campus to honor outstanding students, sending role models to speak at the schools, sponsoring field trips, and pairing faculty with students for experiments. The Consortium also sponsored a Wind Tunnel Construction Contest in one of the local high schools, which has proved to be a very exciting activity. This particular activity will be expanded to include several high schools in the next year. We have worked very closely with the Ron McNair Senior High School in developing its curriculum as an Engineering Magnet School in DeKalb County, Georgia. Currently, the student body at McNair High School is 99% Black, and 65% female.

The Consortium has also recently been successful in negotiating for "Opportunities Skyway," which is a program of the Prince Georgia's Private Industry Council. This program will now be duplicated in Atlanta and funded in part by the Atlanta Private Industry Council and the Atlanta Board of Education. The program is designed to provide an exciting avenue for motivating disadvantaged and minority youth to stay in school and pursue careers in aviation. Opportunity Skyway will bring aviation to the classroom and students to aviation by working with and through the school system in concert with teachers and administrators. Atlanta is the ideal location for such a program because of Hartsfield International Airport, and the large minority population, particularly in proximity to the Georgia Tech Campus. The Consortium will provide role models from Clark-Atlanta University and Tuskegee University. The School of Aerospace Engineering at Georgia Tech will provide instructors and assist with designing the curriculum. Georgia State will provide student assistants from its School of Education. The program will officially begin in August 1991.

The Space Grant Office, located on the Georgia Tech Campus, is a very visible location. Housed in the office is a large collection of space-related educational videos and magazines for all age groups. Several students are working with the Consortium on a space exhibit for the office, which will include models of the Challenger, Apollo, Gemini, Space Station, etc. We have also amassed a large collection of material from NASA Headquarters and its Field Centers, which we have on display. One of the walls in the office is reserved for photographs of the activities conducted throughout the year by the Consortium.

Hawaii Space Grant College

Dr. Peter Mouginis-Mark, Program Director

1. Hawaii Space Grant College is run by the Planetary Geosciences Division on behalf of the University of Hawaii. Dr. Peter Mouginis-Mark is the Director, Dr. Hawke runs the community outreach program, Dr. Postawko runs the Undergraduate Fellowship Program, and Dr. Taylor is in charge of the curriculum development activities.

Space Grant fully funds two support personnel, and provides partial funding to four faculty (50%), one graduate student (50%) and one postdoc on a trainingship (20%).

2. Undergraduate Fellowship Program has provided fellowships (each worth $1,000 plus tuition waiver) to 22 undergraduates. thirteen of these students are at UH Manoa, nine are at UH Hilo.

3. Two-week workshop ("Exploring Planets in the Classroom") for 45 school teachers and school librarians this Summer. Space Grant will provide $250 stipends to each participant, and a copy of the textbook, computer software, and visual aids (slides and video tapes), plus travel funds for outer-island participants. Hawaii Space Grant College will also bring leading space science educators from the Mainland (Smithsonian Institution, Arizona State University and Brown University) to present talks to the workshop attendees.

4. This summer, the Space Grant College is sponsoring a two-week program for Gifted and Talented Native Hawaiian School Children at the UH Hilo campus. ten students, grades 9 - 12, will study astronomy from the perspectives of the Polynesian navigators and astronomers at the Mauna Kea telescopes. Space Grant will pay for all their board and lodging, the salaries of the teachers, transportation to Mauna Kea, and the curriculum development. Total Space Grant funding for this activity is $15,000.

5. Travel funds ($1,600) will be provided to Oahu junior high school students to travel to the Big Island for a week to study the volcanoes, observe the July 11th solar eclipse, and visit the Mauna Kea telescopes.

6. We have already established two new senior-level undergraduate courses in astronomy at the UH Hilo campus, and one senior-level planetary geology course at UH Manoa. Faculty salaries, and computer equipment and software are all provided by the Space Grant College.

Other Activities

1. In order to bring the new developments of space science to the general public, the Hawaii Space Grant College is producing a new book, called "Hawaii: The View from Space," in association with the Bishop Museum Press. We hope this book will be published early in 1992.

2. Interactions with Department of Business and Economic Development — Planning for the State's participation in NASA's Advanced Communications Technology Satellite (ACTS) Program.

3. Leadership role in planning State's involvement in the International Space Year. Dr. Hawke serves on State's main planning committee.

Dr. Mouginis-Mark will chair workshop on "Dynamic Global Change" at the ISY Conference to be held October, 1991, in Kona, Hawaii.

Aerospace Illinois Space Grant Consortium

Dr. Wayne C. Solomon,
Consortium Director

Education in Aerospace Sciences

Abstract

This paper discusses the methodology used within "Aerospace Illinois" to create a statewide Consortium of universities dedicated to the advancement of aerospace sciences. The program has been constructed around the strengths of the existing educational system in an effort to leverage effort across the region.

Background

Aerospace Illinois Space Grant Consortium

- Consortium of universities, called Aerospace Illinois, formed to undertake program.
  - Designated by NASA as a National Space Grant Consortium.
  - Argonne Labs (Illinois Space Institute) as umbrella.
- Members represent strong institutions with a vested interested and individual strengths.
  - University of Illinois and IIT for aerospace engineering.
  - UC and Northwestern for aerospace sciences.
- Attractive for industry participation.

In 1989, "Aerospace Illinois" was designated by NASA as one of 21 Space Grant Colleges/Consortia. Aerospace Illinois, a space grant Consortium, is made up of participants from the University of Chicago, the University of Illinois, Illinois Institute of Technology, and Northwestern University. It is dedicated to expanding our abilities to provide education and training in aerospace sciences within the region. Our Consortium is conducting a balanced program of cooperation within the university, industrial, and governmental agencies to encourage progress in aerospace fields.

NASA's Specific Objectives

NASA's Specific Objectives

- To establish a national network of universities with interest and capabilities in aerospace.
- To encourage cooperative programs among universities, aerospace industry, and Federal, State and local governments.
- To encourage interdisciplinary training, research, and public service programs related to aerospace.
- To recruit and train professionals, especially women and minorities, for careers in aerospace science and technology.
- To promote a strong science, math, and technology educational base from elementary through university levels.

The overall objective of the program is to broaden the education base in aerospace science and technology. The stated NASA specific objectives are shown in the box above.

Approach

Aerospace Illinois Space Grant Consortium Program Elements

- Undergraduates/high school teaching and research.
- Training in graduate research.
- Outreach and public service.
- Industry Matching Fellowships.

The basic elements which make up the program are undergraduate/high school teaching and research; training in graduate research; outreach and public service; fellowships with industry. Within these elements, Aerospace Illinois has established a series of measurable objectives designed to be fully responsive to the grant from the NASA educational division.

Undergraduate/High School Teaching and Research

- General Objectives.
  - Enhance teaching and research participation to attract undergraduates/secondary school students to modern aerospace science and engineering.
- Measurable objectives and strategies.
  - Establish aerospace-engineering design courses, e.g.,
    - Enhance existing capstone design courses.
    - Develop advanced design and systems courses to provide linkage with graduate program.
    - Develop joint multi-university and industry cooperation.
  - Foster existing scholar programs e.g.,
    - Career associates and undergraduate scholars activities.
  - Organize student and teacher workshops, e. g., WISE, CHERUB, CHAMP, MITE.

The first objective is to enhance the teaching and research training to attract secondary school/undergraduate students to modern aerospace science and engineering. The measurable objectives and strategies are:

1. To organize student and teacher workshops with aerospace expertise.
2. To foster scholars programs such as career associates and undergraduate scholarships.
3. To establish new aerospace engineering design curricula through improved existing capstone design courses, advanced systems courses, and multi-discipline (multiuniversity) and industry cooperation.

The second objective is to provide strong academic training through research experiences focused on science and engineering and the building of the cooperative aerospace strength of the Consortium members. The measurable objectives and strategies are:

1. To provide graduate student support in critical targeted areas, such as high temperature materials, large space science applications, small space flight opportunities, fluid dynamics, and very high-speed flight.
2. To initiate interschool interdisciplinary projects which will strengthen Illinois graduate education.
3. To enhance teaching in aerospace by developing some common initiatives within the Consortia.

Training in Graduate Research

- General Objectives.
  - Provide strong academic training through research experiences focused on aerospace science & engineering.
- Measurable objectives and strategies.
  - Provide graduate student support in critical targeted areas, e.g.,
    - Small Space flight projects.
    - Unsteady fluid dynamics and high speed flight.
    - High temperature materials and composites.
    - Dynamics and control for Space applications.
  - Initiate inter-Consortium interdisciplinary projects, e.g.,
    - X-ray mirror design and integration.
    - Novel instrumentation packages for Space and aeronautics research.
  - Capture new faculty participation in aerospace research.
  - Develop specialized graduate courses.

Outreach and Public Service

- General Objectives.
  - Employ the region's extensive existing public educational information networks and outreach programs to provide a window to the highest quality student populations with emphasis on minorities and women.
- Measurable objectives and strategies.
  - Establish pipeline to general education instructions of Illinois, e.g.,
    - Illinois Math & Science Academy.
    - Intercity Wright College.
    - ANL Chicago explorers program.
    - UIUC 4H aerospace programs.
  - Establish participation of secondary students in Consortium member activities.
    - Student/teacher workshops, participation in research.
    - Clearinghouse for NASA educational material.
  - Sponsorship of public awareness activities.
    - Conferences.
    - Museums.
    - Observatory.

A third general objective is to employ the region's extensive existing public educational information networks and outreach programs to provide a window to the highest quality student populations with emphasis on minorities and women. The measurable objectives and strategies within this group are:

1. To establish a pipeline to general education institutions of Illinois, such as Illinois Math and Science Academy, Intercity Wright College, ANL/Chicago explorers program, and UIUC 4H aerospace programs.
2. To involve participation of secondary students in Consortium member activities, such as student/teacher workshops, participation in research opportunities, and NASA educational materials.
3. To sponsor public awareness activities, such as special events at museums, observatories, and conferences.

Fellowships with Industry

- General Objectives.
  - Add substantially to the national aerospace science and engineering pool through award of fellowships.
  - Involve industry.
- Measurable objectives and strategies.
  - Recruit top quality Ph.D. candidates in aerospace science and engineering.
  - Emphasis on minorities and women.
  - Achieve industry matching fellowships.

The fourth general objective is to add substantially to national aerospace science and engineering teaching and research through the award of special NASA and industry fellowships. The measurable objectives and strategies involve:

1. Recruiting top quality Ph.D. candidates in aerospace science and engineering with the emphasis on minorities and women.

2. Attaining the necessary matching fellowships from industry.

Our group of universities conducts a balanced program of cooperation within university, secondary education, and government to encourage progress in education for aerospace fields. Our group has been affiliated for two years through this and related programs and is enthusiastic about our chances to attract the best and the brightest within Illinois in partnership with NASA. This effort also has potential benefits of strengthening the small aerospace component in the State's economy over the longer term. The Illinois members which have been selected are among the better nationally rated institutions. Their existing capabilities and NASA relationships are such that the Consortium as a whole represents a strong point of each institution. The University of Illinois is a leading engineering college and, as such, is the organizer and will concentrate its efforts in the fields of aeronautical and astronautical engineering. Illinois Institute of Technology (IIT) will emphasize its expertise in experimental fluid dynamics and its National Diagnostic Facility (NDF) for the program. Northwestern's nationally recognized efforts in high energy astrophysics and materials science will be deeply involved. Finally, the well known workers in Space exploration at the University of Chicago will add a necessary science component to round out the activities of the members.

The group of universities making up the Consortium are estimated to produce 5% of the country' s graduates among those being employed in aerospace and related sciences. The quality of our student pool is extremely important to us, and filling the pipeline is essential to the maintenance of the national industrial base, as well as meeting the aerospace business development objectives within Illinois. As has been recognized by NASA, the infrastructure of the entire State and region will be substantially and irreversibly improved by the enhanced emphasis on science, math, engineering, and technology throughout all levels of education. We maintain that the long-term effects of the seventeen nationwide educational efforts such as ours will contribute to the future improvement of our Nation's leadership role in the rapidly evolving worldwide aerospace economy.

Iowa Space Grant Consortium

Dr. Wallace W. Sanders, Consortium Director

The Iowa Space Grant Consortium consists of the three Regent's universities in Iowa: Iowa State University (lead institution), University of Iowa and University of Northern Iowa. The Consortium, initiated February 1, 1990, has just completed its first full year of operation and programming. There are six basic programs that were conducted to support the objectives of NASA's program.

- Graduate Fellowships
- Undergraduate (Senior) Scholarships
- Summer Undergraduate Research Experiences
- High School Summer Experiences
- Lecture Series
- Elementary and Secondary Teacher Activities

The three institutions have coordinated their efforts through an Executive Committee with representatives from the member universities. The nature of this organization has been to enhance cooperation and networking.

Subsequent sections will highlight those parts of programs which indicate special or unique activities and opportunities by the Iowa Consortium.

The development of programs with industry and other governmental units has fostered two special activities. The Consortium is supporting the efforts of the volunteer Aerospace Education Council of Iowa (composed of representatives from such diverse groups as the public schools, FAA, Air Force Reserve, Air National Guard and State Aviation Division) to prepare teacher activity kits that are available for loan through the State Department of Education. New or updated kits, which include student and teacher material, are being developed on aerospace history and Space travel. In addition, a major space exhibit and a training program, called "Millennium Station," are being developed in cooperation with the Science Center of Iowa. The program, now being initiated through a feasibility study, will result in a fixed exhibit to train teachers and students, plus an outreach program to schools and other museums throughout the State. The actual construction and the implementation will be funded by grants from Government, private industry and individual contributors.

In addition to the interdisciplinary research programs conducted by our Fellows and Scholars, a special effort is being conducted by a NASA Fellow through one of the summer teacher activities. The Fellow, a science teacher undertaking graduate study, is not only developing an interdisciplinary Space science program for secondary teachers through her fellowship effort, but will work with her institution during the summer teacher training workshop (sponsored by the Consortium) to utilize and implement the new program with teachers at the workshop.

Our lecture program has brought a number of speakers, including NASA staff, to the three campuses. Lectures have included those of general interest as well as some in specific technical fields. The Consortium has utilized these opportunities to provide special presentations by women and minority scientists and engineers to serve as an incentive to our target groups to consider science and technology. Special seminars by outside groups have been downlinked to the campuses for university students, as well as area elementary and secondary students.

The on-campus programs for students at the member institutions consist, in addition to the fellowships and scholarships, of summer research experiences for student/faculty teams in all fields related to Space. This program supports students for 8-10 weeks to work with a faculty advisor on a project in a field related to space. Faculty members who currently do not have NASA funding are encouraged to participate and utilize the opportunity to

develop a research effort in Space-related field. The student receives a stipend and the faculty advisor receives a small grant.

The Consortium will, at each of its member institutions, conduct two- to three-week summer programs for high school students. For example, at Iowa State 20 talented and gifted students will be working with Aero-Space Engineering faculty on special studies in flight dynamics. These faculty will also present half-day workshops for 100 other summer science-focused students. In both parts, focus will be on the participation of women and minorities.

The Johns Hopkins Space Grant Consortium

Dr. George Peterson,
Associate Consortium Director for Undergraduate Programs

Summary of Activities September 1, 1989 to December 15, 1990

The Johns Hopkins Space Grant Consortium was established September l, 1989. The initial activities centered on establishing an office and staff. In accordance with the grant proposal Dr. Richard C. Henry, Professor of Physics and Astronomy at The Johns Hopkins University (JHU) assumed the role of Director, and three Associate Directors, each representing one of the member institutions and responsible for one of the program areas, were appointed. They are Dr. Eric J. Chaisson of the Space Telescope Science Institute (ST ScI) as Associate Director for Public Outreach, Dr. George D. Peterson of Morgan State University as Associate Director for Undergraduate Programs, and Dr. Vincent L. Pisacane of the Johns Hopkins Applied Physics Laboratory (APL) as Associate Director for Interdisciplinary Programs. The Maryland NASA Space Grant Center administrative staff consists of a part-time Administrative Assistant and an Assistant Director.

On May 17, 1990, the Consortium became the first occupant of the new Bloomberg Center for Physics & Astronomy, a 238,000 square-foot teaching and research complex on the JHU Homewood Campus. The Consortium suite includes offices for the Director, Assistant Director, and Administrative Assistant, a small library, a conference room/Associate Directors' Office, and storage Space, all located at the main entryway to the Bloomberg Center. It is hoped that this area will become a public focal point for Space activities at JHU.

Matching funds for fiscal year 1990 were secured through $237,551 in salary support and overhead from The Johns Hopkins University and through $275,000 in private contributions towards construction and equipment of the Space Grant Observatory on the roof of the Bloomberg Center. In addition, four aerospace companies (Allied Signal/Bendix, Computer Sciences Corporation, Martin Marietta, and Westinghouse) have contributed a total of $30,000 in cash and $25,000 designated in support of the Consortium's office Space from a grant towards building the Bloomberg Center. Representatives from each of these companies have formed a Corporate Advisory Board for the Consortium.

Recognizing the need to strengthen the Nation's pipeline of qualified scientists and engineers, the Consortium has three major goals:

1. to increase representation within the Space sciences of historically underrepresented demographic groups, particularly women and nonwhites;

2. to promote public interest in and awareness of opportunities in the Space sciences; and

3. to foster new interdisciplinary and inter-institutional research and educational programs involving Consortium members and affiliated industrial sponsors and NASA Centers.

The following highlights some of our activities toward meeting the above-mentioned goals set forth by NASA and the JHU Space Grant Consortium.

Undergraduate Programs

Space Scholars Program — The core of the Undergraduate Program is a meaningful scholarship program, "Space Scholars," which will support a significant number of high school students who wish to pursue a program of interdisciplinary Space science or engineering. The Scholarship program will provide support for four years of undergraduate study. For the first two years, support will consist of tuition and fees. In the last two years, a greater incentive (stipend) will be added to the support package. The program is characterized by rigorous study, interdisciplinary focuses, and a required summer internship between years three and four. Each scholar has been assigned a mentor — a Space scientist or engineer in professional practice. The program of study is a cooperative offering between the Johns Hopkins University and Morgan State University. The students will be encouraged toward graduate study. It is anticipated to select six students to enter the program each year.

Space Science Internship Program (SSIP) — A three-part Pilot Space Science Internship Program (SSIP) provides eight Baltimore City Public School teachers the opportunity to learn an interdisciplinary approach to earth and planetary science, astronomy, and astrophysics. Participants also become familiar with (1.) the academic preparation needed to become an aerospace engineer or Space scientist, (2.) what an aerospace engineer or Space scientist does, and (3.) an opportunity to meet aerospace engineers and Space scientists from Government agencies and private industry. The program is intended for school teachers who have some background and experience in the sciences and who have the desire to integrate these concepts into the classroom.

The long-range goal of this program is to become self-sustaining with a significant core of enthusiastic teachers who will provide the infrastructure to attract, motivate and nurture students to pursue aerospace or other Space-related careers.

The program includes two Morgan State University graduate courses (Space Science EASC523 and a Summer Practicum — Maryland Pilot Earth Sciences Technology Education Network (MAPS-NET), together with a two-week summer internship at a NASA facility or aerospace research laboratory. Expenses for tuition, fees, books, learning materials, and stipends will be paid by the program.

Interdisciplinary Programs

Cooperative Graduate Program With Goddard — Dr. Maria Zuber, a planetary dynamicist at Goddard's Laboratory for Terrestrial Physics, is being partially funded by the Consortium. Dr. Zuber's presence at JHU is part of Earth and Planetary Sciences', new attempt to establish a cooperative graduate program with Goddard.

Lunar Observatory — An interdisciplinary research team has been assembled to design a 16-meter UV-visible IR telescope for installation at the permanent lunar outpost. Team members represent the Space Telescope Science Institute, the Johns Hopkins University, the JHU Applied Physics Laboratory, Morgan State University and NASA/Goddard Space Flight Center.

Space Grant Observatory Graduate Student — A graduate student assigned to the JHU Department of Physics and

Astronomy has been given a fellowship by the Consortium to assist in the construction and operation of the Space Grant Observatory.

Solar Sail - Provided interim funding of APL Solar Sail (design project for a sailing ship that will compete in a race to Mars in the Columbus 500 Space Sail Cup during the 1992 International Space Year.) The APL Solar Sail Consortium included scientists and engineers from APL, Westinghouse Electric Company, NASA/GSFC, the University of Maryland and the U.S. Naval Academy.

Outreach Programs

Following are specific outreach programs for students, teachers, and the general public which were hosted or conducted by the Consortium:

Space Grant Library— The suite of offices which the JHU Space Grant Consortium occupies in the new JHU Physics and Astronomy Building includes a room which is used as the Space Grant Library. Future plans call for it to be a resource center on Space for educators and students. Materials will be at the lay, popular, and semi-popular level; thus the library will serve as a counterpoint to the numerous research-level libraries in our vicinity.

HST-HUT National Teachers Conference (JUNE 18-21, 1990) — Sponsored and coordinated a national workshop for 232 high school teachers and educators from 36 States, the District of Columbia, and Canada, and 18 astronomers and NASA officials focusing on the Hubble Space Telescope (HST) and the Hopkins Ultraviolet Telescope (HUT) Space astronomy missions. Teachers received curriculum and resource materials from NASA Headquarters, NASA/Marshall Space Flight Center, the Space Telescope Science Institute, the JHU/HUT project office, and the Astronomical Society of the Pacific. In addition, an HST-HUT slide set, a special video on ST ScI and the HST launch and deployment, and an educational poster on the electromagnetic spectrum were prepared and produced for the teachers.

5th Annual Hubble Lecture — Co-sponsored this annual lecture together with Space Telescope Science Institute, which brings leading astronomers before a diverse audience of university and community. Over 300 people were in attendance at this lecture, one of the premier astronomy events in the Baltimore area.

Teaching the Future: Capital-Area Space Orientation — Honored a request from the Alabama Consortium to host 160 teachers who toured the Washington/Baltimore area Space and astronomy facilities during July 1990.

Installed NASA Select TV in Space Grant Library.

JHU Space Astronomy Public Affairs — Coordinated on-campus and public viewings of Hubble Space Telescope and Hopkins Ultraviolet Telescope missions.

Sponsor of "Why Graduate School in Science and Engineering?" a National Satellite Teleconference.

Sponsor of "Sail on Voyager!" (Live teleconference via satellite-Discoveries of Voyager I and II that revealed a diversity of weather systems, geological evolution and atmospheric change).

The Electromagnetic Spectrum, an Education Poster — Space Telescope Science Institute artist Dana Berry completed a spectacular poster which depicts a spiral galaxy symbolically emitting electromagnetic waves of all possible wavelengths.

Hosted 20 Students and two Science Teachers from Southern High School, Baltimore City, to Open Night at Space Telescope Science Institute.

Hosted 225 Elementary and Middle School Students from Seven MESA Schools and One NonMESA School from Baltimore City to View Space Classroom Lesson on the Electromagnatic Spectrum during the HUT Mission.

Consortium Director Spoke at a Career Day Held at Herring Run Middle School, Baltimore City.

The Massachusetts Institute of Technology Space Grant Consortium

Dr. Daniel E. Hastings,
Consortium Director

Abstract

The Space Grant program at MIT is reviewed in the context of the national effort.

Introduction

The Space Grant Programs in the country have the following objectives: (1.) to establish a national network of universities with interests and capabilities in Space and related fields (2.) to encourage cooperative programs among universities, aerospace industry and government (3.) to encourage interdisciplinary training, research and public service programs related to aerospace (4.) to recruit and train professionals, especially those historically underrepresented, for careers in aerospace, science and technology and (5.) to promote a strong science, mathematics and technology education base from elementary through university levels.

The MIT Space Grant Program is a joint MIT, NASA and industry program based on the following two ideas; (1.) the pool of students interested in Space engineering and Space sciences must be increased at every level, (2.) the combination of MIT, its associated labs and industrial partners offers a rich assortment of Space-related educational and research opportunities which can be used to attract and motivate students. The MIT program is one of 21 such Space Grant programs in the country. The program is funded at the level of $150,000 per year by NASA and $30,000 in direct industrial contributions. The industrial partners provided 28 summer positions for students for an approximate matching cost of $280,000. Other in-kind matching contributions raise the total level of matching support to approximately $500,000.

Program History

The program started in September 1989, and has been implemented in the past year through six major integrated components. First, the program has reached out directly to high school students who come to MIT. This was done by sponsoring a design workshop in Space engineering with the Minorities in Technology and Science (MITES) program at MIT.

For six weeks in June and July, a group of juniors from high schools all over the country built devices to dock two spacecraft together. Thirty-five students participated in the design workshop. They were broken into teams of three and four and competed against each other at the end of the workshop. The winning design was chosen on the basis of being able to dock over a wide range of angles, being able to withstand a given force and having the least mass. The comments of the students indicated that they greatly enjoyed this chance to learn about Space and build and test a device.

Second, the program is reaching out to freshmen at MIT with the aim of attracting them into Space science and engineering. The program sponsored the development of a new seminar for undergraduates in the spring semester. The seminar was entitled "Modern Space Science and Engineering." The aim of the seminar was to introduce

the excitement of Space science and Space engineering in a comprehensive way. This was achieved by taking the Hubble Space Telescope as a focal point and explaining in detail the science expected with it as well as the engineering challenges in building and launching it. The first part of the term was general astronautics and astronomy while the second part was specific to the Hubble. As part of the seminar there were guest lectures by Dr. Bob Brown, formerly the project scientist for the Hubble, and Dr. Jay Apt of the astronaut core. Lockheed provided substantial document support for the seminar. During the spring break, the program sponsored a trip to the Washington area to visit the Air and Space Museum, NASA HQ, NASA Goddard and the Space Telescope Science Institute. The seminar had 24 students who participated.

Third, the program sponsored undergraduate Space research awards for undergraduates to participate in Space-related research with faculty and at nearby laboratories. Eighteen students were supported during the spring term. Three of those students were at MIT Lincoln labs and two students were at Draper lab. The research projects were in Space engineering and Space science and ranged from Space life sciences to plasma and astrophysics to robotics to astrodynamics. The typical size of an award was $1,000. MIT waives all overhead charges on these awards so that this money goes directly to the students. In addition, the program, through its industrial partners, offered summer positions to many undergraduates. This enabled those undergraduates interested in the Space enterprise to see the aerospace field at work. Eighty students applied for summer positions through the program, thirty-eight students were offered positions and twenty-eight accepted and were employed in locations all over the company. The companies that are participating in the program are Raytheon (MA), MIT Lincoln Labs (MA), Draper (MA), GE Astrospace (NJ), Martin Marietta (CO), Lockheed (CA), TRW (CA), Hughes (CA), Rockwell (CA) and Aerospace (CA). Of those who were employed seven were minority students and nine were women. All students were visited in place and their summer project evaluated. Most summer projects were extremely good and met the criteria of being educationally challenging and useful to the company.

Fourth, the program has sponsored four graduate fellowships at MIT for education and research in Space science or Space engineering. The aim is to use these graduate fellowships as an incentive to undergraduates to do well enough to be admitted to graduate school. The departments nominated candidates for the fellowships. The criteria for the choice of fellowship students was an expressed interest in Space science or Space engineering, followed by a measure of excellence as seen in grades or references, and finally issues such as sex and race.

Fifth, the program sponsored a public lecture by Dr. William Lenoir on the state of the art of Space science and Space engineering. The lecture was well attended and informed the MIT community as to the Nation's plans for Space exploration into the future.

Sixth, the program arranged for the MITES workshop, the freshman seminar and the public lecture to be videotaped. From these many hours of tape, a half-hour video was constructed around the theme of Space as the next frontier. It is planned to distribute this tape to high schools as a vehicle for reaching out to high schools generally with the message that students can be involved in the Space enterprise. In other significant activities, the program was awarded a $2,500 award by Hughes Research Labs to give to a minority student interested in Space. The award was made to Mr. Chris Blanc who is entering the Aeronautics and Astronautics Department this fall. The program also sponsored a set of meetings this year to bring together researchers in the Space area at MIT and neighboring schools to hear an interesting speaker on a Space-related topic. These have been called Space Forum meetings and have been in

conjunction with the Space Engineering Research Center and the Center for Space Research. The first meeting was a dinner for Professor Yuri Masjorin, Director of the Kallingrad Launch Center in the Soviet Union. The second was a lunch for Dr. Bill Lenoir, NASA Associate Administrator for Space Flight, and the third was a dinner for Dr. Gerry Soffen, Associate Director of NASA Goddard.

Finally, in program activities there is under development a local high school outreach. The program has recruited a small group of undergraduates and is developing a forty-minute program consisting of a video, live demonstrations and a question and answer time. It is planned to try out this outreach in the spring term.

Conclusions

In conclusion, the program is off to a good start in meeting the original goals advocated in the proposal. The MIT Program is directly responding to the first objective of the national programs through the participation in the Space Grant Directors council. The second through fifth objectives are being met through the MIT Program. The summer positions are an example of a cooperative program between industry and MIT and manifestly meet the second objective. The number of students involved this year in the summer positions was 27. The undergraduate research positions in Space fields meet the third objective. This spring semester we had 16 students involved in this aspect of the program. The fourth objective is met through the freshman seminar and the other programs up through the graduate fellowships. The number of students in the seminar was 24, while four students received graduate fellowships. Finally, the fifth objective is being met through the outreach program and the videotapes. The program has considerable room for expansion. Limitations on the program's growth right now are mainly due to lack of staff and very limited resources.

The first year of the MIT Space Grant Program

The MIT Space Grant Program developed an integrated program consisting of five components. The K-12 thrust of the program has four components. The program has supported an outreach to elementary school children, developed a video for distribution to high schools and a demonstration program for junior high schools. Finally, the program developed a design workshop in Space engineering in conjunction with a preexisting MIT program for minority juniors in high school. The design workshop had 35 students in it. The next part of the program is aimed at freshmen and consists of an introductory seminar in Space engineering and Space science. The number of students who participated last year was 27. Currently, there are almost 50 students in the seminar. The core of the program is the third part, which is generally aimed at undergraduates. In this part there is substantial interaction with a Consortium composed of industrial companies, Government centers and MIT associated labs.

For the academic year, the program supports undergraduate research projects in all areas of Space science and Space engineering. A substantial part of the support for this comes from the industrial partners. The Charles Stark Draper Laboratory is one of the key partners, and provides support, through the provision of staff, to help teach the seminar, supervisors and projects for undergraduate research experiences, as well as to provide some financial assistance. Finally, the industrial partners, labs and centers supply summer positions to undergraduates in the program. Last summer, 28 undergraduates were employed at Draper Lab, MIT Lincoln Lab, Raytheon, GE Astrospace, Martin Marietta, Lockheed, Rockwell, Aerospace and Hughes. This year they will be joined by positions at TRW, JPL and NASA Goddard. In addition

to these summer positions, Rockwell is supporting a specific project through the Space Grant associated with the exploration initiative. This is joint with Draper Labs and will result in a demonstration at NASA HQ.

The final two parts of the Program are the graduate fellowships and the public outreach. The graduate fellowships are preferentially given to undergraduate participants in the program as an incentive when they apply to graduate school. The public outreach consists of periodic lunches for the faculty organized by the program and a public lecture on the state of the Space Program. Last year the public lecturer was Dr. Bill Lenoir. This year it will be Mr. Norman Augustine.

Michigan Space Grant Consortium

Dr. Joe G. Eisley,
Consortium Director

In the first year we have placed most of our efforts on the precollege student in pursuit of Objective 4: Recruit and train professionals, especially women and underrepresented minorities, for careers in aerospace science, technology and allied fields; and Objective 5: Promote a strong science, mathematics and technology educational base from elementary through university levels. We have at least one program directed at Objective 3 and we believe we are contributing to Objectives 1 and 2 as well.

The importance of recruiting and training women and minorities to this particular Consortium is reflected in the following figures: In 1979, there were 142,739 high school graduates in the State of Michigan; by 1994, there will be only 98,838 high school graduates - a 31-percent drop. A substantial increase in the number of women enrolling in engineering courses must occur if we are to meet employers' needs. In addition, we have a large minority population which has dismal high school graduation and college enrollment records. We must reach larger segments of these groups before they are tracked out of science and engineering careers.

All the outreach programs described below have content which stress the science, mathematics and technology base. Some parts of give each program specific instruction in science and mathematics principles; some parts are intended to motivate students to elect science and mathematics courses in high school; still other parts are informational, that is, are aimed at providing a more informed citizenry. The major programs are summarized with brief statements in the following list, which is taken directly from our Annual Report.

University of Michigan

1. In cooperation with the Minority Engineering Program Office (MEPO) and the Detroit Area Pre-College Engineering Program (DAPCEP), a series of five Saturday morning classes on science and engineering topics were held last spring for three different groups (total 85 attended) - one for middle school students and one for high school students in Ann Arbor, and one class in Detroit for 9th graders. A follow-up to this program was a trip to the Air Force Museum in July, which 45 students from the group attended, and a visit with Astronaut Col. Charles Bolden in September. This program generated a community effort by local parents and school teachers who instituted a Saturday morning program (65 initial enrollees) with our support, based on the concept we developed to run throughout the current academic year. Several more similar classes are planned, in cooperation with MEPO and DAPCEP this current academic year. These are all new programs.

2. In June 1990, we supported the expansion and redirection of content of a one-week course on campus for high school age women (60 attended) sponsored by the Society of Women Engineers. We plan to continue this support next summer. This is an existing program.

3. In June 1990, we supported the expansion and redirection of content of a two-week course for 8th graders, called Summerscience for Girls, (75 attended) in cooperation with our Center for the Education of Women. A modified version of this program will be supported next summer. This is an existing program.

4. We have supported the addition of aerospace-related material to several summer residential programs sponsored by the Minority Engineering Programs Office of the College of Engineering. These are existing programs.

5. The College of Engineering recently instituted a one-day on-campus program for prospective students and parents consisting of campus tours and hands-on activity. Space Grant developed the hands-on part, which emphasizes computer-aided engineering activity. This is a year-round activity and over the course of the year several hundred students will visit. This is a new program.

6. We have received several requests for presentations to elementary, middle, and high school classes, ranging from one hour at the school to half a day on campus. In a similar way, organizations, such as the Office of Minority Affairs, regularly request presentation by visiting groups. We have responded with presentations developed by Space Grant for the programs listed above. This is being formalized with help from the student branch of the AIAA and other student organizations. A mailing has gone out to schools in Southeastern Michigan and a crew of student volunteers has been recruited and trained to give these presentations on request. This is a new program.

7. In quite another approach we support a computer conference on the "Uses of Space in the 21st Century" in cooperation with the UM School of Education. Twelve experts on Space formed a panel, including those with technical, social, and political interests. Fourteen high schools joined the conference in the pilot program in the spring of 1990. The program is being repeated in the fall of 1990 and again in the spring of 1991. Students and teachers at the participating schools join in as conferees. This is a new program.

8. We have developed hypermedia-based computer software for career guidance, have tested prototype versions of the software on students in the precollege programs, and are about to distribute it more widely. The first is a Hypercard Tour of the NASA Lewis Research Center featuring people, places and projects. The second is a tour of the engineering programs at the UM. This must be seen to understand what it is. We have found interest in industry in developing similar tours of their organizations. This is a new program.

9. An adopt-a-school program, whereby we provide support for activities at the school site, has had mixed results. Two such projects are floundering, while a third may be succeeding. A program with a local school district, in cooperation with industry, to bring robotics instruction to the students may get started this year. This is an extension and expansion of an existing program.

10. We have received requests from major airshows in the area to have displays. We have responded at one and are considering another. The displays empha-

size careers in aerospace. We are evaluating the effectiveness of displays at public events. This is a new program.

Wayne State University

1. The Summer Research Associate Apprentice Program works with science and mathematics secondary school teachers to develop student interest in careers in engineering. The basic approach is to match teachers with selected faculty on ongoing research projects.

2. The Computer Aided Tutoring Center was established. To encourage use of the center by minority students, student assistants were recruited from the Association of Black Engineers and Scientists.

Michigan Technological University

1. Michigan Technological University conducted a series of five programs called Summer Youth Program Explorations on campus for pre-college students. Space Grant was used to develop aerospace-related content. These are existing programs. Additional Space-related topics are being planned for future offerings.

2. The Native American Science and Mathematics program. An expansion is being prepared for the summer of 1991. This is a new program.

3. The Minorities in Engineering and Women in Engineering were modified to include more aerospace-related material. Scholarships were provided for 23 attendees. These are existing programs.

Saginaw Valley State University

1. Saginaw Valley State University conducted a summer workshop on campus for precollege minority students (Black and Hispanic) at the ninth grade level. Space Grant permitted an expansion of the program from 35 to 65 students and the introduction of Space education themes. This is an existing program.

2. The SVSU Science-Math Education Center works with public school science teachers to develop curriculum materials for science course in grades four through seven. This is an existing program.

New Mexico Space Grant Consortium

Dr. Stephen Horan,
Consortium Director

Performance Period: 1 February 1990 - 31 January 1991

The New Mexico Space Grant Consortium established the following goals for the performance period 1 February 1990 through 31 January 1991. Each goal is indexed to its corresponding NASA Space Grant College and Fellowship goal. Performance of work accomplished during the 1990-1991 year is briefly discussed.

I. Space Grant College National Networking

a. To expand the New Mexico Space Grant Consortium by increasing the number of participating colleges and universities within New Mexico.

The Institute of Mining and Technology in Socorro and the University of New Mexico in Albuquerque have joined NMSU and the

Space Center as members of the New Mexico Space Grant Consortium. Arrangements are being made for the New Mexico Museum of Natural History and Dona Ana Branch Community College to become Consortium members by June of 1991.

b. To network with the other Space Grant programs in the southwest region connected with Johnson Space Center.

The New Mexico Space Grant Consortium organized and chaired the first meeting for the Western Regional Space Grant Consortium. Consortia attending were New Mexico, Colorado, Texas, Rocky Mountain, and Arizona.

II. Cooperative Programs

a. To establish an advisory board representing each of the named groups to guide the Consortium' s growth and programs.

An advisory board is being finalized with members comprised of member delegates, educational institutions, industry, federally-sponsored laboratories and Field Centers, State legislative and educational bodies, public school system, aerospace facilities, and alumni.

b. To seek areas of potential cooperation and to begin planning future cooperative programs.

We are working with the WERC program and the SWOOPE program funded by the Department of Energy. We are also in the process of finalizing proposals that will incorporate programs of New Mexico State University's Engineering, Education, and Arts and Sciences colleges; the Las Cruces Public Schools; and the Department of Energy.

III. Interdisciplinary Training

a. To enhance and expand the quality of the existing aerospace public service programs

We are working with the Space Center to enhance its Shuttle Camp, Space Van, and Space Station Program Initiative.

b. To expand the interdisciplinary coursework that is aerospace-related in the university.

The "Living and Working in Space" class was taught for the first time in Spring 1991. This course is part of the honors program of general education and is aimed at nontechnical students.

IV. Professional Training

a. To encourage the participation of students, especially women and minorities, in educational activities in this area through the fellowship program, educational, and career opportunities on campus.

Twelve scholarships for undergraduate, graduate, and education majors were given this year. They included two women and five minority students.

b. To enhance the pre-college programs aimed at public school students.

A Pre-Freshmen Enrichment Program is being planned for the summer of 1991 for sixth grade minority students. The Space data center is acquiring aerospace-related teaching materials to make available to public school teachers for use in their classroom.

V. Strong Educational Base

a. To enhance the educational program being offered for students pursuing public school teaching licensure through coursework enhancement and the fellowship program.

Two $10,000 fellowships are being offered to education majors which require the students to participate in teaching Space education for the Space Center for six months.

b. To assist the public schools in curriculum development in the fields of mathematics, science, and technology.

A pilot program with the Las Cruces and Roswell School Districts is being coordinated by our office. The purpose of the pilot program is to evaluate books, software, videos, lesson plans, and other materials for use in the public school classroom and to make these materials available to the teachers.

Ohio Aerospace Institute Space Grant Consortium

Dr. Paul Claspy,
Consortium Director

First Year Activities - Summary Report

The Ohio Aerospace Institute is a unique Consortium of Ohio's nine aerospace-related engineering doctorate-granting universities, the two Federal laboratories located in Ohio, the State of Ohio, and aerospace-related Ohio industry. The primary objectives of the institute are virtually identical to those of the NASA Space Grant College and Fellowship Program, and the Institute was selected as a Phase I Space Grant Consortium. Highlights of the Ohio Aerospace Institute Space Grant Consortium's first program year activities, grouped by NASA Space Grant program objectives are summarized in this report.

Objective 1: Establish a national network ...

Several cooperative programs have been initiated to form a network of not only universities, but also Federal laboratories and industry. These programs encompass research, graduate degree programs, graduate student activities, and outreach. The avenues through which this networking is proceeding include:

a. Research Focus Groups: These 16 groups, each of which encompasses several aerospace-related disciplines, offer a regular forum for networking among faculty and graduate students from the nine universities, and researchers from Federal laboratories and industry. The Focus Groups, which meet at various locations around Ohio, have a combined membership of 602, including 328 from universities, 155 from Federal laboratories, and 119 from industry,

b. Cooperative Outreach Program: the Education Pipeline Committee, which includes representatives from all Consortium universities, from two historically Black Ohio universities, community colleges, Federal laboratories, and industry, provides a vehicle for expanded networking among a broad spectrum of constituencies, and

c. On-Site Faculty and Student Program: Faculty, graduate students, and undergraduate students are encouraged to spend time at the Institute, and funds are available to support this program. This multiuniversity environment has

resulted in enhanced interaction among individuals from all member universities.

Objective 2: Encourage cooperative programs ...

Several activities have been established to encourage the development of cooperative programs among universities, aerospace industry, and Federal, State, and local governments. While many of these are in an early stage of development, major cooperative accomplishments can be reported. These include:

a. Industry and government involvement: As observed above, the Research Focus Groups have 155 active participants from Federal laboratories and 119 from industry. These individuals represent two Federal laboratories and 23 companies,

b. Economic commitments: Both the State of Ohio and our industrial partners have been strong financial supporters of all activities and programs,

c. Interaction with NASA: A primary component of OAI's Graduate Fellowship program is a requirement that Doctoral Fellows conduct a major component of their dissertation research in residence at OAI and Lewis Research Center (LeRC), in collaboration with NASA researchers and using the unique research facilities at the Center. At present two Fellows are in residence.

Objective 3: Encourage interdisciplinary ...

This has been done primarily through the Research Focus Groups and the On-Site Faculty and Student programs. The focus groups have memberships representing from two to eight engineering and scientific disciplines, and seed funds have been provided to encourage these groups to prepare broadly-based research proposals. The on-site programs provide the opportunity and the environment for both casual and formal interdisciplinary activity.

Objective 4: Recruit and train professionals ...

Highly attractive undergraduate scholarship and graduate fellowship programs have been established to encourage study and careers in the critical aerospace-related disciplines, as briefly described below:

a. Undergraduate Scholarships: Scholarships are provided, on a competitive basis, to undergraduates at all levels. There are currently 34 undergrad- uate scholars. Scholars must study in aerospace-related disciplines. Junior and senior scholars must conduct a research project that they have proposed in a laboratory on their home campus,

b. Graduate Fellowships: Fellowships are provided, on a competitive basis, to master's and doctoral students in aerospace-related disciplines. Doctoral Fellows conduct their dissertation research on site at NASA LeRC in collaboration with NASA researchers. There are currently 29 Graduate Fellows.

Objective 5: Promote a strong science ...

Achievement of this objective is the primary task of the Education Pipeline Committee, which consists of representatives of the Consortium members, of several companies, of the two Federal laboratories, and of several organizations and institutions representing groups that are currently underrepresented in aerospace-related disciplines. This committee has undertaken several major tasks, including:

a. Accumulation of information on existing programs: Committee members are compiling information on outreach programs already existing around the State.

This will be distributed to all relevant organizations who will be encouraged to copy successful programs,

b. New program development: New science experience programs are being established for Cleveland area teachers and, in collaboration with the Society for Women Engineers, programs are planned for children's groups around the State,

c. Pre-Graduate Minority Program: A proposal has been submitted to NASA LeRC for establishment of a cooperative program for recently graduated minority engineers. The objective of the program is enhancement of qualifications for graduate study, and research work and special classroom instruction will be included.

Pennsylvania State University Space Grant Consortium

Dr. Sylvia Stein, Consortium Director

Astrophysics I: We send this first-level course via satellite to 12 community colleges.

Buddy System: To encourage capable undergraduates to continue to graduate school, we have set up 30 teams, each consisting of one graduate student and three undergraduate students not intending to go to graduate school, but who are capable of doing so. Each team meets six times a year just to talk. Funded by a private gift of $23,000.

Buhl Science Center School Presentations: We support the Buhl Planetarium's excellent science presentation to schools in socioeconomically depressed areas. Program costs $1,300. Until our input, only rich school districts could afford it.

Commonwealth School of Excellence in Engineering: We are seeking funding from industry to establish a Commonwealth School of Excellence in Engineering at PSU—100 high school students for five weeks a summer. This effort is aimed at having this school become a Pennsylvania Governor's School of Excellence in Engineering with its concomitant line-item funding from the State each year. We have involved the Pennsylvania Department of Economic Development. The College of Engineering is putting $12,000 into our program in exchange.

Community Programs in Science and Technology: We support the presentation of a Space program to community groups and fairs throughout Pennsylvania. This summer we will present at the three largest Pennsylvania fairs (two presenters for one week). Total attendance 1,549,000

Energy and Technology Program for Schools: Seventy percent of the requests from schools (K-12 Statewide) are for our presentations about Space. In a six-month period in 1990, 107 Space presentations to an audience of 5,000.

Expanding Your Horizons: We participate (steering committee and $) in the PSU chapter of this national organization to encourage young women to pursue careers in math, science, technology and engineering. There is a conference at PSU next week for approximately 100 girls involved in hands-on workshops and career exploration.

Farm Show - Remote Sensing in Agriculture: The Pennsylvania Farm Show attracts 250,000 visitors each year. We have added a booth to the PSU College of Agriculture's booth to present a remote sensing in agriculture (and NASA's role) demonstration.

Governor's School of Excellence in Agricultural Science: We have obtained a NASA speaker for this group of 55 top

flight high school students who spend five weeks at PSU.

Mission to Mars Exhibit: When this Mars habitat, $2,000,000 exhibit comes to the Pittsburgh Carnegie-Buhl Science Museum, we will arrange to have elementary school children bused to see it. This outstanding exhibit will be in Columbus, Ohio, until June 2. Then it will go to Philadelphia, Orlando, Charlotte, Indianapolis, Atlanta, Seattle, Los Angeles, Lubbock, Nashville, and St. Louis from June 1991 to June 1994. (HANDOUT), The Pennsylvania Department of Education, will contribute $10,000 toward this effort.

Packaging Project: A $500,000 proposal is in preparation for submission to NSF to prepare and distribute prefabricated Going-to-MARS grade 1-3 and MARS Habitat grade 4-6 packages for teaching science and engineering.

Retired Engineers & Scientists As Community Speakers: We are planning to recruit and train retired engineers and scientists in Pennsylvania communities to present programs on Space to local clubs. Since State College, a community of 35,000 has 73 clubs, the audience Statewide must be large.

Scholars Program: We continue to encourage PSU Scholars, our best undergraduates, to pursue their research in NASA-funded labs.

Science Expo: We will present a Space program for the 3,000 Pennsylvania high school students who attend this one-day College of Science sponsored exposition.

See the Future: We help fund and participate in this residential one-week science and technology adventure for minority students in grades 7-9. A half-day program on Space is provided.

Space - The Last Frontier Course: This three-credit course raises the level of interest among nonscience majors in science using Space as the focus is given every fall.

Space - The Last Frontier via Satellite to Community Colleges: Above course will be sent via satellite to 22 community colleges this fall.

Summer Space Academy: We are continuing our two-week residential research program in NASA-funded laboratories for 22 high-achieving high school students.

Teacher Resource Center (TRC) Project: We have instigated a pilot project to apply state-of-the-art library and information science techniques to the TRC materials to improve and increase access.

Teaching the Teachers: We are giving a half-day presentation on NASA material available for incorporation into science teaching at a meeting of elementary science education professors from small colleges all over the State. Next year we will demonstrate the use of Space Shuttle BLAKE for teaching science.

TVOntario: We have signed a Memorandum of Understanding with TVOntario, the largest distributor of video science education material in the United States. Penn State is the only university so designated.

What's-in-the-news in Space: WPSX, a public broadcasting station, is producing for us four TV programs a year on Space for 4th, 5th, and 6th grades to be aired via their distribution networks, which reach two million children. The station is also preparing teacher manuals to accompany these programs.

Rocky Mountain Space Grant Consortium

Dr. Frank J. Redd,
Consortium Director

The First Year

Objective 1: National Network of Universities

The first year's networking efforts were concentrated primarily upon establishing interfaces and organizational structure among the Consortium members. This was accomplished through a series of face-to-face organizational meetings and teleconferences. The fellowship program was organized and the first recipients were selected. The first issue of the Consortium newsletter was published and distributed.

The Consortium membership joined together to sponsor the "Visit to Mars" workshop, held on the University of Utah campus during June 18-19, 1990. A mixture of 20 college undergraduates and high school seniors were selected from a number of applicants to participate in the conference. Members of the public were welcome to attend the sessions. The conference was highlighted by the keynote address presented by Dr. James Fletcher, and an exciting presentation by Gen. Bernard Schriever, USAF (Retired). Additional presentations were made by speakers from industry, NASA and the military. In return for their stipend, the 20 participants were required to write a major paper on the exploration of Mars. The Thiokol Corporation donated $1000 in prize money to the winning papers. The papers will be bound for publication.

Our efforts to reach outside our Consortium have centered upon activity in the Western Regional Group, activated by Dr. Stan Goldstein at Johnson Space Center. We attended the organizational meeting at JSC on September 5-6, 1991.

The Rocky Mountain Space Grant Consortium was expanded during its first year to include Brigham Young University as an Affiliate Member and the Hansen Planetarium in Salt Lake City as an Outreach Center.

Objective 2: Cooperative Programs Among Universities, Industry, and Government

The Rocky Mountain Space Grant Consortium receives substantial support from the State of Utah. Utah State University (USU) and the University of Utah (U of U) have State supported Centers of Excellence in Space Engineering and Biomedicine and both the States of Utah and Colorado are members of the Aerospace States Initiative. The Governor of the State of Utah has commissioned a special Task Force on the Aerospace Industry.

The Thiokol Corporation, our industrial member, has provided much welcome support to all aspects of Consortium activity. Thiokol provides matching funds, fellowship funds, prize money for the Mars papers, co-sponsorship of the "Visit to Mars" workshop, co-sponsorship of the USU Conference on Small Satellites, etc. Thiokol will coordinate additional industrial expansion.

Consortium members have engaged in considerable interaction with NASA Centers. USU has interfaced with JSC and KSC on a number of Space shuttle flight experiments, and has worked with Langley and JPL on funded research projects. USU and the U of U are working with the University of Utah to establish an Institute for Life Support Systems through the ARC. U of U research in Space life-support systems has included cosponsorship with NASA Hq of a symposium on Emergency Surgery and Critical Care in Space and research links with ARC and JSC.

Objective 3: Interdisciplinary Training, Research, and Public Service

Utah State is now in its fifth year of participation in the NASA/USRA Advanced Space Design Program. In addition, Utah State continues to be a major participant in NASA's Get Away Special program. Now

offered as a minor in Space Experimentation, the program has two canisters of experiments ready to fly. Several experiments have been flown in the past year on high-altitude balloons and the NASA Zero-G aircraft. Other interdisciplinary activities included the "Visit to Mars" workshop and a "Mars Day" at the Hansen Planetarium in Salt Lake City.

Objective 4: Recruit and Train Professionals

The primary recruiting tool has been the Consortium's aggressive fellowship program. Over $165K of our first year's $300K has been focused upon fellowship awards. Twenty-one graduate and undergraduate fellowships have been awarded. Seven of the 21 are females, one of those is Hispanic.

Objective 5: Promote Science/Math Educational Base K-University

Mr. R. "Gil" Moore has conducted a very aggressive outreach program directed at igniting interest in science, math and engineering at the middle and high school levels. (1.) He has given over 200 lectures at various middle and high schools throughout the region. (2.) He organized and conducted a "Physics Teachers Workshop" on the campus at Utah State to help physics teachers integrate Space topics into their curriculum and to construct classroom demonstrations. (3.) He instituted a flight program for experiments on high-altitude balloons. Forty-five high school and college students have fielded four experiments, so far. (4.) He has established a computer-controlled meteorological data collection network in intermountain schools. Eventually some 250 schools will be involved. (5.) He has arranged for and coordinated flight experiments on the NASA Zero-G airplane. And, (6.) he has stimulated the Utah State Get Away Special program. Also, the University of Denver produced a videotape on the "Ozone Hole."

Next year's activities include a repeat of "Visit to Mars," a Physics Day for High School Students, an undergraduate research effort in hybrid rockets, a local high-altitude balloon launch program, and participation in the MESur Mission Workshop for High School teachers and students at NASA/Ames this summer.

Tennessee Valley Aerospace Consortium

Dr. Alvin M. Strauss, Consortium Director

The first year of the grant witnessed the organization of the TVAC into an effective Consortium. We coordinated and integrated the programs at Fisk University and Tennessee State University with the Vanderbilt University Programs to produce synergetic enhancements of the Space Research and Engineering Design activities of the three institutions. In addition the University of Tennessee including the University of Tennessee Space Institute (which was designated by the UT systems as the Consortium representative) was added to the Consortium.

The Fellowship Program was defined and the recruitment process resulted in exceeding the goals originally set by the TVAC. At Fisk University one Fellow is working on the Environmental Life Support System for the Space Station and presented his research results at the National American Society for Microbiology meeting. Another Fellow at Fisk is at work on the Astrophysics of Gamma Ray Bursts.

At Tennessee State University three undergraduate Fellows were supported and each was a coauthor of a scientific publication in Astrophysics journals - on Variable Stars, Binary Stars, and Stellar Magnetic Cycles.

At Vanderbilt University, 10 Fellows were engaged in Space Research Activities. The areas included the Design of a Human Exoskeleton for Mars and Lunar

Exploration, The Re-entry Aerodynamics of Tektites, Antimatter (P - P) Propulsion Systems, Supersonic Combustion in National Aerospace Plane (and Engines), Solar Sail Propulsion System Design, the design of a Large Orbiting Solar Furnace for the Production of Very Large Crystals in Microgravity, Space Station Reliability, Astronaut EVA Performance Biomechanics, and Automated Spacecraft Docking.

A significant effort was also started by a Fellow at the Vanderbilt University-George Peabody College for Teachers and the Learning Technology Center. This resulted in a Microcomputer Videodisc-based Learning System. Macintosh Hypercard and NASA and FAA public domain videos were integrated into an adequate program to demonstrate the basic principles of lift and wing design. A Mars Adventure Video is now in production and the dubbing additions to NASA videotapes are now underway.

The TVAC is also preparing to participate in the 43rd International Science and Engineering Fair that will be held in Nashville on May 10-16, 1992. TVAC will ensure that the 800 finalists from 48 states, 800 teachers, over 1,800 parents and judges, and 4,000 visiting school children are exposed to NASA and TVAC Space Activities. Another major activity was the writing of a joint proposal with the TRW Corporation. The TVAC-TRW joint effort proposed to perform the Systems Integration function for the COMET program. The COMET solicitation was for the design, development, launch and recovery of small commercial orbiting payloads. The objective of the proposal was to get undergraduate and graduate students involved in actual scientific and engineering activities in cooperation with experienced industrial scientists and engineers. TVAC continues negotiations with a view toward student participation in this NASA Code C funded project.

Tennessee has one of the most extensive statewide K-12 Space-related programs with a multitude of activities including the annual statewide Space Week program. Given the high degree of sophistication and level of NASA-related activities, TVAC has developed a strategy to provide K-12 teachers with the most modern and instructive video-disc educational technology.

Texas Space Grant Consortium

Dr. Wallace T. Fowler,
TSGC Education Committee CoChair

Program Activities Summary

Education

Fellowship Program

The Texas Space Grant Consortium awards 18-20 fellowships per year in the amount of $5000 per year. These fellowships are supplements to otherwise fully funded graduate student stipends and are targeted for recruitment/retention of talented students in Space studies, with emphasis on women and underrepresented minorities. Each Consortium educational institution is allowed to nominate three students for the awards, and a committee of institutional representatives not from the three Space grant colleges makes the selection.

Space-Related Curriculum Inventory

An inventory of all Space-related courses in Consortium educational institutions has been initiated. The goals of this inventory are (1.) to determine the spectrum of Space-related academic offerings in Consortium institutions, (2.) to help Consortium institutions who are planning new courses to identify where similar efforts have been carried out, (3.) to foster sharing of curriculum materials, and (4.) to provide information for exchange with other Consortia.

Cross Enrollment for Unique Space - Related Courses

An effort is being initiated in the Texas Consortium to make it possible for students at one Consortium to enroll in a unique Space-related course at another Consortium institution and receive credit at the home institution. This effort will take a LOT of time — institutional rules for 23 educational institutions must be investigated and brought into agreement.

Space Medical Library

A Space medical library is being formed at the UT Southwestern Medical School in Dallas. Information concerning the contents of the library will be circulated among Consortium members and the documents in this library will be available to all Consortium members.

Institutional Representatives on Electronic Mail

All Consortium institutional representatives have accounts on LIFENET, an electronic mail system managed for the NASA life sciences community by the Universities Space Research Association (USRA). A Texas Space Grant Consortium bulletin board has been established and has been running for two months. It is anticipated that much of the Consortium's routine mail will be handled via electronic mail by May 1, 1991.

Outreach

Lift-Off '90 at NASA JSC (TAMU)

The Lift-Off '90 program, held at NASA JSC in July 1990, involved 24 students and 24 teachers from around Texas and focused on the CRAF-Cassini satellite mission. The philosophy behind the program was to guide participants from the initial planning stages to the actual design and development phases of a NASA mission and thus stimulate interest among high school students and teachers in Space science and engineering. Follow up activities have included in-service training of teachers in individual school districts and regional workshops based on the Lift-Off '90 theme.

Space Drama (TAMU)

The Space Drama project melds elementary school theater arts with the study of Space exploration. The program employs a company of 12 Texas A&M students majoring in elementary education to develop three 50-minute lesson plans, each of which will explain one concept of the life cycle of a star, including gravity, nuclear fusion, white dwarfs, and supernovas. Elementary school classes will submit creative writings based upon the subject of outer Space exploration and the company will select some of these writings to serve as the foundation for performances which will be developed using techniques of creative drama.

Semis Workshop (UTSA)

The Science, Engineering and Medicine in Space Workshop was at The University of Texas - Pan American in Edinburg, Texas. Attending the event were 120 teachers and students representing 14 school districts within the Rio Grande Valley area. The workshop objectives were to provide secondary school teachers and students with knowledge and materials to enhance learning of science and mathematics, and to provide secondary school teachers and students with insight into the opportunities for scientists, engineers, and health professionals in Space-related career fields.

ASE - Space (UTSA/UTHSC at San Antonio)

The ASE-SPACE program is designed to provide high school students with the laboratory skills needed to qualify for summer jobs in San Antonio's high technology community. The program will include two phases: the first being an 8- to 10-week

program of instruction, demonstration and laboratory exercises; and the second phase being the ASE-SPACE office acting as a job/student referral service.

Mathcounts Program

The Texas Mathcounts program, an annual competition among seventh and eighth grade students to encourage interest in math education, is supported by the Consortium.

Partners in Space (Houston, Austin areas)

The Partners in Space Program, an alliance of regional coalitions of business and education support for the Space program, is seeking Consortium membership to leverage its programs and expand Consortium resources for education and outreach activities.

Young Astronaut Workshop (Milwaukee)

Resources were provided to The Young Astronauts Program in Milwaukee, Wisconsin, for a Space station design project.

Astronomy Workshop (UT Austin)

This program is developing teaching materials on astronomy for elementary and middle school science teachers.

Research

Industrial Member Meetings

Meetings of the Consortium's industrial members are held to discuss how to increase their involvement within the Consortium and how to facilitate collaborative research between industries and between industries and universities.

Verification and Validation of Expert Systems - IBM

The objectives of this workshop will be to identify key issues of expert systems verifications and validation; understand who has addressed these issues; understand the current state of practice; and determine mechanism for cooperative research.

Bioregenerative Life Support- University of Houston

The purpose of this workshop will be to determine how the expertise at various Consortium institutions match the need for design expertise in bioregenerative life support or advanced Space missions.

Materials Structures and Microgravity - General Dynamics

A research workshop has been proposed in the area of structural maintenance and monitoring of Space stations.

Lonestar Communications Satellite - Rice University

The purpose of this workshop is to follow up on the results of a report submitted to the State Communications office for the development of a State communications satellite.

Texas Space Policy Workshops - University of Houston at Clear Lake

The objectives of this workshop were to identify and explore incentives, impediments, and policy options for the development of the Space industry in Texas; to establish a dialogue and generate consensus on suitable policies and initiatives among leaders of the Texas Space industry; and to evaluate a cross-impact workshop as a model for future workshops among national policy makers.

Minorities / Women

Efforts are being made to attract more women and underrepresented minorities into careers in Space science and engineering. Their concerns are addressed by efforts integrated throughout the Education and Outreach programs.

Consortium Composition

23 Education Institutions
17 Industrial Firms
1 Nonprofit Research Institute
2 State Agencies

Consortium Membership

Space Grant Colleges

Texas A&M University
University of Houston - University Park
University of Texas at Austin

Space Grant Affiliate Institutions

Baylor University
Lamar University
Prairie View A&M University
Rice University
Southern Methodist University
Texas A&I University
Texas A&M University at Galveston
Texas Christian University
Texas Southern University
Texas Tech University
University of Houston - Clear Lake
University of Houston - Downtown
University of Texas at Arlington
University of Texas at Dallas
University of Texas at El Paso
University of Texas at San Antonio
University of Texas Health Science Center-Houston
University of Texas Health Science Center-San Antonio
University of Texas Medical Branch-Galveston
University of Texas Southwestern Medical Center-Dallas

Industrial Members

Barrios Technology Inc.
Davis Aerospace
E-Systems
Eagle Aerospace, Inc.
Entech, Inc.
Ford Aerospace Corporation
General Dynamics
Grumman Space Systems
IBM Corporation
ILC Space Systems
Krug International
LTV Missiles & Electronics
McDonnell Douglas
Microelectronics and Computer Technology Corporation
Rockwell International
Space Industries, Inc.
Space Services, Inc.

Nonprofit Institute

Southwest Research Institute

Governmental Agency Members

Texas Higher Education Coordination Board
Texas Space Commission

Viginia Space Grant Consortium

Ms. Mary L. Sandy,
Consortium Director

Consortium Members

College of William and Mary
Hampton University
Old Dominion University
University of Virginia
Virginia Polytechnic Institute and State University
State Council of Higher Education for Virginia
Virginia's Center for Innovative Technology

Other Consortium Participants

Mathematics and Science Center for Virginia
NASA Langley Research Center
Science Museum of Virginia
Virginia Air and Space Center
Virginia's Center for Public and Private Industry
Virginia State Department of Education
Virginia State Chamber of Commerce

Old Dominion University's Peninsula Graduate Engineering Program

- Corporate classroom environment. Nine modern telecommunications classrooms in a 10,500 sq. ft. facility.
- A complete, corporate-level, multi-camera Broadcast Studio operated by professional staff.
- Nationwide satellite broadcast capability.
- Two-way audio capability in classrooms and conference rooms for interaction with distant transmission sites.
- Computer Laboratory with WIN 386 workstations and Epson 1050 printers.

Undergraduate Scholarships 1991 - 1992 Academic Year

- First year awards totaled almost $40,000 in scholarship awards and stipends.
- Seven students chosen on academic excellence and aerospace promise.
- Undergraduates are juniors/seniors a the five VSGC Space Grant Colleges a Universities, studying applied physic chemistry, geology and electrical engi neering.
- Five females and two underrepresent minorities.
- VSGC Undergraduate scholars will b conducting research on the following topics:

1. Indoor reception of low earth orbit satellite signals.
2. Laser spectroscopy of degenerate e gy levels of laser crystal ions. Blue-green and UV laser excitation by hard-core flashlamp plasma device
3. Materials for cosmic ray shielding.
4. Absorption and photoluminescenc ions in laser crystals.
5. Quantification of amounts and typ of gases produced by global bioma burning.
6. Patterned substrate epitaxy of com pound semiconductors with applic tions to photovoltaics.

Graduate Fellowships 1991 - 1992 Academic Year

- Graduate Fellowships were awarded the second academic year.
- Ten new graduate fellows for a total $50,000.
- Five follow-on renewals for last year' recipients.
- Fellowships are $5,000 per student; t $75,000.
- Space Grant Fellows are studying co puter science, electrical engineering, aerospace and ocean engineering, applied science, mathematics and statistics, physics, engineering scienc

and mechanics, and engineering and applied science at the five VSGC colleges and universities.

- Composition of the group includes five females and four underrepresented minorities.
- Some of the research topics for the Virginia Space Grant Consortium Graduate Fellows are:

1. Propulsion-aircraft integration and high-lift for advanced subsonic transports.

2. Ozone generating systems study.

3. Space power transmission via continuous flow, high-power, direct solar-pumped iodine lasers.

4. Analysis of gases produced by global biomass burning.

V-Quest - Virginia Quality Education in Science and Technology

VSGC is a partner with the State Department of Education.

Goals: Ensure that quality math and science education is available to every child in Virginia.

Achieve scientific literacy through systemic reform and restructuring of curricula.

Scientific Literacy for children would be manifested in demonstrated understandings of conceptual connections, problem-solving and inquiry skills, scientific attitudes and relevant content.

Science Museum of Virginia Aerospace Outreach Van

- VSGC is cosponsoring planning phase with the Virginia Department of Education.
- Van has Aerospace focus.
- Van carries unique, hands-on experiences — set up in gym or auditorium environment.
- Education specialists accompany the van and work with students and teachers.
- Unique, hands-on scientific experiences.
- Each experience is designed to travel - easily set up and broken down.
- Designed for school assemblies, school programs, or classroom workshops for K-12.
- Teacher workshops will also be conducted at school sites.
- The Aerospace Van can travel to rural schools which lack museum access.
- The van can also be used at fairs, festivals, libraries and special events around the Commonwealth.
- The VSG - SMV Van will be available for college-community outreach and can promote the value of Space exploration.

Viktore (Virginia Kids Tidewater Observations and Regional Experiment)

- A Virginia Space Grant Consortium grant targeted for public school teachers and students.
- Grant first awarded to the Virginia Space Grant Consortium in 1990 from NOAA through the Sea Grant Program.
- Phase I is a "Teacher's Guide to Interpreting Satellite APT (Automatic Picture Transmission) Images."
- Draft of the Teacher's Guide will be ready June 1991.
- IBM compatible software and hardware was developed to capture satellite images for the classroom with a simple receive station.
- The VSGC has developed a Phase II grant proposal which would field test the teacher's guide at classroom sites throughout Virginia.

Targeting Middle School Counselors and their Students

- Virginia's middle school counselors and middle school students have been targeted for VSGC Outreach programs in 1991.
- Program themes are workforce issues in the future and opportunities for women and minorities in science and engineering fields.
- Planned activities: Program at Virginia's State Counselors Association meeting in October 1991.
- Brochure/fact sheet on relevant issues to be developed and shared with every middle school counselor in Virginia.
- Brochure/information piece for student dissemination at middle school level.
- A Consortium Advisory panel has been established to advise on Counselor Programs and Activities. Participants include State and School System Supervisors, Counseling Education Professors, Counselors, and others with special interests in workforce/underrepresented issues.

A National Satellite Television Event: The National Aerospace Plane

- A nationally broadcast television program scheduled for April 9, 1991.
- The plane will be marketed by VSGC to schools and colleges nationwide.
- The free public service broadcast will feature Dr. Robert Barthelemy, Director of the NASP Joint Program Office, who will focus on the technological challenges and progress made to date on the aerospace plane.
- The remainder of the program will turn to a more detailed technical analysis of NASP technologies, such as flight systems, structures and materials, and propulsion and will be available from ODU/NTU/NUTN.
- For more information on the program, call Old Dominion University, 1-(800) 548-4807 or FAX 804-683-5176.

Summer Programs for Teachers and Students

- A Space Technology Summer Internship program is under development to pair elementary and middle school teachers with local industry partners in an applied science summer experience.
- This one-week internship may carry graduate credit, pay a stipend to each teacher, and unite industry engineers, university professors, and classroom teachers in the challenge of bringing science and mathematics relevance to the classroom.
- Other summer programs the VSGC supports include the Aerospace for the Elementary Classroom project, a science enrichment workshop for elementary teachers sponsored by NASA/Langley Research Center and Hampton University.
- The Hampton University Interdisciplinary Science Center also produces a Summer Science Enrichment Workshop designed to assist teachers in relating science to technology and society. The VSGC supports this effort aimed at elementary and middle school teachers.

Other Cooperative Programs

- Televised workshops for Elementary Teachers with NASA/LaRC.
- School Science Comes Alive Fourth- and Fifth-Grade Science Enrichment Program done in conjunction with NASA LaRC and Christopher Newport College.
- Participation in the Virginia Space Business Roundtable.
- Audiovisual Production on University based Space Research in Virginia, together with VCIT and VPI.

Washington Space Grant Cosortium

Dr. George K. Parks,
Consortium Director

Objective 1. "Establish a national network of universities with interests and capabilities in aeronautics, Space and related fields."

Three institutions have been invited to join the Washington State Space Grant Program as Consortium members: the Pacific Science Center, Washington State University, and the Office of Superintendent of Public Instruction (OSPI).

- The Pacific Science Center will produce and distribute Astronomy—Our Solar Family to Washington State teachers. This teaching kit is an integrated science, mathematics, and computer-based curriculum structured in a 10-day teaching unit package. The kit provides a hands-on inquiry experience for K-6 students in the study of astronomy.

- Washington State University will concentrate on distributing Space science news material to the eastern half of Washington State. Specifically, they will bring scientists into elementary classrooms, establish contacts between elementary school teachers and scientists, provide science resources for elementary teachers, and develop simple scientific demonstrations that can be used in elementary classrooms.

- OSPI is cooperating with the Space Grant Program to provide small grants to K-12 teachers to implement special science projects. The teachers will be required to submit a proposal that will be evaluated by the Space Grant Program for quality and substance.

Objective 2. "Encourage cooperative programs among universities, aerospace industry, and Federal, State and local governments."

Several industries have expressed a strong interest in the Washington State Space Grant Program. Boeing has provided a financial commitment of $75,000 for 1991 and 1992. These funds will be used for grants for K-12 science projects, graduate fellowships, and undergraduate scholarships. Other industries that have been contacted are Rockwell International, General Dynamics, TRW, Honeywell, Precision Cast Parts, Westinghouse, Sundstrand, John Fluke, Battelle, and Penwest. The State government has become involved through the Superintendent of Public Instruction, and negotiations have begun with the State Legislature for support of our Program.

In September 1990, the Space Grant Program and the Public Service Satellite Consortium cosponsored an Advanced Communications Technology Satellite conference. This conference was held on the University of Washington campus and attracted over 40 representatives from local industries interested in satellite and Space research.

The Space Grant Program has interacted with NASA/Ames and the Jet Propulsion Laboratory (JPL). Both agencies have strongly supported our Program. One of our Space Grant Fellows is currently doing his research at JPL.

Objective 3. "Encourage interdisciplinary training, research and public service programs related to aerospace."

In the spring of 1990, the Washington State Space Grant Program held an introductory course in interdisciplinary aerospace science. We have since completed the formal establishment of this course with the University of Washington. This course is open to undergraduates, graduates, and the university professional community. The purpose is to familiarize students with ongoing NASA-sponsored research at the University of Washington. Faculty and researchers from all four colleges involved in the Space Grant Program delivered lectures on diverse topics. Eighty-five students enrolled in this course during Spring Quarter on a credit/no credit basis. This

course was held again during Autumn Quarter 1990 and will be offered on an annual basis, beginning in the spring of 1991.

Objective 4. "Recruit and train professionals, especially women and underrepresented minorities, for careers in aerospace science, technology and allied fields."

The Space Grant Program selected 10 students to receive Space Grant Fellowships. All of the Fellows were awarded a two-year fellowship that began in September 1990. The funding for the second year of the award is provided by the students' departments.

The Space Grant Program has also begun an Undergraduate Fellowship Program. We have given four-year scholarships to five minority and women senior high school students who expressed an interest in science and scored in the top two percent on their SATs. This is the only program at the University of Washington offering full four-year academic scholarships to incoming freshmen.

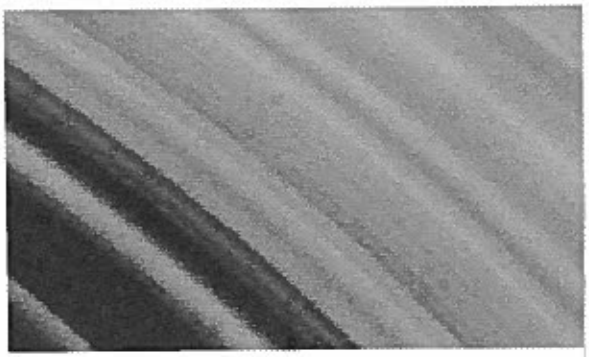
Objective 5. "Promote a strong science, mathematics and technology educational base from elementary through university levels."

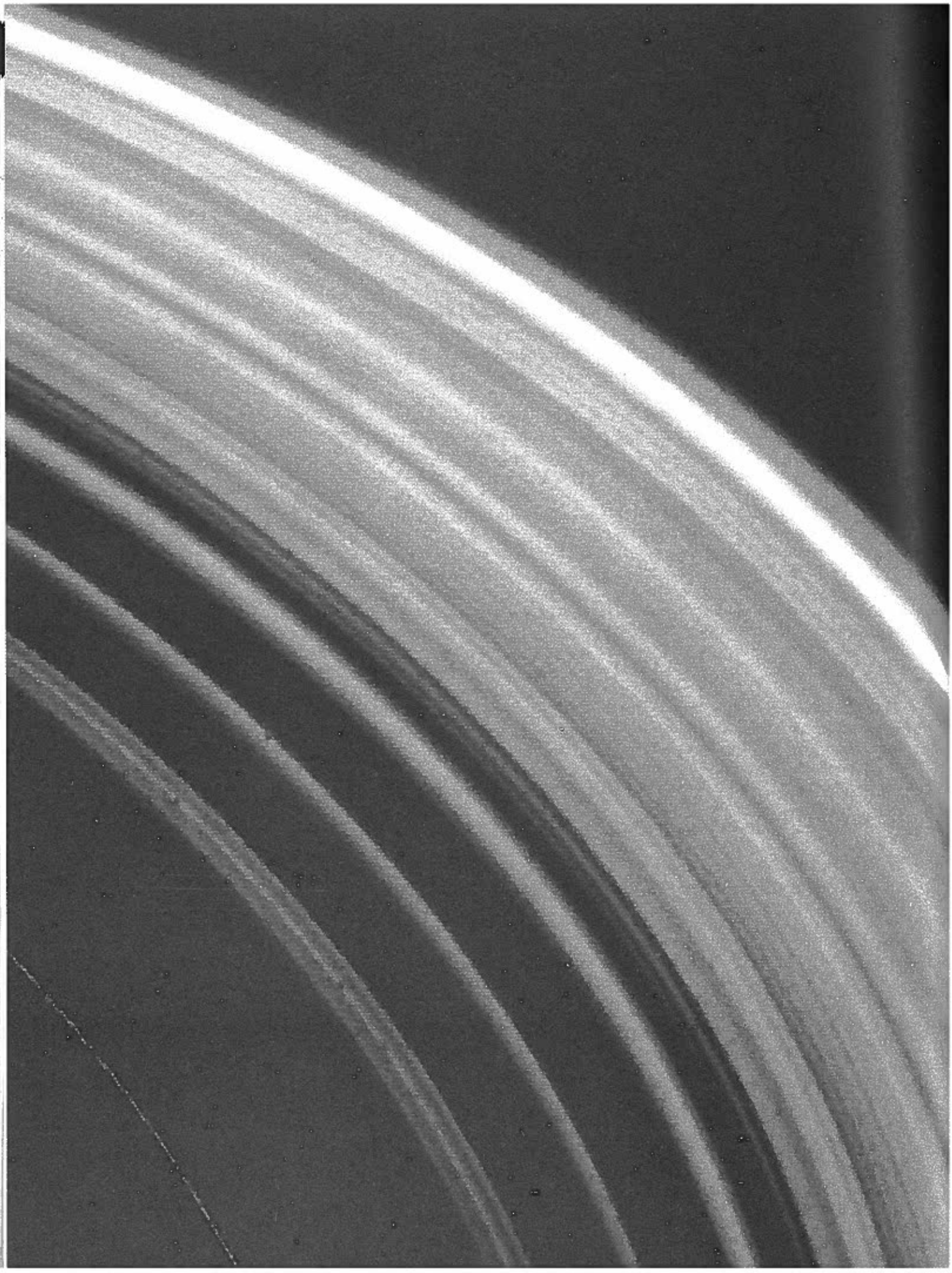
In June of 1990, the Space Grant Program sponsored a three-day course for Washington State junior and senior high school science teachers that focused on recent aerospace research. Sixty-one teachers attended the course. The course consisted of current topics by leading scientists in the field, including UN faculty members and NASA officials. The teachers also received brochures, slides, lecture materials, and other items that are useful in the classroom.

In the summer of 1991, we will be sponsoring a three-week long course in conjunction with the Geophysics Program that will be aimed toward science teachers. Students will receive three advanced science credits from the University of Washington. The course topics will begin with an introduction to the geophysical processes at the center of the earth and will then focus on the atmosphere and outer Space. We will also be sending 10 teachers and 10 high school students to attend the MESur educational workshop at Ames Research Center in June of 1991.

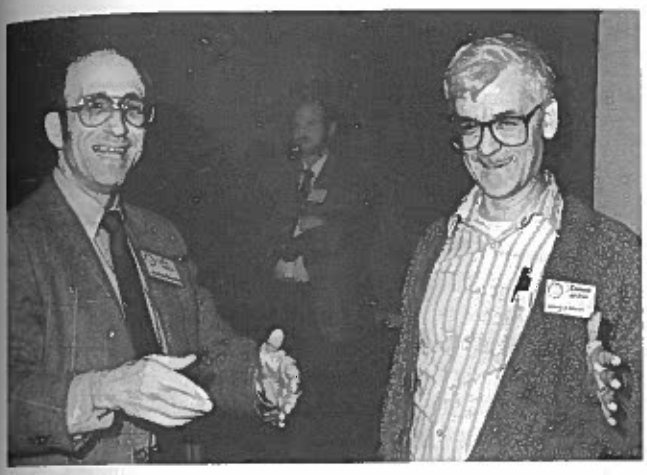
The Space Grant Program is a part of the Zoller Outreach Program, which was begun in November of 1989 by three undergraduates who were concerned about the declining number of people entering science-related fields. Under the supervision of Dr. William Zoller, undergraduates visit high schools and talk about their science projects and try to get high school students excited about science. This program has been extremely successful and has received outstanding reviews.

Phase II Presentations and Workshops





Introduction to Phase II Programs



Phase II participants (left to right) John Perkins and Dermott Mullan.

The Program Grant States

In Phase II of the National Space Grant College and Fellowship Program, 14 States entered the program under the Program Grant provision. This desigNation is for States that already have colleges and universities with nationally competitive aerospace research and educational capacity. Their programs, like Phase I, can equally address all the goals of the National Space Grant College and Fellowship Program. The Program Grant States are meant to represent their State as a whole and, where feasible, incorporate all the interested, relevant institutions in the State. The 14 Program Grant Programs have 34 affiliates, including 26 institutions of higher education and 6 industries.

The 14 Program Grant States are Alaska, Delaware, Indiana, Kansas, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, North Carolina, Oregon, Rhode Island, Washington, D.C., and Wisconsin.

The Capability Enhancement Grant States

In Phase II of the National Space Grant College and Fellowship Program, 12 States entered the program under the Capability Enhancement Grant provision. Their programs, like the Program Grant States, are meant to represent the State as a whole and, where feasible, incorporate all the interested, relevant institutions in the State. However, their program goals should particularly focus on a subset of the goals of the National Space Grant College and Fellowship Program which corresponds to the EPSCoR approach developed at the National Science Foundation. This entails concentrating on building the research infrastructure to promote the research performance of the State in Space-related science and/or engineering. The 12 Capability Enhancement Grant Programs have 72 affiliates, in addition to the authoring institutions. These affiliates include 55 institutions of higher education and 11 industries.

The 12 Capability Enhancement Grant States are Arkansas, Connecticut, Idaho, Louisiana, Maine, Montana, Nevada, North Dakota, Oklahoma, South Carolina, South Dakota, and West Virginia.

Welcome to Phase II Awardees

Dr. Robert W. Brown, NASA Headquarters

Dr. Robert W. Brown, Director of Educational Affairs, on behalf of NASA Administrator Admiral Richard H. Truly, welcomed Phase II members of the National Space Grant College and Fellowship Program on Monday, March 11. The 26 new States include 110 colleges and universities as well as industrial affiliates, national laboratories and State governments.

"I am excited about this new partnership," Brown said, calling Space Grant, NASA's newest program, an "idea whose time has come," in the Land-Grant and Sea-Grant university tradition.

"Your role is to be partners with us in these endeavors" Brown said as he shared recent NASA accomplishments with the audience, reminding them that despite worrisome reports, NASA completed in the previous 18 months, 12 successful Space missions. He cited the Galileo mission to Venus; the retrieval of the Long Duration Exposure Facility (LDEF); the launch of the Hubble Space Telescope which, despite an

aberration in the lens, Brown said, has successfully provided scientists with important new data; the Ulysses mission to study the sun's poles; and Astro-1, during which the first live lesson from Space was broadcast.

Brown described upcoming Space missions, including the deploying of the Gamma Ray Observatory (successfully completed in April); the launching of the Space shuttle Columbia; and a host of other NASA Space and aeronautics projects including the completion of Space Station Freedom.

Program Grant and Capability Enhancement Grant Workshops

On Monday afternoon of the conference, the Phase II representatives formed two workshops to discuss a number of topics. Those representing the Capability Enhancement Programs took the topics of Research Infrastructure and Faculty Development, State and Local Government, and Underrepresented Groups. The meeting was moderated by Dr. James V. Taranik (Nevada). The Program Grant group discussed Evaluation of Programs, University-Industry Interactions, and Fellowships. The meeting was moderated by Dr. Gary T. Moore (Wisconsin). Those who led the discussions on Monday formed study groups and continued to work on the topics during the week. On Friday morning, they gave the presentations on these topics. These are summarized below. An additional topic, the role of computer networks, was discussed briefly in both groups, by the Phase I, and then the combined Phase I and II Director's councils. The presentation on Friday morning for this topic was given by Molly Daniel (Mississippi). This is reproduced in the section on computer networking.

Space Grant and the Role of NASA Field Centers

Dr. Stanley Goldstein, University Affairs Officer, Johnson Space Center

There is a University Affairs Officer (UAO) at each of the NASA Field Centers. They usually report to a chief scientist and they are usually separate from the elementary and secondary education programs, which are located in Public Affairs Offices at the Centers. The UAOs provide liaison services between the NASA Centers and the Nation's universities.

The University Affairs Officers administer a wide variety of NASA programs, of which the NSGC&FP is one. Others include the RRA, the SFF, and the GSRP. The Resident Research Associateship (RRA) is a post-doctoral program of 1-2 years duration. The Summer Faculty Fellowship Program (SFF) supports 25-30 faculty to work at a center on a project for a summer. The Graduate Student Researcher Program (GSRP) provides a graduate student with $22,000 a year for up to three years. Their research is done on campus under the supervision of a faculty adviser.

The NASA Centers also have many center-specific programs. For example, the Johnson Space Center has a Medical Clerkship Program where students in medical school spend 4 weeks at JSC. The Centers also help develop totally new programs, such as the postdoctoral in Space physiology that has been developed at JSC.

The University Affairs Officers should be the first point of contact at the Centers for faculty at universities who have been, or wish to be, funded by NASA with Center

involvement. The UAO will then provide advice on whom to call at their Center. It should be noted that the UAOs themselves do not have funds for disbursement and their staffs are very small.

For the NSGC&F Program, the University Affairs Officers can help with outreach (finding existing educational resources), research (act as broker, facilitator, or catalyst, and sponsor technical briefings), and networking. An example of the latter is the role JSC has played in establishing the Western Regional Space Grant Consortia.

There is a need for each Center to develop an efficient means of codifying and communicating information concerning their center specific programs.

Organization and Management of Programs

Dr. Sallie V. Sheppard,
Associate Director,
Texas Space Grant Consortium

Dr. Sallie V. Sheppard, Associate Director of the Texas Space Grant Consortium, is Associate Provost for Undergraduate Programs and Academic Services at Texas A&M University, College Station, Texas. Because of the extensively developed Texas Space Grant Consortium and Dr. Sheppard's having facilitated a workshop on the subject of Organization and Management of Space Grant Programs at the First National Space Grant Conference in 1990, she was asked to discuss this important subject for Phase II attendees.

Dr. Sheppard illustrated her remarks with a set of viewgraphs, using the Texas Space Grant Consortium organizational structure as an example. These illustrations are reproduced at the end of this article.

Consortia Infrastructures

I. All programs have a director who serves as P.I. for the NASA award, provides overall guidance and direction, and is responsible for:

- technical contributions
- fiscal accountability
- reporting requirements to NASA
- leadership in program development, identification strategies, and affiliate networking

II. Larger programs have expanded administration:

- Additional program officers (and office locations) frequently identified as associate directors.
- Support Staff
- Board of Directors - to provide policy overview
- Committees - to develop program activities in focus areas.

Diversity among Consortia Structures

Illinois
Five universities work with the Argonne National Laboratory

Matching funds provided by State of Illinois

Florida
Four university members and eight university affiliate members

New Mexico
Organized as one university and one State agency member

Matching funds provided by New Mexico State University

Hawaii
One member: The University of Hawaii

NASA Membership Categories

Space Grant Designated Institution:

An institution averaging $2 million per year in NASA funding for the previous three years.

An institution with at least three Ph.D. programs in appropriate Space-related academic fields.

Members of Space Grant Consortia:

Participating institutions that do not meet funding and Ph.D. program criteria.

Other sectors of affiliates: industry, not-for-profit, Government agencies.

Charter Document

Formalization and documentation of:

Organizational goals

Staffing and office procedures

Selection of Director/other personnel
Funding/operation of program office(s)

Board of Directors (or advisory group)

Responsibilities of board members
Representation procedures
Election of Chairman

Committees

Focus areas (research, minorities, education, public service)
Selection of committee chairs

Membership participation and selection criteria

Categories of members
Responsibilities by category
Addition/deletion of members

Funding and award procedures

Fellowship guidelines

Texas Space Grant Consortium Charter

1. **Name**
2. **Purposes**
3. **Membership**
   - 3.1 Membership Classification
   - 3.2 Charter Members
   - 3.3 Addition and Removal of Members
4. **Management**
   - 4.1 Host Institution
   - 4.2 Director
   - 4.3 Associate Directors
   - 4.4 Institutional Representatives
5. **Board of Directors**
6. **Bylaws**
7. **Adoption and Amendments**
8. **Duration**

Communication among Members

- Semi-annual Consortium meetings
- Quarterly Board meetings
- Committee meetings
- Monthly newsletter
- E-mail connection in progress
- Fax/U.S. mail distribution
- Conference calls between program offices

Western Regional Consortia

First meeting in September, 1990 of five Consortia:

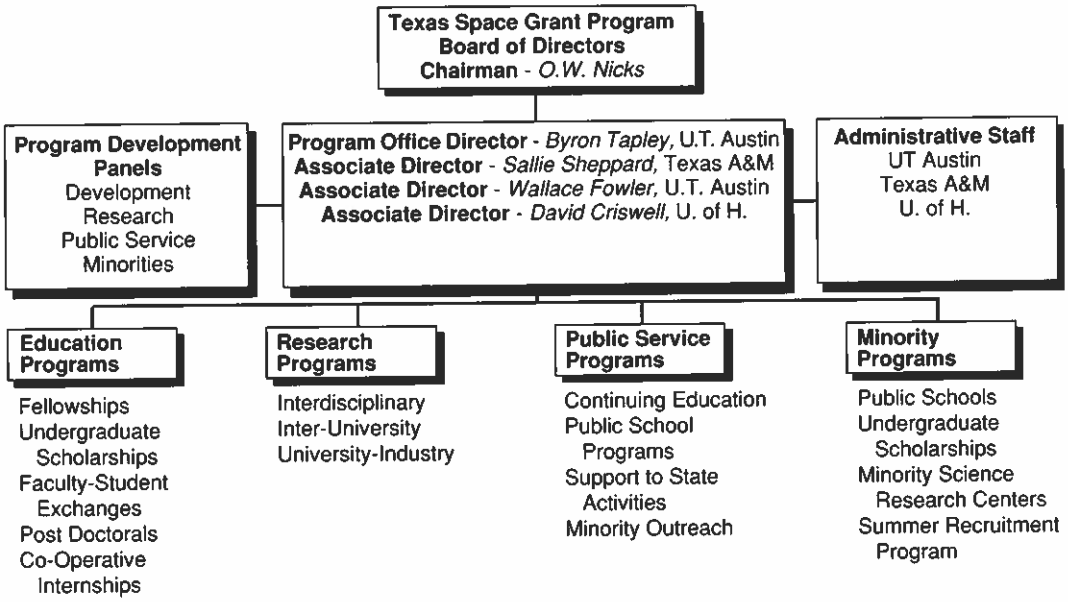
New Mexico Space Grant Consortium
Texas Space Grant Consortium
Colorado Space Grant Consortium

Rocky Mountain Space Grant Consortium
Arizona Space Grant Consortium

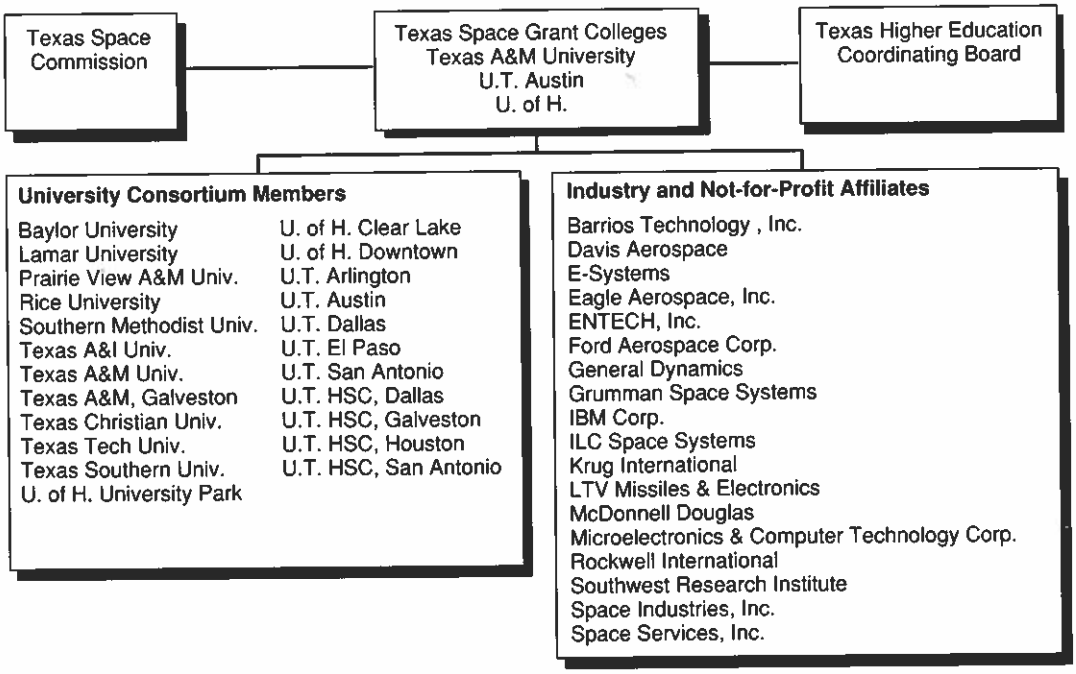
Semi-annual meetings provide opportunities for exchange and dialogue on programming, concerns, and future regional objectives.

Regional grouping facilitates networking and potential among Consortia with certain commodities.

Texas Space Grant Organization Structure



Members of Texas Space Grant Program



Introduction to Phase II Topical Workshops

The Friday morning session for Phase II participants consisted in the presentation and lively discussion of six topics which were chosen before the meeting, introduced on the first day of the meeting, and organized and modified within small groups during the conference week. Six presentations were made by Phase II Program Directors, and Steven Oxner of Rockwell International Corporation contributed a seventh. Dr. Richard F. Devon, Associate Program Manager for Space Grant, moderated the morning program.

Each of the seven presenters was asked to prepare short reports on their subject, modified with respect to final discussion. These papers are included in the pages which follow.

Institutional and Research Development

Dr. Charles A. Wood, Director, North Dakota Space Grant Consortium

Many of the universities and colleges selected to participate during the second phase of the NASA Space Grant program have received Capability Enhancement Grants (CEG). The purpose of the CEGs is to develop the infrastructure necessary to compete successfully in aerospace research and economic development. Although all of the CEG States appear to have some existing involvement in aerospace activities, often their participation in NASA funded projects has been minimal; e. g., North Dakota received only $0.1M from NASA in FY 89, ranking 50th in the Nation.

This small amount contrasts with the situation of recipients of Program Grants awarded during the first phase to States with well established academic and research programs in aerospace. Indeed, in FY 89, 37 individual universities received more NASA funding than 12 entire States. Thus, the NASA Space Grant Program is critically important to the CEG States, and the amount of funding should be brought into parity with the larger funding received by the Program Grant States to redress the continuing bias in favor of established aerospace programs.

For the Space Grant Program to be considered successful, CEG States must receive significantly more (non-Space Grant) NASA funding at the end of the program than they do now. Six suggestions to help CEG scientists become more competitive are proposed here. These proposals require hard work by the scientists and enthusiastic participation by NASA administration.

1. Development of infrastructure to do research requires that Space Grant funds are available to purchase laboratory equipment and computers. Remove the current prohibition against using NASA Space Grant funding for this critical infrastructure hardware.

2. Submission of proposals to NASA program offices should be followed by a notification of that fact to the Space Gran office. The Space Grant Program director can encourage the selection of CEG proposals when the funding cut involves decisions between equally ranked CEG and other proposals.

3. Within each NASA program office that funds research, a percentage (10%), of each data and analysis budget should be marked specifically for CEG proposals. Thus, competition would be between CEG scientists, and would not pit funded veterans against newcomers. This would guarantee that new blood would come into the relatively closed NASA research programs. This suggestion is based on the existence of similar programs in NSF for young or never-before funded researchers.

4. To be successful, CEG scientists must interact personally with NASA program managers. Telephone calls to program

offices are essential when trying to understand the goals of announcements of opportunities. Time should not be wasted responding to AOs when the program is essentially limited to scientists who are already involved (unfortunately very common) or when the science goals are not in areas of CEG team expertise.

5. The most important way for a scientist to understand how NASA works is to serve on proposal review panels, science working groups, advisory committees etc. Unfortunately, such advisory groups almost always are composed of already-funded scientists. NASA should include one or two researchers from CEG universities in each advice group, even if only on an ad hoc or ex-official basis.

6. All proposals, but especially rejected ones, need significant constructive reviews from the program office involved (and/or established researchers) so that unsuccessful applicants can learn to improve future proposals.

In many respects the six recommendations above are actions for NASA. Yet, to paraphrase a ringing challenge: Ask not what NASA can do for you, but what you can do for yourself. No CEG scientist or school is going to become successful in research without accepting responsibilities for that success. You must write better proposals. You must do your homework to understand what is known and where the research frontier is. For most CEG State Consortia, development of one area of strength - using scientists from different departments or institutions - may be the best way to become competitive. Discover existing capabilities within each State and build interdisciplinary cooperation. The same reaching out to build research teams offers opportunities to leverage the association with NASA and the Space Grant funds to acquire or enhance available State seed money.

We all learn by example. Try to become part of an established research team. Take advantage of NASA summer faculty research appointments such as the JOVE program. Perhaps a mentor or "Big Brother" relationship can be established with a research team in another State. Perhaps NASA should build into the Space Grant program a formal connection between CEG and full Space Grant Consortia.

These recommendations all ask for some degree of special treatment for CEG grantees. This needs to be achieved without reducing the quality of NASA's programs and without implying that CEG recipients are second-class citizens. There is already a perception, and some Freudian slips, that suggest the need to combat a Phase I /Phase II "caste system" mentality, whether it is real or imaginary. A good way to begin is to remove the financial differences between the two parts of the program. And next year's meeting should mix presentations from all the participants, not sequester Phase II speeches to a final day after Phase I participants have already departed.

The comments above are based on the existing Space Grant programs which is an excellent start to developing a 50-State Space program. There may, however, need to be agencywide changes in the way NASA works to really improve the entire Nation to participate in a future based on scientific and technical understanding. NASA must incorporate education into every one of its programs, not simply stuff it into an Education Office. Every new project - from individual missions like Magellan and Cassini, to large programs like the Space station - must include funding to help develop new scientists and engineers.

This report is a distillation of ideas generated by a half dozen participants at the Second Space Grant College meeting in Huntsville, AL. In particular, I thank Jim Taranik and Kumar Krishen for specific ideas and suggestions.

Relations with State and Local Government

Dr. John P. Wefel,
Director, Louisiana Space Grant Consortium

Introduction

Interactions between Space Grant Consortia and Government offices, both local and Statewide, are vital to achieving the long range goals of the Space Grant program. This relationship varies from State to State, as evidenced by presentations and discussions at this conference. Some State Consortia have a strong connection to State government, either directly through the governor's office or as a line item appropriation in the State budget. Others interact through the State education boards, while others have little or no connection to the governing bodies.

There are also differences between the Phase I and Phase II Consortia, based mainly on the longer period of time that Phase I Consortia have had to develop the relationships. Within Phase II, there are further variations between States with Program Grants and those with Capability Enhancement Grants. The remainder of this report focuses upon Capability Enhancement States, but many of the observations are applicable to the other groupings. For a discussion of the Virginia experience, the reader is referred to Workshop 9, by D. Barnes in the First National Space Grant Conference Report (NASA Publication EP-275, page 64).

Developing Relationships — Why?

The simple answer to this almost rhetorical question is that your Consortium wants governmental support! But, over and above that, there are several practical reasons for developing good working relationships with your State and local government bodies, particularly for Capability Enhancement (CE) States.

One of the tasks for a CE State is to develop a summary of current Statewide capabilities in the Aerospace area and to use that to formulate a plan to enhance those capabilities. Here the focus is on all aspects of the "pipeline" problem. Capabilities in research and education at the State's colleges and universities are but one aspect. The capabilities of Business and Industry in the State, particularly as they relate to the Space Grant goals of your Consortium, and the status of pre-college education and outreach programs throughout the State must also be evaluated. For Space Grant to be effective, it must work with, and through, as well as parallel to, the existing activities in the State.

One of the long-range program goals for Space Grant is to promote more aerospace awareness in the educational curriculum, from the K-12 level through undergraduate and graduate courses. In most educational systems, curricula are rather strictly controlled. Affecting permanent changes or modifications involves working through the university or State educational hierarchy, a job that is made much easier if good contacts and relationships have been established.

Finally, there is the goal of "networking." Space Grant is designed to develop a network, stretching across the country, whereby one State can profit from the success (or mistakes) of the others and can contribute its ideas to the general "pool." This, plus the links to NASA Centers, form a potent tool for the CE States to use in their development. On a smaller scale, a State Consortium needs to develop its own Statewide network to focus and promote the activities within the State. In both of these areas, the help and support of State and local government is essential, or, at least, highly desirable.

Approaching State/Local Government

Convinced that you need the support of the governing bodies, the next problems are how to make contact, to whom to talk, what to request and how to garner the support. These are all important issues, and the answers will vary from State to State and from situation to situation. However, there

are a number of ideas and results that seem to apply generally. To have been selected for the Phase II program, each State Consortium has already made initial contacts at some level. This may be only at the campus administration level or it may have involved Statewide agencies. In either case, a starting point already exists. You can use this initial support to gain access to higher echelons.

One important aspect involves knowing your State's organization and determining where the power or the decision authority lies. As an educational program, Space Grant normally falls under the State educational system, which is an important group with which to work and one with which your campus administrators interact.

The education boards, usually divided between elementary/secondary (K-12) and higher (colleges/universities) education, fall under the executive and legislative branches of State government. Much of the work of these boards is handled by full-time staff working with a system of committees. It is often these committees that must be convinced before a new idea or procedure can be implemented. Many of the CE States also have a State EPSCoR committee. In the case of Louisiana, the EPSCoR group falls under the Higher Education Board and reports through the existing committee system. Our Space Grant effort (LaSPACE) is an extension of the Louisiana EPSCoR committee. In other States, however, the Space Grant effort is separate from the EPSCoR effort and may fall at different levels within the State structure. The Space Grant mission, however, requires interaction across organizational lines. Space Grant projects may involve not only colleges and universities but also K-12 schools and business and industry in the State. Certainly, there is an important interaction with Federal agencies, particularly NASA, and with other State Consortia. Thus, Space Grant officials must be sensitive to the existing organizational structure and use it to obtain the support needed but, in addition, must develop liaisons that cross traditional structural lines. In our case, we have found that the EPSCoR committee members and the Higher Education Board staff and committees have been extremely helpful in making contacts and aiding in setting up the liaisons with other agencies. Utilizing this existing structure, along with your college/university heads, will simplify the task of making contacts and developing working relationships with your State's organization.

The State EPSCoR committee has a special role to play for CE States. The EPSCoR committee has the task of evaluating Statewide capabilities and responding to EPSCoR initiatives from Federal agencies, the principal one, up to now, being the National Science Foundation. CE States under Space Grant are tasked with infrastructure development and planning for aerospace research/education enhancement. This is precisely the task that the State EPSCoR committee performs for overall R&D. Thus, the EPSCoR group can help your Consortium with this task and should be contacted as early as possible.

One of the important questions is what to tell the people you contact to elicit their support for Space Grant. A legislator or administrator is always interested in the "bottom line," i.e., what will it do for me or my organization. Here there are a number of themes that are often successful and several that are not.

Prestige Factor: Your Consortium, and therefore your State, has just been named a "Phase II Space Grant Consortium" and you are now part of a growing national network of State Consortia. This is an important award and carries with it a level of prestige. Do not underestimate the significance of this designation when talking to governmental representatives. One can emphasize the importance of the Consortium's and the State's obligation to follow through with the planned program.

Federal Research Funds: There is often a misconception that Space Grant status involves significant research funding. This misconception should be eliminated early

and replaced with the notion that Space Grant involves building research infrastructure and capabilities to enhance research competitiveness. Space Grant can also provide contacts within the NASA research hierarchy, so that researchers can obtain the latest information on research opportunities.

Education: Space Grant is fundamentally an educational project designed to use Aerospace to stimulate student and teacher interest. We have heard reports at the conference on the "pipeline" problem, and most governmental representatives are also aware of the problem and the need for them (your State) to do something about it. There is a natural resonance here which can be used to get you a "hearing."

Research and Economic Development: While somewhat less well defined than Education, economic development is an important factor in most States, particularly CE States. The high-tech industries that have developed around major research universities in a number of States are well known success stories, and most States would like to duplicate, to some degree, that success. While Space Grant itself will not lead to direct economic development in most cases, the improvement of State infrastructure and enhancement of the research base is the *necessary* first step to attracting high-tech business/industry or to establishing "new" companies as a result of research "spin-off." Aerospace is an important area, the significance of which should both increase and broaden with the re-emergence of the USA in Space — EOS, Moon/Mars missions, outer planet missions, Space Station, robotics, advanced launch vehicles, Space life sciences, communications, etc. Such opportunities should be emphasized in the discussions.

Networking: As discussed above, the opportunity for your State to become part of a national network is a good selling point. Add to that the development of a Statewide Aerospace network to facilitate Space Grant activities, and this becomes an important asset for the State.

Local Benefits: This applies mainly to contacts with legislators or with governing board members that are selected to represent a certain geographical area. It is always good to be able to point to what Space Grant might do for that particular area. This requires a little "homework" to learn about specific districts, but that is where having a Consortium can help. In any case, Prestige, Education and Networking are applicable to all districts, from rural to urban areas.

Contact is best made after the Space Grant award has been made public, so that the Prestige factor is applicable, and before the newness has worn off, i.e. NOW! Beginning to develop the relationships early is important, since it will be necessary to continue the contacts over the next 4 to 5 years as your State's program expands and matures. The form of the initial contact is somewhat less important and should be determined by "what you are going to ask for." In simple cases, a short letter or phone conversation may be sufficient, while for more complex requests a meeting may be necessary. It is important not to "give up" if an initial contact proves unsuccessful. The people you are trying to meet are very busy, and a follow-up call or letter is often needed to get onto their schedule. Of course using your existing contacts, i. e., University or other infrastructure, to provide an introduction or to help you gain access is probably the most efficient way. It is important to have a specific request to make of the official you are contacting. This can range from the very simple, e.g., a letter of support or an introduction to someone else, to the complex, e.g., support for, or introduction of, legislation or modification of curricula. The trickiest request is one for financial support. While such support is clearly desirable, it is often very hard or impossible to arrange and can leave a bad impression, especially a first impression. An alternative can be to ask for help, for example, volunteers, to launch a specific project or initiative. Such help can often be more beneficial than an outright financial contribution. On another track, one can request information on potential sources o

support from the private sector, foundations, business/industry, civic groups, etc. It is then your responsibility to follow up such leads and, if successful, to report back in some form (letter, phone, or meeting).

Summary

The Space Grant program represents a new approach to one of the pressing problems of this decade — the supply of technically trained people for the future. It is a problem that involves every segment of the educational community, as well as the research groups, and is of concern to national, State and local leaders. For a successful State Space Grant Program, involvement of State and local governmental bodies is necessary, and good working relationships need to be developed at an early stage. The reasons for developing these relationships, as well as some ideas on how to proceed, have been discussed in this report. Not everything will be applicable to every State or situation, but the reader should adopt whatever strategy is most applicable. Probably the most important idea is the one that is not discussed here, the one that actually works for you!

On a final note, it is important to keep your State/local government contacts abreast of your programs and your progress. Periodic meetings/reports or copies of mailings or newsletters are important methods of communication. Articles in newspapers, magazines and campus publications are also important in keeping Space Grant activities in full public view.

Underrepresented Groups

Dr. Gary Maki,
Director, Idaho Space Grant Consortium

Introduction

The following represents the initial thoughts that were generated during the Second National NASA Space Grants Conference held at Huntsville, Alabama, March 1991. The contributors to this discussion were:

Jean Teasdale	University of Idaho
Linda Payne	South Carolina State College
Randy Webb	NW State University of Louisiana
Edmond Wilson	Harding University
Lorrie Peterson	Western Nevada Community College
Ramesh Malla	University of Connecticut

Underrepresented Groups

Some of the underrepresented groups include the following:

- Women
- Blacks
- Hispanics
- Native Americans
- Pacific Islanders
- Disabled Persons
- Other Currently Underrepresented Groups

Currently, women comprise the largest group of underrepresented individuals in science and engineering. They therefore represent the largest pool of potential talent in the Nation. While some feel that Asians are not underrepresented in the fields of science and engineering, it is unfair to classify all Asians in the same category. For example, Vietnamese and others may be experiencing the same kinds of difficulties experienced by other underrepresented groups listed above.

Another underrepresented group that does not receive much attention is the student from rural America. It is sometimes assumed that because they reside in small schools with limited resources and limited opportunities they may have reduced potential. Moreover, since the total number of students is small, the possibility of

recruiting many quality students is also small. As a result, few recruiting teams from major universities are likely to travel to rural schools.

Because of the diversity among the States and institutions, programs for identifying and recruiting underrepresented groups must be tailored to the individual State or institution. In addition, specific recruitment and retention efforts must be developed for each underrepresented group.

Problems

- Students are unfamiliar with the rewards and opportunities available in science and engineering professions. Many individuals have found that careers in science and engineering provide an excellent opportunity to pursue creative professions. Working at the State-of-the-art in science can be one of the most exciting opportunities available in modern society. Moreover, positions in science and engineering provide personal satisfaction by allowing the person to make meaningful contributions to the advancement of science and society. In addition, the financial opportunities available in science and engineering professions provide another incentive for entering the fields.

- Teachers are often not prepared to teach science and mathematics, particularly at the elementary levels. Science and mathematics in fact may be their weakest subjects thereby producing a reluctance to pursue these subjects with vigor. It has been widely reported that the best time to interest students in mathematics and science is in the elementary grades. Having teachers with strengths in science and mathematics will take advantage of the most opportune point in a student's program.

- Parents and students are not motivated. If the parents realized the opportunities and potential available to students seeking careers in science and engineering, they may be motivated to encourage their children. The goal for many Asian-American families is to have their children obtain a Ph.D. from one of the best universities. Most American families do not have this goal for their children.

- Students often have a reluctance for science and mathematics. A common belief among high school students is that they cannot succeed in math and science or that math and science are not interesting. As a result, students with potential are discouraged from even starting a scientific program.

- Diversity of groups requires specific recruiting/retention programs. A universal program is not feasible. Each group requires a unique program which must be developed and then implemented.

- A scientist or engineer has an image problem among primary and secondary students. The real creativity and rewards are not apparent to the average student, teacher or parent. In many instances, the student, teacher, and parent is unaware of what scientists and engineers do and what service they perform for society.

- Retention is a major problem. Individual attention often is required to assist the student through a sometimes strange campus environment and a difficult program. Many universities do not have the resources to provide the individual attention that is needed.

- The lack of student/teacher interaction can be discouraging to the underrepresented student. The pressures to publish and teach do not allow the individual faculty member the time to develop personal relationships with students.

- There is limited relationships between universities and minority groups. A good relationship between university faculty and key leaders in minority groups would greatly aid in the recruitment process. Few such relationships exist today.

- The modern campus is viewed as an unfriendly environment. The natural fear for any parent is that the campus can be a hostile environment for the student. Parents are naturally concerned about having their children leave home. Underrepresented families may have greater fears.

- Industries, universities, governmental agencies, etc. frequently complain about the elementary/secondary education system, but do little to improve the situation.

Potential Solutions

- Personal contact is exceedingly important. Since many underrepresented groups have little contact with universities, they need to have continuous personal interaction. Faculty must cultivate relationships with key minority leaders and gain their confidence. Letters, announcements, and programs are not sufficient. One example is the Space Science Camp at the University of Idaho which reaches out to junior high school American Indians. Margrit von Braun devotes much of her time traveling to tribal areas throughout the northwest to attract potential students. Without the personal contact the program would greatly diminish. She has made contact with key individuals in several tribes who assist her in her recruiting efforts.

- The improvement of the mathematics and science skills of elementary teachers would greatly increase the awareness of science by the students when they are most receptive to ideas.

- Role models are very important. The opportunities for underrepresented groups to observe or meet role models will increase the chances for success in recruiting/retention. Therefore, efforts must be made to draw more underrepresented groups into the teaching profession at all levels.

- Community colleges can be used to assist the nontraditional student in reentering the educational arena. The community college is prepared to work with these people and can serve as an excellent conduit for NASA science programs.

- For many underrepresented groups, it is important to provide assistance in transitions to college. It might be necessary to provide help to people completing the forms for entrance into the college program.

- Involve faculty with students to aid in retention. Students who have personal help can avoid many of the problems facing students. Universities must recognize the problems and make the resources available.

- There are many Federal and State programs that are available to assist underrepresented groups. The NASA Space Grant schools should identify and use the programs that already exist.

- Women represent a large talent pool and must be recognized and promoted. Allowing primary and secondary females to realize that they can play a major role in developing technology in this country can challenge some of them to seriously consider science and engineering.

- Success breeds success. Sports teams develop a winning tradition that becomes well known. Academic teams can also be developed with NASA as the focal point of the Space Grant Universities.

Evaluation of NASA Space Grant Consortia Programs

Dr. J. N. Perkins,
Director, North Carolina Space Grant Consortium

The addition of 26 Phase II Space Grant Consortia to the original 21 Designated Space Grant Institutions further complicates an almost intractable problem: the evaluation of a program involving more than 300 institutions in 46 States and the District of Columbia. While the goals and long term objectives of the Space Grant Program are well defined, the diversity of 47 Consortia makes it difficult, if not impossible, to define a rigorous set of guidelines by which each individual Consortium can be measured. An additional complication is the inclusion of Capability Enhancement Consortia, with objectives that are necessarily different from the other Consortia. Finally, when NASA's stated goal of permitting each Consortium maximum flexibility is factored in, it is obvious that no simple guidelines for evaluation can be drawn. However, the committee does recommend the following possible review criteria:

Development and Operation of the Consortium

a. The extent of coordination among pertinent disciplines

b. Consistency between plans and funding profiles

c. Management and competence - leadership, technical competence, and organizational strengths of team and key individuals

d. Quality of undergraduate and graduate training programs, curriculum development, student participation in research, etc.

e. Continued university and State support

Quality of Research

a. Innovative, fundamental, creative research in emerging technologies

b. Cross-disciplinary research - linkage of knowledge, methodologies, and tools

c. Contribution to the advancement of Space technology including dissemination of information, peer reviewed publications, etc.

d. Contribution to Nation's pool of engineering and scientist talent (U.S. student, faculty, etc.) including developments in education and outreach to underrepresented minorities

Achievement of Planned Goals and Objectives

a. Comparison of results to the stated goals and objectives in proposal to NASA (distribution of fellowship monies, courses developed, new faculty, etc.)

b. Evolution of goals and objectives with maturity of the Consortium

Relevance and Growth Potential

a. Potential impact of research and academic training on future Space missions

b. Plans/potential to attract additional support - interactions with other universities, industry, and NASA Centers (exchange of expertise, facilities, etc.)

c. Long-term plans/potential to become self sustaining

In more general terms, discussions with a number of program directors indicated that they were as concerned with what the evaluation process should not be as with what i should be. For example, it was the consensus of those polled that the development of a formalized and burdensome evaluation process should be avoided. Each Consortium should be allowed to set its criteria in accordance with its needs as long as

it stays within the framework of the Space Grant Consortia goals and objectives. Since significant experimentation with, and modification of, programs is anticipated in the early years, it is hoped that the reporting of failures as well as successes would be encouraged so that members of the Consortia could benefit from others' mistakes as well as their successes. While it recognized that NASA must be concerned with its own accountability, there is concern about any evaluation process which tries to measure a 'delta' improvement in a specific program. This is particularly true among the States which have a long history of obtaining funding, both from Government and industry sources. The final conclusion of the committee was that while the above will hopefully serve as a guideline for program evaluation, evaluations will ultimately remain subjective, requiring an ability to look beyond statistics.

University-Industry Interactions

Dr. Michael R. Dingerson, Director, Mississippi Space Grant Consortium

These discussions, the final presentation on 15 March, and this report were all benefited by the document shared from the previous year entitled "University Industry Interaction" by Daniel E. Hastings, Director, MIT Space Grant Program.

The focus of this overall effort was to explore what institutions had done in the past, were doing currently and had plans to do in the future. Essentially, it was of interest to learn what had been successful, what had not, and why. There was a very broad range of types of efforts and of success and maturity effort as well.

This topic was introduced to Phase II directors at the beginning of the meeting, was discussed informally all week by many/most of the participants, was the subject of an extended small-group discussion at mid-week and concluded with a summary presentation at the end of the meeting.

During the initial session, the presenter made a brief introduction and then introduced a listing of activities for consideration, and led discussion to determine the level of each activity represented in Phase II Consortia on university-industry interactions. These areas included: associate programs; summer employment; seminar series "trades"; student competitions sponsored by industry; special academic programs for industry employees; job fairs; courses taught by industry representatives; industry people serving on graduate committees; career advising; employee exchanges; and many others. The focus of these discussions was around experiences of Phase II institutions or familiarity with experiences of other institutions as well as around what institutions were planning for the near and long term.

By the end of the week, there were several overall conclusions which could be drawn:

a. Phase II institutions had relatively few notable interactions with industry;
b. Phase II institutions had much to learn from their Phase I counterparts;
c. There is no standard pattern for a successful interaction - they are "custom" relationships;
d. a new "paradigm" exists - the word of the day is "cooperation" not "philanthropy."

It was concluded that a Phase II institution should proceed as follows in investigating an industry interaction:

a. Survey what industries exist which demonstrate potential interest to Space Grant concerns -
    1. Determine their history of related activities (the institution's development office and/or research office may be helpful),
    2. Determine as specifically as possible the nature of activity around which an industry might be interested in developing a relationship,

b. Schedule a meeting with an appropriate person to begin discussions (focusing on Space Grant and related efforts is suggested as an appropriate start for such discussions);
c. Determine as specifically as possible what is of interest to each party;
d. Suggest the viability of an institutional-level agreement which would be supportive of individual efforts as they were identified;
e. Establish goals -
   1) consider Small Business Innovation Research issues if relevant,
   2) plan consciously to start small, but be ready to adapt,
   3) encourage interchanges of any kind.

Once a relationship is established, the following considerations are suggested:

a. Meet regularly (have this scheduled at a consistent time);
b. Do not be presumptuous in your interactions, but do not be bashful either;
c. Pursue active efforts such as
   1. mutual research needs,
   2. associate programs,
   3. summer employment,
   4. employee/faculty exchanges,
   5. student co-ops, and
   6. industry involvement in graduate study in all ways.

In summary, it was concluded that the National Space Grant College and Fellowship Program would provide a focal point of activities in teaching, research, and outreach, which would be advantageous in expanding institutional interactions with industry. It was fully recognized, however, that these interchanges will be successful if they are truly partnerships by which both parties receive something of value. It is up to Space Grant directors/participants to take the initiative in seeking and securing these important relationships on behalf of their institutions.

Industrial Affiliation in Space Grant Programs

Steven G. Oxner,
Rockwell International Corporation,
Space Systems Division

NASA's commitment to university Space science and technology programs has a direct impact on the character and level of investment in programs sponsored by industrial affiliations with universities. A significant and very important effort is directed at using Space science and technology as a vehicle for educational curricula development; in-turn fostering considerable change in how, and how much, math and science are taught in our Nation's schools in future decades. Equally important is the pursuit of industrial affiliations with near-term high potential for increasing market share with new proprietary knowledge and processes, niche markets, and commercially marketable high-tech products.

Industry's perspective of collaborative relationships with universities emphasizes the pursuit of technology and transition to marketable products. Educational outreach is an important but secondary objective. Thus, we distinguish the universities' centers of excellence in Space engineering and the Centers for the Commercial Development o Space (CCDS) from the Space Grant College and Fellowship Program. Although these Programs' Charters fundamentally differ, they are mutually supportive. Wonderful opportunities exist for synergistic collaboration.

Most, if not all, industrial concerns have moral commitments to their communities. These include: assistance to local K-12 schools and universities, ethical and legal responsibility for the impact business operations have on the environment (even after operations cease), and potential political liabilities. All compete for precious economic

resources, while endeavoring to give society a contribution proportionate to the economic benefit derived from it.

At this Second National Space Grant Conference forum, many of the Program Directors wear two hats: the Educator and the Space Scientist or Engineer. Industry shares a common bond with you. We have made a commitment to our society; investing in the education of our young citizens through renewed emphasis in the teaching of math and science. We, too, seek to encourage career paths which sustain a productive, moral, and progressive society for the 21st Century and beyond. The other commitment we share is the economic benefit bestowed reinvesting in our going concerns, in our communities, in the tax dollars contributed to State, local and Federal governments, and in the continued research and development which enables a progressive society.

Industrial affiliations take many forms. Generally, they are technology/engineering based research efforts funded through a company's business segment IR&D program, or in the form of scholarships, fellowships, or grants. Their nature and value determines whether divisional or corporate resources are committed. Since the Space Grant Program sponsored by NASA is relatively new to industrial managers, the relationship is more likely to be the latter; and it is typically underwritten by profit dollars authorized through the corporation's trust organization. Postdoctoral Fellows, or capitalization of the university's facilities, are often targets for industrial sponsorship.

Maximizing leverage of both corporate and university resources could have constituents of both; a program thrust funded through IR&D, and a corresponding grant for a K-12 initiative or university fellowship. Industry's financial resources may come from divisional as well as corporate budgets depending upon the extent that collaboration might benefit a single or multiple divisional program within the corporation. A specific technical objective in one business area of a company in collaboration with a specific university, 'Center of Excellence,' might be joined with a similar relationship in another of the company's business areas to underwrite a high-tech research project in the university laboratory. Concurrently, the parent corporation may provide grant resources to sponsor an educational outreach K- 12 program through the State' s Space Grant Consortium.

Everyone is a beneficiary. Academic institutions are able to leverage their Federal and State agency grant monies and corresponding contributions from their industrial affiliates. Individuals gain exposure and practical career experience in real world problems and solutions. Corporate sponsors expand resources with little added overhead to their programs, while providing strong and visible leadership in the community and education of our Nation's youth — a Win-Win situation for all.

The following are some collaborative activities Rockwell International's Space Systems Division has initiated with universities:

Winch Cart Robot Experiment: Space Systems Division recently placed a contract with the University of California's Agricultural Machinery Collection, an affiliate of the University's Agricultural Engineering College, to conduct an experiment for its Space science program. The university will perform test and evaluation activity on a robotically controlled towing vehicle prototype which is designed to explore advanced concepts for excavation and mining of Lunar regolith.

New Mexico State University Proposal for Rockwell Education and Endowment Program: New Mexico State University's College of Engineering has submitted a Proposal to Rockwell's Space Systems

Division for directed innovative research and development teaming in the area of telemetering technology in support of the company's National Launch System program (NLS). The Rockwell Education and Endowment Program (REEP) proposes employing a Space vehicle health monitoring system under development at SSD, and NMSU's noted expertise in telemetering technology as a vehicle for pre-college enrichment programs, and long-term scholarship support under the auspices of the State's Space Grant Consortium.

Texas A&M University Microwave Power Beaming Experiment Payload Integration: Space Systems Division submitted a proposal to Texas A&M University for the integration of the University's Microwave Power Beaming experimental payload on board the Space Shuttle for flight in 1993. The proposal, the first in support of NASA's Commercial Centers for the Development of Space Program (CCDS), sought to mate the university-designed experimental payload into the Shuttle's cargo bay on a specially designed carrier assembly. Originally scheduled to fly in early 1992, NASA's Office of Commercial Programs has proposed to remanifest the Texas University's experiment to maturate near-term commercial prospects for power beaming.

University of Colorado Center for Space Construction Collaboration on Lunar Base and On-Orbit Operations and Support: Rockwell's Space Systems Division has opened a dialogue with the University of Colorado's NASA designated Center for Space Construction to explore areas of potential collaboration in Space operations and support, Space Shuttle maintainability and availability issues, and the broad logistical imperatives of the Company's Space Exploration Initiative (SEI). George Morgenthaler, the Center's Associate Dean for New Programs explained some of the University's previous investigations into Shuttle "Launch-On-Time", Space Station Freedom construction interruptability, lunar base construction options, and development of a Model for Constructablity Analysis (DYCAM).

Space Systems Division Shuttle Simulation Project at University of Central Florida: Rockwell's Space Systems Division has collaborated with the University of Central Florida to develop a high fidelity model of crew return capsule simulating the dynamics of an ocean splashdown after reentry into the Earth's atmosphere. The Water Post-Landing Dynamics and Testing Project is designed to develop a simulation of the dynamic response of such a capsule in the critical post-splashdown and pre-recovery period of Space flight. Identification of critical modes of response of the capsule subject to a range of boundary conditions is of prime interest in the safe recovery of Astronauts in the event of an emergency return to earth.

Fellowships

Dr. Paul W. Weiblen,
Director, Minnesota Space Grant Consortium

Abstract

The report on the Workshop on Fellowships of the First National Space Grant Conference defined the objectives of the fellowship program, outlined the types of fellowships and institutional strategies that can be pursued in offering fellowships, and discussed criteria for evaluating the fellowship program. This report was reviewed at the Second National Space Conference and attention then focused on strategies for achieving the objectives of increasing the number of talented students, underrepresented minorities, and women in Space and aerospace fields, and strategies for increasing fellowship funds and their effective u

Strategies to Increase the Number of Talented Students in Space and Aerospace Fields

High school students' interests in Space and aerospace fields can be stimulated by information on the Nation's Space Program in general and by information on research within a State's Space Grant Consortium, but information on specific undergraduate fellowship programs will be very effective in nurturing and focusing early casual interests. Dissemination of information on undergraduate fellowship opportunities to high school students is therefore an important strategy for increasing the number of talented students in Space and aerospace fields. State Departments of Education can provide effective mechanisms for the dissemination of information on undergraduate fellowships. Feedback to high school counselors and newspapers on school alumnae who have been awarded undergraduate and graduate fellowships can also be an effective way of communicating the reality of opportunities to succeeding classes of high school students.

Undergraduates typically place a great deal of weight in choosing majors on their knowledge of real opportunities for undergraduate and graduate research support. An effective mechanism for disseminating information on fellowship programs is therefore very important. Beyond the conventional activities of program and award announcements, feedback, again, from the Consortia to undergraduate institutions on recipients of graduate fellowships (including their progress) may swing the balance when undergraduates are involved in focusing their interests and planning their educational futures and eventual careers.

Recipients of fellowship awards can be recruited to participate in K through 12 outreach programs. A recipient of an undergraduate or graduate fellowship speaking to an elementary or high school class, science club, or scout troop provides living proof of opportunities in Space and aerospace fields. This is particularly useful for reaching underrepresented minorities and women.

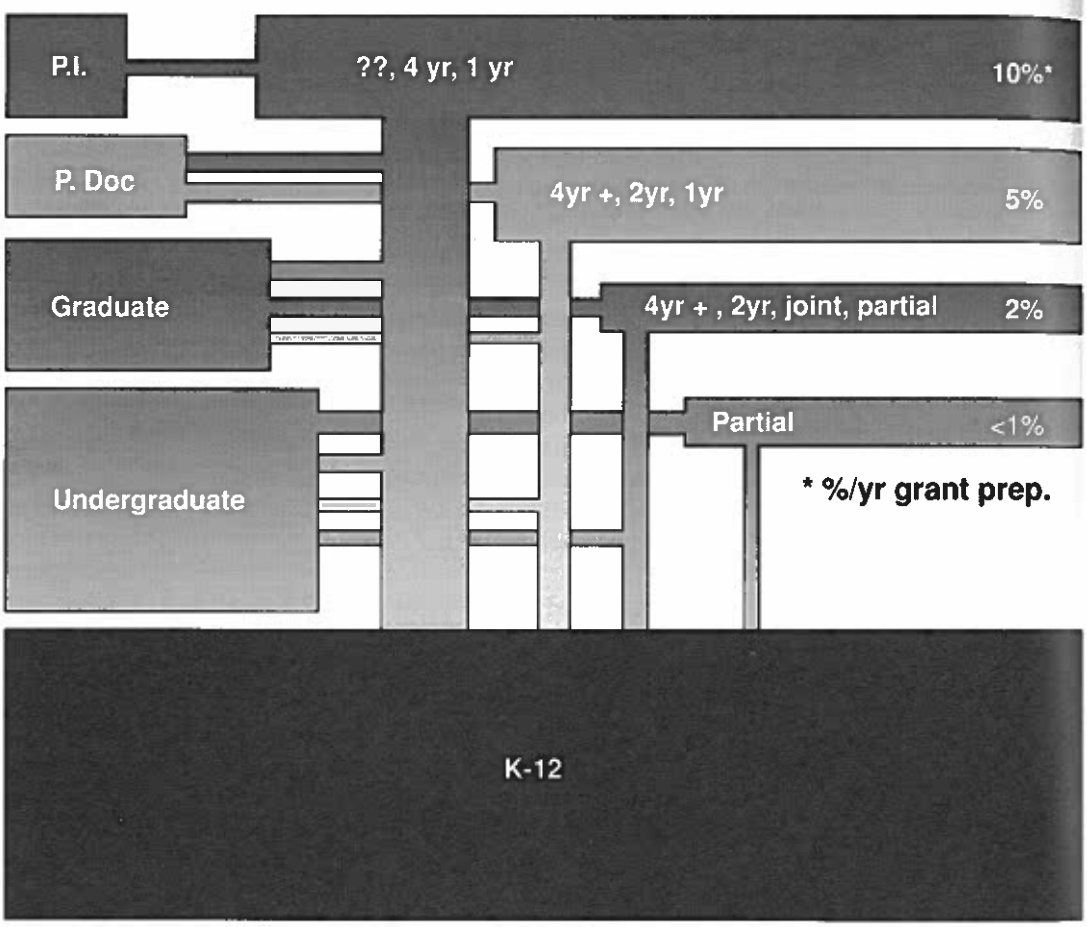
The proposed electronic network for the Space Grant Consortia can greatly facilitate the process of matching a prospective fellowship recipient (in particular, graduate students) with the most appropriate program and institution. This will require that each Consortium maintains and shares a regularly updated data base on potential candidates for fellowships.

Strategies for Increasing Representation of Minorities and Women in Space and Aerospace Fields

Space Grant Consortia can enlist the help of a wide variety of existing agencies and institutional programs throughout their State in the effort to increase the representation of minorities and women in Space and aerospace fields. It requires time and effort to locate and develop working relationships, and program directors will find it necessary to develop a strategy for assigning personnel and funds to this effort. It will be important in these cooperative efforts to assure that Space Grant Consortium fellowships are not used as a budgetary statistic for other programs to meet their quotas for contributions to minority assistance. It should be made clear in any cooperative effort that a Space Grant Consortium Program is a new and additional contribution to any pre-existing program.

The fellowship programs of the Space Grant Consortia should not just focus on locating talented students in the underrepresented minority and women student populations. Using the strategies outlined in the first section, fellowship programs can effect an increase in the number of minorities and women who can acquire the necessary background in their K-12 through undergraduate programs to have successful careers in Space and aerospace fields.

Recipients of Space Grant Consortium fellowships for underrepesented minorities and women will require support beyond their monetary stipends in the form of extra guidance, counselling, and tutoring as needed. Organization of this support will logically be the responsibility of the advisor, but fellow graduate students and post-docs can be enlisted in this effort. A well-integrated program in Space and aerospace fields will require that some attention be paid to promoting the interactions of principal investigators, post docs, graduate students, and undergraduates with appropriate student populations in the "pipeline". The following figure illustrates these interactions schematically.



Schematic Illustration of the Interactions of Potential Fellowship Recipients in the Educational Pipeline.

The size of the boxes are crudely proportional to the number of students in the different populations. The time periods indicate the likely duration of fellowship and grant support. The percentages are relative indicators of time spent preparing grant and fellowship applications. The vertical and horizontal bars indicate the interactions (advising, counselling, sharing information) that should take place between the different populations in an effective Space Grant Consortium fellowship program. The diagram highlights the fact that exceptional demands are placed on the time of principal investigators.

Strategies to Increase Fellowship Funds and their Effective Use

Solicitations for contributions to Space Grant Consortium fellowship programs from industry and private foundations should emphasize the goals of the Space Grant Program and its long-term impact on the Nation's Space program. The solicitations need to be oft-repeated to work into the cycle of funding of the contributors.

Fellowships can be named for distinguished alumnae or emeritus faculty in the Consortia and funds solicited from alumnae. If only some of the interest is used from such funds they will grow with time.

Space Grant Consortium fellowships can be matched with other fellowship funds such as departmental endowed funds, graduate school funds, MacArthur Fellowships, etc.

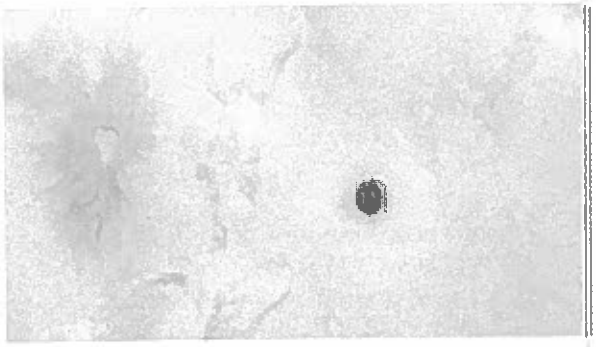
The figure suggests that a constraint on an effective fellowship program other than funds may be the time available to individual principal investigators and advisors.

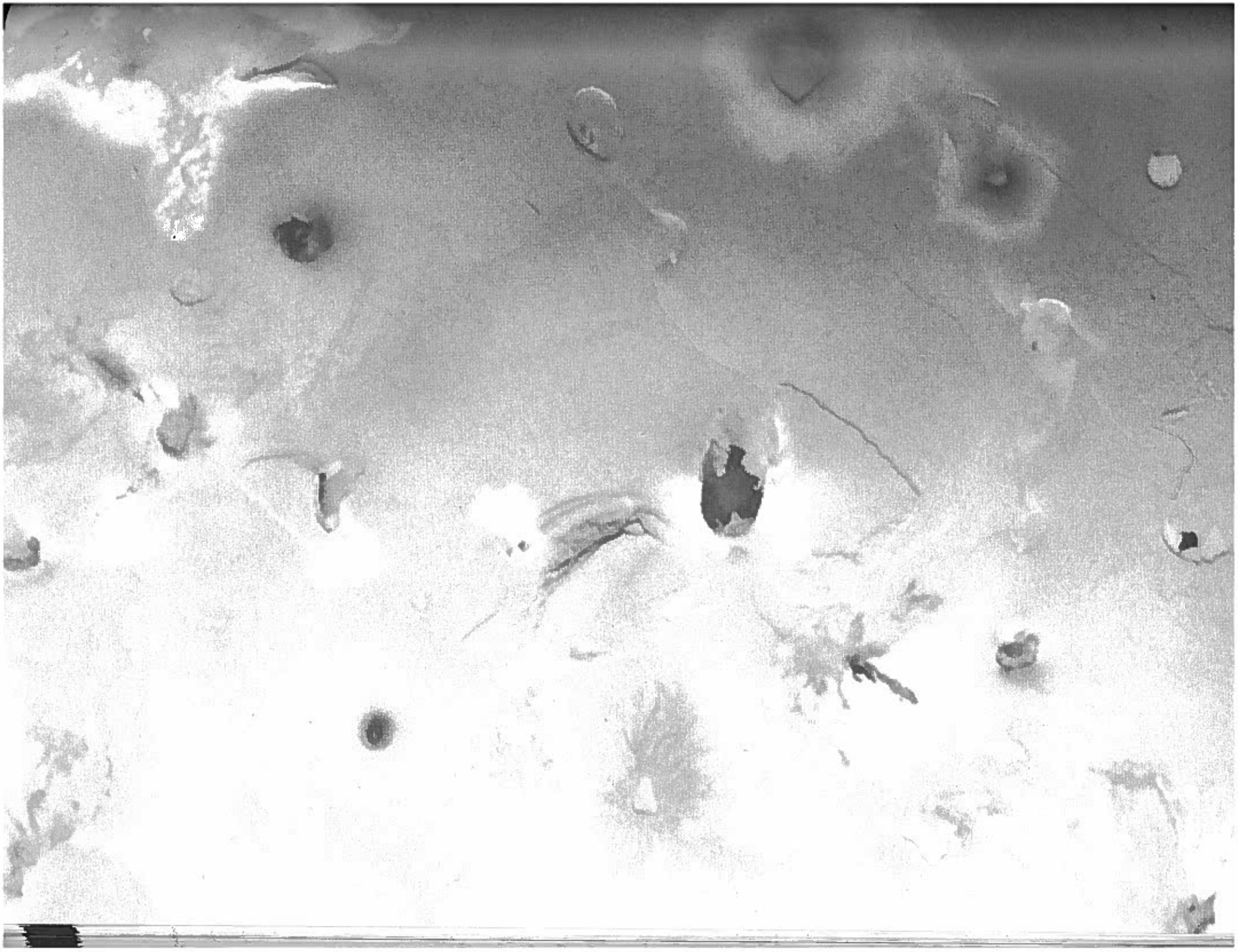
Additional Points Raised during the Fellowship Workshop at the Second National Space Grant Conference, March 15, 1991.

The question was raised whether there should be a standard set of national guidelines for the selection of recipients of fellowships. This could entail standardized announcements, application procedures, award dates, and review processes. The consensus of the response was that these details are best left to the discretion of the individual Consortia. It was pointed out, however, that the proposed electronic network if used in the fellowship program would unobtrusively introduce a certain amount of standardization and coordination.

The question of the importance of personal interviews in fellowship selection was raised. The consensus was that the more information that goes into the selection process the better. Again it was emphasized that the proposed electronic network could facilitate the efficient exchange of up-to-date information in the fellowship selection process.

Breakout Lunch Meetings





Phase I Directors' Council Meetings

The Phase I Directors' Council met twice before the combined Phase I & II meeting on Thursday. These two meetings were at lunch on Tuesday, March 12th, and at 6 pm of the same day. At the lunch meeting there were 20 people in attendance, 18 of whom were directors.

The lunch meeting opened with the introduction of three new program directors, John Gregory of the Alabama Space Grant Consortium, Wayne Solomon of the Illinois Space Grant Consortium, and Mary Sandy of the Virginia Space Grant Consortium. The subject of E-mail was added to the agenda.

The Charter for the Directors' Council, which had been FAXed to the directors prior to the meeting, was unanimously approved for signature ratification without discussion.

The 1992 Space Grant conference to be held in Texas was discussed. Although no decisions were made, suggestions included the following: have a short two-day conference with an optional third day at the Johnson Space Center, make it less structured than the 1991 conference, use the weekend to take advantage of weekend air-fares, hold it in the Fall or during Spring Break, distribute brochures of Space Grant Consortia programs before the conference, invite legislators, Congressional staffers and OMB staff to see how well the money is spent, have poster sessions, find a theme for the conference, and decide whether the Directors should have a meeting at the next conference.

The lunch meeting ended with a discussion of the sad state of school science textbooks, California excepted.

At the 6 pm meeting, a presentation was made by Dr. Jerry Ventre, (407) 658-5599, for a Space education conference to be held in the Cocoa Beach Hilton, Florida, October 23–25, 1991. The name of the conference is "Meeting Space Education Needs of the Future," and its main focus will be undergraduate education. For more information call Dr. Ventre or Dr. David Webb, (407) 695-8847.

The evening meeting also included a discussion of the potential uses of computer networks within the Space Grant community.

Western Regional Space Grant Consortium Meeting

A breakout luncheon on Wednesday, March 13, provided 17 members of the Western Regional Space Grant Consortium (WRSGC) and other interested participants an opportunity to catch up on WRSGC activities and plans. The WRSGC, facilitated through the participation of Dr. Stanley Goldstein, University Affairs Officer of the NASA Johnson Space Center, has been active in pursuing issues of regional significance to western Space Grant Consortia.

Dr. Sallie V. Sheppard, Associate Director of the Texas Space Grant Consortium and Associate Provost for Undergraduate Programs and Academic Services at Texas A&M University, served as Chair for the WRSGC meeting. An agenda for the meeting follows:

1. Call to order. Welcome. Introductions.
2. Informal "Two Minute" Updates from Members on Activities.
3. Discussion of Goldstein Proposal for Regional Guidelines.
4. Discussion of "Regional Member Exchanges" (Sharing Materials, Joint Proposals, Seminar Videos, etc.); Dr. Elaine Hansen, Program Director, Colorado Space Grant Consortium.
5. Administrative Items:
   A. Addition of New Members;
   B. Invitation to Attend Texas Space Grant Consortium Annual Meeting;
   C. Plans for Summer Regional Meeting.

6. Other Business.

7. Adjournment.

After reviewing his Monday presentation to Phase II participants, Dr. Goldstein discussed the purpose of the WRSGC—to maximize each Consortium's resources, plans, and performance by sharing ideas, facilities, equipment, etc. This objective can be accomplished through activities such as: establishing a database to exchange information concerning existing resources (eg. research capabilities, current research grants); sharing information about existing activities and programs, and their successes and/or failures; assisting each other in recruiting minority and female students into WRSGC schools; sharing ideas on obtaining matching funds and leveraging; developing an approach to "exchange" graduate students; and, investigating and discussing "regional issues."

The next meeting of the Western Regional Space Grant Consortium, tentatively set for September 27 and 28, 1991, will be hosted by the Colorado Space Grant Consortium in Boulder, Colorado.

Phase I & II Program Directors' Meeting

A lunch meeting of Phase I and II program directors took place on Thursday, March 14. The meeting was chaired by Dr. Steven P. Nichols of the University of Texas at Austin. Nichols chairs the National Council of Space Grant Directors, which was formed shortly after Phase I directors met in January 1990, at the first National Space Grant Conference in Columbia, Maryland.

Nichols stressed that the Directors' Council is a forum where program directors may discuss common interests and problems, and is separate from NASA.

On this day, the group discussed such issues as electronic communications, the organization's position on lobbying, and future conferences. A motion presented by the ad hoc Space Grant Networking Working Group was passed. The motion recommended establishing the above-named working group comprised of two subgroups. The first subgroup will:

- Define access modes and user services
- Define existing capability for networking access
- Conduct survey of emerging capabilities on networks
- Develop necessary documentation and training materials for Consortium members

The second subgroup will:

- Develop standards for information capture, dissemination, storage and archiving
- Facilitate database content and structure and evolution
- Develop necessary documentation and training materials

Additional recommendations of the working group called for funding to be provided to the subgroups to carry out assigned tasks, and urged the development of a Space Grant "white pages" as an immediate, short-term goal.

A motion was passed to convene the Council of Space Grant Directors in October 1991, to discuss such topics as research, education, outreach, underrepresented groups, and university/industry interrelations. Phase I Program Directors, Dr. Stephen Horan (New Mexico State University), Dr. Martin A. Eisenberg (University of Florida) and Nichols; and Phase II Director Dr. Gary T. Moore (University of Wisconsin /Milwaukee) agreed to serve on the Executive Steering Committee for the Council of Directors, which will prepare the agenda and oversee activities prior to the October meeting.

Elaine Schwartz and Richard Devon.

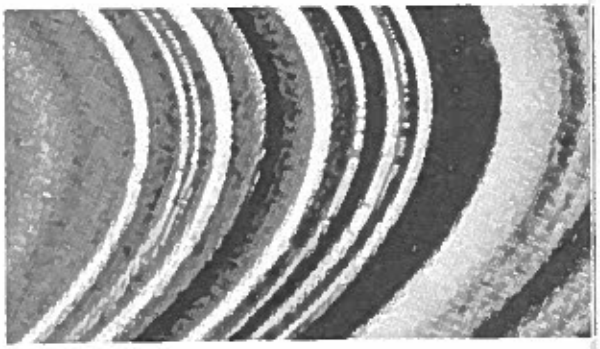
(left to right) Pinky Nelson, Bob Brown, and Bill Anderson.

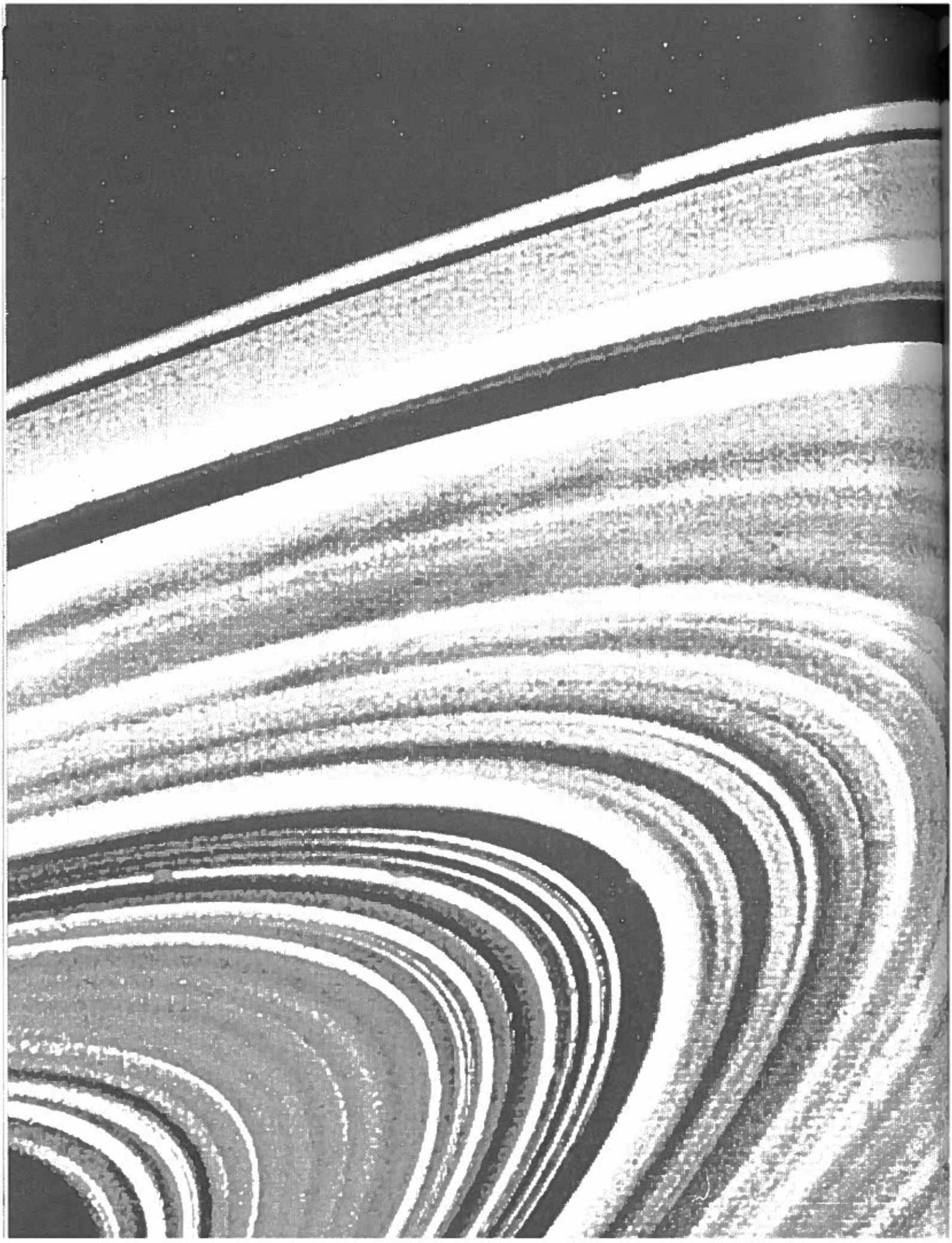
Michael Wiskerchen and Harry Ashkenas.

(left to right) Louis Clark, James Miller, LaDell Swiden, David Targen, and Frederick Waltz.

Al Strauss, Bill Martin, Martin Eisenberg, Ed Howard, John Perkins, Dermott Mullan, and William Lucas.

Special Events





Marshall Space Flight Center Tour

On Thursday afternoon, March 14, about 50 participants took a bus tour of the Marshall Space Flight Center. The host was Dr. Frank Six, the University Affairs Officer at Marshall.

The first stop was for a walk-through of a full-scale, mock-up of a recent conception of the Space station. En route to the next facility, we passed the one-kilometer long X-ray calibration facility. This is used to accommodate testing for AXAF optics and other flight instruments.

The next stop was the neutral buoyancy tank containing a full-size shuttle cargo bay. This is NASA's largest neutral buoyancy tank. The water is particularly highly filtered, allowing for excellent visibility.

After the buoyancy tank, the group went to the flat-floor facility. This contained epoxy surfaces with a tolerance of 1mm over about 20 meters. This high tolerance, in conjunction with airbearing platforms, permit testing the docking and maneuvering of robotic systems with 5 degrees of freedom and extremely low friction. Included in the facility was a fake satellite hanging on an arm attached to the ceiling.

For a while, the group had anticipated seeing a test firing of a main shuttle engine. This apparently stunning display of technological power did not take place, unfortunately. However, we did see the test facility which, although developed and used for the Apollo program, is still used. With new launch systems under consideration, its future use seems assured.

U.S. Space and Rocket Center Activities

Conference attendees optionally spent two of their evenings at the U.S. Space and Rocket Center in Huntsville. Tuesday, March 12, the Center hosted a reception and buffet dinner, at which the group was welcomed by its director. The guests were allowed to walk through the Space Camp facilities and the "Red Star in Orbit" exhibition, which featured models of Soviet spacecraft. After dinner, the guests were treated to a screening of "The Blue Planet" in the Center's specially-designed theatre. Thursday, March 14, the attendees were given a demonstration of the shuttle's ceramic heat tiles, and then took part in various Space Camp simulators.

Alabama A&M University Laboratory Tours & Reception

Prior to the reception at the State Black Archives Research Center and Museum and Dr. Shelby G. Tilford's public lecture at the Bibb Graves Auditorium, Alabama A&M University, conference participants were treated to a guided tour of four Space Grant-related facilities at the University. In addition to faculty participating in these research activities, several Alabama A&M University Space Grant Fellows were on hand to describe their research.

Short descriptions of the four research facilities follow:

Tour #1, Stress Physiology Laboratory

The Stress Physiology Laboratory within the Department of Plant and Soil Science has a long history of Space science-related research with plants. The laboratory, with approximately 720 sq. ft., contains equipment and facilities to study the many aspects of stress physiology as it applies to plant growth. The laboratory has tissue culture, growth chamber, and greenhouse facilities and also features instrumentation for measuring growth and development of

plants, including photosynthesis, transpiration, leaf area, root lengths, and endogenous hormones.

In the past, there have been several contracts and projects related to plant growth in Space. In the early 1980s, work was performed to enable characterization of the Space environment using wheat, rye and triticale cultivars in suspension culture. The cells obtained were subjected to protoplasting techniques using cellulase and pectinase enzymes for study of cell wall regeneration. This research established baseline information to determine how cell suspension growth and cell wall regeneration will be altered by the microgravity environment.

Guests enjoy the dinner reception at Alabama A&M University. (left to right) Ching-Jen Chen, Paul Weiblen, George Parks, and Kumar Krishen.

A later project, funded by Battelle Pacific Northwest Laboratory (1986-1988), investigated a novel means of producing food in Space. Most fruit-producing plants are expensive in terms of area and materials required for successful production in Space. The different medium requirements were evaluated for a process which involved harvesting the preformed floral bud, placing it on inductive media, and forcing the resulting fruit to grow. Theoretically, this would allow buds to be harvested on earth, frozen in cryogenic storage, thawed and put on appropriate media for growth with the finished fruit available for eating.

(Facing) Charles Wood, Gordon Johnston, Ramesh Malla, James Vedda, and Willy Sadeh.

A project that is currently funded by NASA involves the production of salad crops in a Space station plant growth rack within the Space station mockup facility at Marshall Space Flight Center in Huntsville. This work has focused on building a plant growth rack and developing nutrient delivery systems to provide for crop growth. Based upon preliminary species evaluations using lettuce, radish, tomato, scallions and carrots, an estimate has been made of the potential salad vegetable production possible within the plant growth rack.

Having fresh salad vegetables available to the inhabitants of the Space station will help to prevent dietary boredom and also provide a needed recreation component - gardening in Space.

In the current design of the Space station, physical and chemical systems of air and water recycling are a main thrust. Before plants can be incorporated into these, information is needed on how plants grow and what they contribute in terms of oxygen, carbon dioxide, water and biomass. In a grant funded by Boeing, a plant growth model is being developed to describe plant growth of lettuce in terms of the basic functions of the plant including photosynthesis, respiration, transpiration, and biomass accumulation. This model can then be used to evaluate the potential role for plants in water and air recycling.

Tour #2, Alabama Center for the Applications of Remote Sensing

The Alabama Center for the Applications of Remote Sensing (ACARS), established in 1976, is a research center within the Department of Plant and Soil Science. ACARS is devoted to applications of the science of remote sensing in the solution of agricultural and natural resource problems. These problems are solved through the merging of the science of mapmaking (cartography) with other ancillary data derived from the digital processing of remotely sensed data obtained from Space-borne platforms.

The ACARS Laboratory occupies approximately 2,000 sq. ft. of laboratory workspace with hardware and software capabilities for processing satellite-based data in a user-friendly format. ACARS has two hardware systems, along with a fully equipped photointerpretive laboratory and a portable

spectral radiometer available for field research. The two hardware systems, with appropriate software packages, are:

1. Earth Resource Data Analysis System (ERDAS) is a microcomputer system designed for processing MSS, TM and SPOT data. ERDAS is a complete system with user designated database software, floppy and a hard disk storage capability, 9-track tape drive, high resolution image processor with RGB monitor, digitizer, and color inkjet printer.

2. The second system is the Antiaircraft MicroVax minicomputer with network capability through which eight remote sites can be interconnected and which is expandable to over four Gigabytes (Gb). This graphic data processing system provides multiuser and multitasking processor support in a single package.

The Center is involved in research and development of newer and more efficient ways to extract information from data obtained from Space-borne systems, particularly those of Landsat. As a means of qualitative enhancement, emphasis is placed on the combinations of other informational sources such as geological and topographical sources. At present remote sensing techniques are being utilized in crop inventory, watershed analysis, land-use analysis, soil survey, forest inventory, water quality, and geographic information systems (GIS) development.

ACARS professionals and staff are members of the American Society of Photogrammetry and Remote Sensing. Lectures and seminars are presented to academic, professional and user communities. Periodic workshop and short courses are also offered by the Center for training in new developments in the field.

Tour #3, Howard J. Foster Center for Irradiation of Materials

Alabama Agricultural and Mechanical University is the home of a new research center, which is devoted to the interaction of energetic particle beams with condensed matter (a sophisticated phrase for solids and liquids). The Center for Irradiation of Materials is built around a brand new model SSDH-2 Pelletron high-voltage accelerator made by the National Electrostatics Corporation of Middleton, Wisconsin. This general purpose accelerator systems provides a wide variety of light and heavy ion beams. A tandem machine, it normally supplies protons up to 4 MeV, and alpha particles to 6 MeV. Other heavier ions also can be accelerated to correspondingly higher energies.

The Center for Irradiation of Materials is used for research projects, which include both material modification (such as by ion implantation, ion peening, and ion milling) and material analysis, using such advanced techniques as Rutherford Backscattering, channeling, particle induced x-ray emission, resonance scattering analysis, and induced radioactivity.

The Center has expert groups specializing in Surface Science, Radiation Science, and Particle-Solid Interactions. As well as the direct involvement of five members of the Department of Physics of Alabama A&M University, the Center enjoys the collaboration of the departments of Chemistry, Biology, Civil Engineering, and Industrial Engineering. There is a surface science theory group which uses the Alabama Supercomputer Center, and analytic support is provided as well by A&M materials research group.

External to the University, there are collaborators at UAH, UAB, M.I.T., the University of Lowell, Massachusetts, Cornell University, Syracuse University, Oak Ridge National Laboratory, NASA/Marshall Space Flight Center, Nichols Research Corporation, and United Applied Technology. An important function of the new center is to train advanced undergraduate and graduate students in materials science as well an analytical services to the high tech industries of Alabama. As the facilities are unique in the State, this will constitute a quantum leap in our technological capabilities.

Tour #4, Solution Crystal Growth Laboratory

Crystals for room-temperature infrared detectors, second harmonic generation devices, and other nonlinear optical applications are grown in the Solution Crystal Growth Laboratory at Alabama A&M University. The laboratory has facilities to measure electrical and dielectric properties of crystals and all other solutions relevant to crystal growth. Four graduate and five undergraduate students are working on different projects.

The laboratory supports four projects:

1. Growth of triglycine sulfate (TGS) crystals for IR detectors and the study of growth kinetics. This project is funded by the NASA Office of Microgravity Science and Applications.

2. Growth of doped-TGS crystals for improved IR detectors and the growth of L-arginine phosphate (LAP) crystals for second harmonic generation of Nd:YAG lasers. This project is funded by the NASA Office of Space Commercialization.

3. Growth of organic nonlinear optical crystals. This project is funded by NSF under the Minority Research Center of Excellence (MRCE) program.

4. Growth of TGS and LAP crystals by Gel technique. This project is under the NASA Space Grant Consortium program.

TGS crystals are grown by a specially developed technique of cooled sting where heat is extracted from the crystal through a thermoelectrically cooled sting to create a desired supersaturation. This work is in preparation for a flight experiment to be flown on the First International Microgravity Laboratory (IML-1) on STS-42 in November 1991. The six payload and mission specialists were trained in the Solution Crystal Growth Laboratory. Professor R.B. Lal of the Physics Department is the Principal Investigator of the project with Drs. A.X. Batra (AAMU), W.R. Wilcox (Clarkson University) and J.D. Trolinger (Metrolaser) as the coinvestigators. This experiment is a modification of an earlier experiment on the Spacelab 3 mission in May 1985.

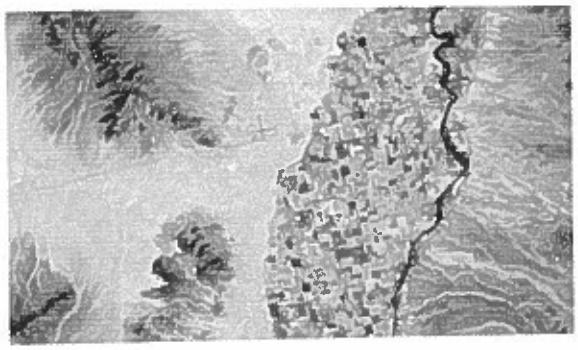
As part of the NASA Space Grant Consortium program, an undergraduate student, Narvaez Stinson, is working to grow TGS and LAP crystals by gel technique. By growing crystals in gel, convection effects are somewhat reduced, giving rise to better crystal quality. These studies will help future flight experiments.

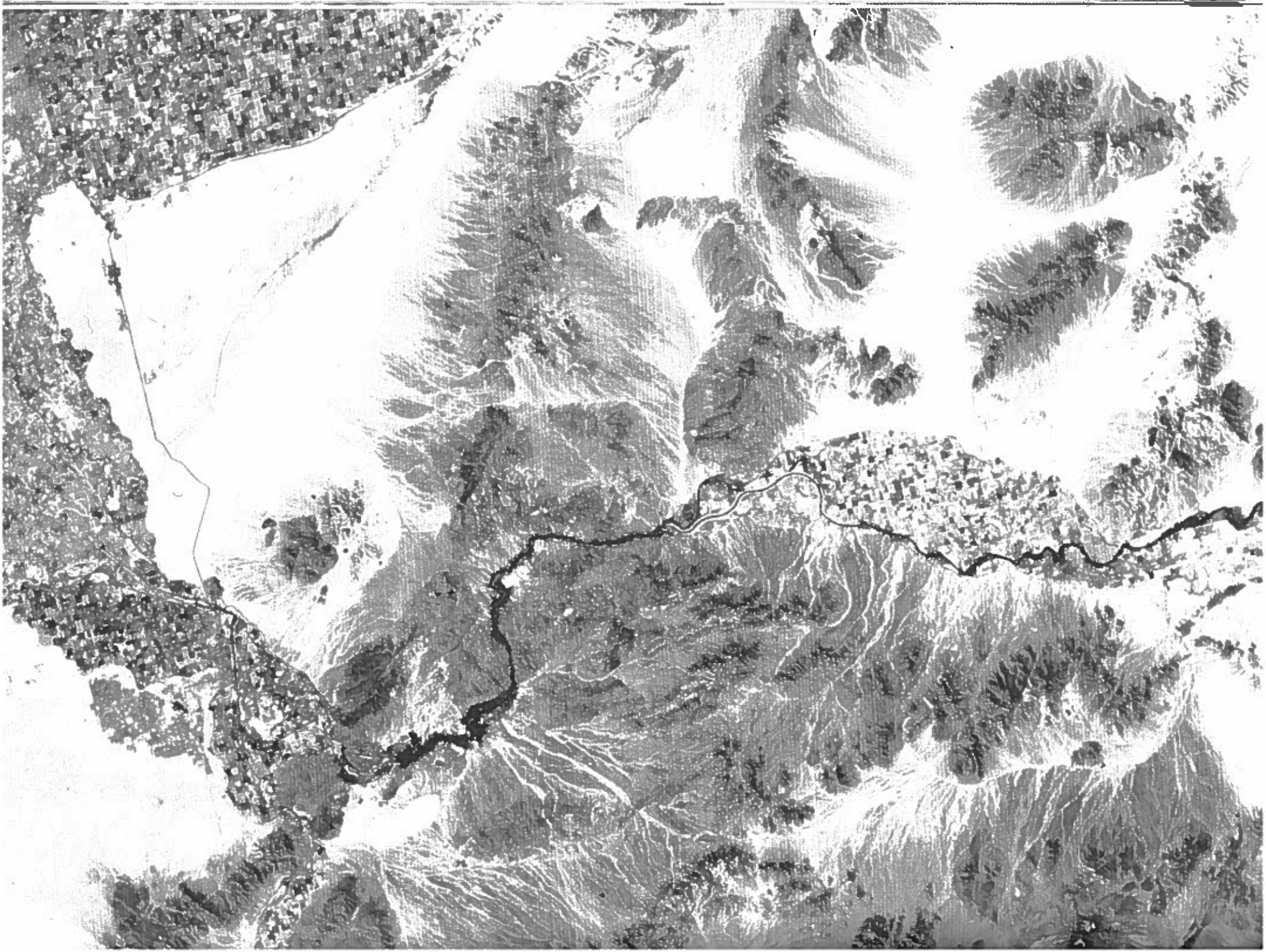
Alabama Space Grant Consortium Fellowship Awardee Introductions

The Alabama Space Grant Consortium Fellowship Awardees.

Alabama Consortium Director Dr. John Gregory introduced the Alabama Space Grant Consortium Fellowship awardees during the lunch break on Wednesday, March 13, 1991. The awardees present were undergraduates Debra A. DiPiano, Trent H. Griffin, Karen E. Harwell, and Narvaez L. Stinson, and graduates Nathan A. Barclay, John B. Bishop, Alan K. Minga, Michael W. Price, Michael Turner, Deon T. Williams, and Steven E. Zutaut. Awardees not present were undergraduates Rebecca P. Conway, Leslie A. Cothran, Kristina Kirby, Latunia G. Pack, Sandra G. Parker, Laura T. Richardson, and Preston Scarber, and graduates Michael A. Richards and George J. Williams.

Appendices





Appendix A. Conference Agenda

Monday, March 11
Space Grant Phase II Participants

1:00 - 1:30 p.m.
Registration, Phase II participants

University Center
University of Alabama in Huntsville

1:30 - 1:40 p.m.
Welcome by Conference Chair

Dr. E. Julius Dasch
Program Manager
National Space Grant College and Fellowship Program
University Programs Branch
NASA Educational Affairs Division

1:40 - 2:00 p.m.
Welcome to Phase II Awardees

Dr. Robert W. Brown
Director
NASA Educational Affairs Division

2:00 - 2:30 p.m.
Space Grant Objectives: Results from Phase I; Expectations for Phase II

Dr. E. Julius Dasch

2:30 - 3:15 p.m.
Phase II Programs and NASA Field Centers; Regional and Topical Affiliations

Dr. Stanley Goldstein
University Affairs Officer
NASA Johnson Space Center

3:15 - 4:45 p.m.
Workshops for Program and Capability Enhancement Grant Programs

4:45 - 5:30 p.m.
Organization and Management

Dr. Sallie V. Sheppard
Associate Director
Texas Space Grant Consortium

7:00 - 9:00 p.m.
Welcoming Reception: Refreshments and Cash Bar, Registration for Phase I Participants

Main Lobby, Marriott Hotel

Tuesday, March 12
Main Conference

7:30 - 8:30 a.m.
Conference Registration (continued) and Continental Breakfast

Lobby, Administrative Science Building
University of Alabama in Huntsville

8:30 - 9:00 a.m.
Welcome to Conference

Dr. E. Julius Dasch

Dr. Wayne Littles
Deputy Director
NASA Marshall Space Flight Center

Dr. John Yost
Provost and Vice President for Academic Affairs
University of Alabama in Huntsville

9:00 - 9:50 a.m.
Educational Affairs and the Space Grant Program

Dr. Robert W. Brown

Mr. Frank C. Owens
Deputy Director
NASA Educational Affairs Division

9:50 - 10:10 a.m.
Decoding NASA

Ms. Elaine T. Schwartz
Chief, University Programs Branch
NASA Educational Affairs Division

10:10 - 10:30 a.m.
Break

10:30 - 12:30 p.m.
Phase I Updates: Innovative Activities in Designated Space Grant Programs (seven 10-minute talks by Phase I Program Directors)

12:30 - 2:00 p.m.
Lunch; Exhibits from Industry and NASA Field Centers.

(Breakout lunch meeting for Phase I Directors' Council; Room 126A)

University Center
University of Alabama in Huntsville

2:00 - 2:30 p.m.
International Space Year

Mr. Frank C. Owens

Administrative Science Building

2:30 - 3:00 p.m.
A Proposal for an International Space Year Partnership with the Challenger Center

Mr. Richard A. Methia
Vice-President of Educational Programs
The Challenger Center

3:00 - 4:00 p.m.
Second Golden Age of Exploration

Dr. Charles R. Chappell
Chief Scientist
NASA Office of Space Science and Applications

4:00- 4:15 p.m.
Break

4:15 - 5:15 p.m.
Teacher Education at the Research University

Dr. Richard Greenberg
Arizona Space Grant Consortium
University of Arizona

5:15 - 5:45 p.m.
Electronic Integration: Can Computer Networking Help the Space Grant Program?

Dr. Stephen Horan
New Mexico Space Grant Consortium
New Mexico State University

Dr. Michael J. Wiskerchen
California Space Grant Consortium
University of California at San Diego

7:00 p.m.
Dinner Buffet; Red Star in Orbit Exhibition and Screening of "The Blue Planet"

U.S. Space and Rocket Center (Museum Area), Huntsville, Alabama

Wednesday, March 13

8:00 - 8:30 a.m.
Continental Breakfast

Lobby, Administrative Science Building

8:30 - 9:30 a.m.
The NASA Space Exploration Initiative

Dr. Wendell W. Mendell
Chief Scientist, Lunar Base
Studies, Solar System Exploration Division
NASA Johnson Space Center

9:30 - 9:45 a.m.
Break

9:45 - 11:00 a.m.
Phase I Updates: Innovative Activities in Phase I Space Grant Programs (four 10-minute talks by Program Directors)

11:00 - 11:45 a.m.
The National Science Foundation EPSCoR Program

Dr. Joseph G. Danek
Director, Office of Experimental Programs
National Science Foundation

11:45 - 1:00 p.m.
Lunch and Exhibits

Introduction of Alabama Space Grant Fellowship Awardees

(Breakout lunch meeting: Western Regional Space Grant Consortium; Room 126A)

University Center

1:00 - 2:00 p.m.
Experience and Results from Centers for the Commercial Development of Space

Dr. Charles A. Lundquist
Associate Vice-President for Research,
Director, University of Alabama Consortium for Materials Development in Space
University of Alabama in Huntsville

2:00 - 3:00 p.m.
Phase I Updates: Innovative Activities in Phase I Space Grant Programs (three 10-minute talks by Program Directors)

Administrative Science Building

3:00 - 3:15 p.m.
Break

3:15 - 4:15 p.m.
Problems and Solutions in the Recruitment and Retention of Blacks in Science and Engineering

Dr. Jeanette Jones
Associate Director, Alabama Space Grant Consortium
Assistant Vice President for Research
Alabama A&M University

4:30 p.m.
Buses leave for Alabama A&M University via Twickenham Historic District

5:00 - 6:30 p.m.
Laboratory Tours at Alabama A&M University

7:00 - 8:00 p.m.
Reception

State Black Archives Research Center and Museum
Alabama A&M University

8:00 - 9:00 p.m.
Earth Observing System: An Interdisciplinary Initiative

(Lecture open to Public)

Dr. Shelby O. Tilford
Director
NASA Earth Science and Applications Division

Auditorium
Alabama A&M University

Thursday, March 14

8:30 - 9:00 a.m.
Continental Breakfast

Lobby, Administrative Science Building
University of Alabama in Huntsville

9:00 - 10:30 a.m.
Aerospace Curriculum Development

Overview:

Dr. E. Julius Dasch

Technical and Graduate Curriculum:

Dr. David R. Criswell
Texas Space Grant Consortium
University of Houston

Survey Courses and Undergraduate Curriculum:

Dr. David C. Webb
Florida Space Grant Consortium
University of Central Florida

10:30 - 10:45 a.m.
Break

10:45 - 11:45 a.m.
Space Research and Technology Overview

Mr. Gordon I. Johnston
Program Manager, Global Change Technology,
Program Manager, Space Technology University Programs
Directorate for Space Technology
NASA Office of Aeronautics, Exploration and Technology

11:45 - 1:15 p.m.
Lunch and Exhibits

(Breakout lunch meeting: Phase I and II Space Grant Program Directors' meeting; Room 126A)

University Center

1:15 - 3:15 p.m.
Phase I Updates: Innovative Activities in Phase I space Grant Programs (seven 10-minute talks by Program Directors).

Administrative Science Building

3:30 - 5:15 p.m.
Tour: NASA Marshall Space Flight Center

Dr. Frank Six
University Affairs Officer
NASA Marshall Space Flight Center

5:30 - 7:30 p.m.
Tour: Space Camp and Simulator Participation

The U.S. Space and Rocket Center (Rubber-soled shoes advised)

7:30 p.m.
Dinner on your own

Friday, March 15
Space Grant Phase II Participants

8:00 - 8:30 a.m.
Continental Breakfast University Center

8:30 - 11:30 a.m.
Presentations by Phase II Space Grant Program Directors on the Following Topics:

Research Infrastructure and Faculty Development
Dr. Charles A. Wood
North Dakota Space Grant Consortium

State and Local Government
Dr. John P. Wefel
Louisiana Space Grant Consortium

Underrepresented Groups
Dr. Gary Maki
Idaho Space Grant Consortium

Evaluation of Programs
Dr. J.N. Perkins
North Carolina Space Grant Consortium

University - Industry Interactions
Dr. Michael R. Dingerson
Mississippi Space Grant Consortium

Fellowships
Dr. Paul W. Weiblen
Minnesota Space Grant Consortium

Electronic Networks
Dr. Richard F. Devon (Moderator)
Associate Program Manager
National Space Grant College and Fellowship Program
University Programs Branch
NASA Educational Affairs Division

11:30 a.m.
Adjournment

Appendix B. Selected Short Biographies

Dr. Robert W. Brown

As Director of NASA's Educational Affairs Division, Dr. Brown is responsible for a wide range of elementary through postgraduate school aerospace education programs, designed to help increase the Nation's talent pool of scientists, engineers, and technicians. During his extensive Federal career, Dr. Brown has held technical, managerial, and executive positions in six agencies. His leadership performance has led to many awards. Among his eclectic publications are journal articles on aerospace education, supervisory and executive development, executive stress, and performance appraisal and public policy. [Dr. Brown has since taken the position of Associate Administrator, Office of Human Resources and Education.]

Dr. Charles R. Chappell

Dr. Chappell is responsible for the development of the JOVE (Joint Venture) Program, an initiative between NASA's science and education divisions. He currently is on a leave of absence from the NASA Marshall Space Flight Center, working at NASA Headquarters, where he temporarily is filling the position of Assistant Associate Administrator (Science and Applications) for the Office of Space Science and Applications.

Dr. Joseph G. Danek

Dr. Danek is the Division Director (SES Level), Division of Research Initiation and Improvement, National Science Foundation. Dr. Danek has established and implemented six new NSF programs in the past four years designed to enhance research competitiveness of academic institutions and investigators, as well as women and minority investigators. He also has been active in the academic areas of coordination/liaison and representation, human resource management, and consulting and faculty development. A noteworthy program developed by Dr. Danek, among others, is NSF EPSCoR (Experimental Program to Stimulate Competitive Research), an initiative designed to increase NSF grant success in States not currently heavily involved in science. NASA has modeled its Phase II Capability Enhancement Grants Program after EPSCoR. Other Federal agencies are developing similar programs.

Dr. Stanley H. Goldstein

Dr. Goldstein has worked for the Johnson Space Center since 1961, and is currently the Director of University Programs. He received his M.S. degree in Labor and Industrial Relations from the University of Illinois, and Ph.D. in Public Administration from the University of Colorado.

Dr. Goldstein has worked for NASA Johnson Space Center since 1961 and has held a number of positions, including that of Training Director, from 1967-1985. He served on a temporary assignment at NASA Headquarters before returning to JSC in his present position. Dr. Goldstein has been very active in the development of the Western Regional Space Grant Consortium.

Dr. Richard Greenberg

Dr. Greenberg is Professor of Planetary Sciences and Professor of Education at the University of Arizona in Tucson. All of his degrees are from the Massachusetts Institute of Technology.

Dr. Greenberg has been a Principal Investigator in the NASA Solar System Exploration Division for the past 15 years. His specialties include: celestial mechanics involving nontraditional processes such as tidal evolution; dynamics of planetary ring formation; asteroid belt dynamics; and the orbits of natural satellites. Dr. Greenberg has recently become known for his careful work with the methods and problems associated with the education of pre-college sci-

ence teachers. He currently is working on two large-scale NSF grants related to this topic, including the use of planetary digital data for image enhancement as a teaching instrument.

Mr. Gordon Innes Johnston

Mr. Johnston is Manager, Global Change Technology Program, and Manager, Space Technology University Programs, NASA OAET Space Technology Directorate. He received his B.S. and M.S. degrees in Mathematics from California State University, Northridge.

Mr. Johnston worked at a variety of jobs in Space technology at the NASA Jet Propulsion Laboratory and at Kett Engineering before joining NASA Headquarters. He has published significantly on Space technology in journals such as those of AIAA, IAF, and Nature.

Dr. Jeanette Jones

Dr. Jones is a Professor of Biology at Alabama A&M University. She received her B.S. degree in Biology/Education from Fort Valley State College, and M.S. and Ph.D. in Botany-Microbiology and Medical Mycology from The Ohio State University.

Prior to her administrative post, Dr. Jones was successful in obtaining Federal and other grants which resulted in significant and numerous publications on fungi. She has served as graduate advisor for more than a dozen students at Alabama A&M University. She has augmented her training with appointments at several prestigious locations, including the National Center for Disease Control, the NASA/Kennedy Space Center Life Science Training Program, and the Massachusetts Institute of Technology (Biotechnology Program).

Dr. Charles A. Lundquist

Dr. Lundquist is the Associate Vice President for Research at the University of Alabama in Huntsville. He received his B.S. degree in Engineering Physics from South Dakota State University, and his Ph.D. in Physics, Mathematics minor from the University of Kansas.

Prior to administrative positions at the University of Alabama in Huntsville, Dr. Lundquist worked at NASA Marshall Space Flight Center, the Astrophysical Observatory of the Smithsonian Institution, and at Harvard College Observatory, among other posts.

Dr. Wendell W. Mendell

Dr. Mendell is the Chief Scientist, Lunar Base Studies at the Johnson Space Center. He received his B.S. degree in Physics at the California Institute of Technology, M.S. in Physics from the University of California at Los Angeles, and M.S. in Space Science and Ph.D in Space Physics and Astronomy from Rice University.

In his current assignment, Dr. Mendell serves as coordinator for the NASA/JSC efforts toward future lunar missions leading to a manned lunar base. He participates in the development of long-range strategies for initiating and sustaining manned and unmanned planetary exploration, taking into account scientific, technological, programmatic, fiscal, and political factors.

Mr. Richard A. Methia

Mr. Methia is Vice President of Educational Programs for the Challenger Center, with primary responsibility for Challenger Center's education network.

Before joining Challenger Center, Mr. Methia was stationed at NASA Headquarters, where he served as liaison to aerospace education organizations and conducted a national speaking tour as part of the Teacher-in-Space Program. In 1985 he was chosen as one of the ten finalists for Teacher-in-Space. Aside from aerospace activities, Mr. Methia has published stories in national magazines and has published poetry, short stories, and award-winning plays.

Mr. Franklin C. Owens

Mr. Owens is the Deputy Director of the Educational Affairs Division at NASA Headquarters. He received his B.S and M.S. degrees from Virginia Polytechnic and State University.

In conjunction with the Director of Educational Affairs, Mr. Owens, a member of the Senior Executive Service, is responsible for developing goals, objectives, policies, formulation, and procedures governing relationships with institutions of learning from elementary through university and adult educational levels. Prior to his NASA Headquarter posts, Mr. Owens worked at NASA Langley Research Center as an Employee Development Specialist. He began his career as a teacher. [Mr. Owens has since taken the position of Director, Education Division.]

Dr. Sallie V. Sheppard

Dr. Sheppard is the Associate Provost for Undergraduate Programs and Academic Services at Texas A&M University, and serves as the Associate Director of the Texas Space Grant Consortium. She received her Ph.D. in Computer Science from the University of Pittsburgh.

Dr. Sheppard is responsible for leadership in the development of policies and procedures in the area of undergraduate studies. She also is a Professor of Computer Science and served as the Director of Software Research. A specialist in computer simulation and software engineering, Dr. Sheppard worked previously for Lockheed Electronics Company at the NASA Johnson Space Center during the Apollo mission.

Dr. Frank Six

Dr. Six is the Assistant Associate Director for Science, and University Affairs Officer at the Marshall Space Flight Center. He also serves as Deputy Project Scientist for Hubble Space Telescope. He received his B.S. degree in Physics from the University of Florida, M.S. in Applied Physics from the University of California at Los Angeles, and Ph.D. in Physics (Radio Astronomy) from the University of Florida.

Prior to his present Marshall Space Flight Center experience, Dr. Six worked at a variety of jobs, including Special Assistant to the Director, Space Science Laboratory, the Universities Space Research Association, Arecibo Observatory National Astronomy and Ionosphere Center, and the NASA Jet Propulsion Laboratory. Dr. Six also has taught physics and astronomy at Western Kentucky University and at the University of Florida.

Dr. Shelby G. Tilford

Dr. Tilford is the Director of Earth Science and Applications Division for NASA. He received his B.S. degree in Chemistry Physics at Western Kentucky University, and Ph.D. in Physical Chemistry from Vanderbilt University.

Dr. Tilford joined NASA as a Space Scientist in the Solar Physics Program. He later transferred to the Upper Atmospheric Research Program. With the NASA reorganization of several years ago, by which the Office of Space Science and the Office of Space and Terrestrial Applications were combined, Dr. Tilford became responsible for NASA's programs in Solar-Terrestrial Theoretical Studies, Ionospheric and Space Processes, Atmospheric and Climate Processes, and Ocean Processes. Dr. Tilford provides direction, planning development, and implementation of programs in these areas, and coordinates with other agencies, Field Centers, the private and commercial sectors, and the university community.

Space Grant Personnel

Dr. E. Julius Dasch

Dr. Dasch is the Program Manager of the National Space Grant College and Fellowship Program. Dr. Dasch received his degrees, all in geology, from Sul Ross State University, The University of Texas in Austin, and Yale University.

After a Fulbright Fellowship at the Australian National University, Dr. Dasch taught geology at Oregon State University. At OSU he became known for his popular course for nontechnical students called "Rocks and Stars" which annually attracted ten percent of the university population. His research interests are in isotope geochemistry; his current work deals with the ages and genesis of volcanic rocks from the Moon.

Ms. Lynne Keffer

Ms. Keffer is an Associate Program Manager for the Space Grant College & Fellowship Program. She received her B.S. degree in Journalism from the University of Maryland.

Dr. Richard F. Devon

Dr. Devon is an Associate Program Manager for the Space Grant College & Fellowship Program. He is on a one-year Space Grant Traineeship from the Pennsylvania State University, where he is an Associate Professor of Engineering Graphics, and a member of the Science, Technology, and Society Program. He received his B.S. degree in Civil Engineering from Southampton University, England, and M.S in Structural Engineering and Ph.D. in Education from the University of California at Berkeley.

In recent years, Dr. Devon has been active in running pre-engineering and pre-science summer programs for NSF and NASA. He is very active in the American Society for Engineering Education and has written on engineering education and the social context of technology. At Penn State, he directs the microcomputer lab for first-year engineering students.

Mr. Jeffrey T. Heimsoth

Mr. Heimsoth is an Assistant Program Manager for the Space Grant College & Fellowship Program. He received his B.S. degrees in Finance and Management from Drake University.

Appendix C. Conference Attendees

Name	Institution, Agency, or Firm	Space Grant Affiliation or Department
Achtor, Mr. Thomas	Univ. of Wisconsin-Madison	Wisconsin Consortium
Anderson, Ms. Chris S.	Michigan Tech. Univ.	Michigan Consortium
Anikis, Ms. Anne	Johns Hopkins Univ.	Johns Hopkins Consortium
Andrews, Dr. Rose	Univ. of Alabama at Birmingham	Alabama Consortium
Annexstad, Dr. John O.	Bemidji State Univ.	Minnesota Consortium
Armstrong, Dr. Terry	Univ. of Idaho	Idaho Consortium
Ashkenas, Dr. Harry I.	Jet Propulsion Laboratory	University Affairs Office
Bacon, Ms. Pamela	NASA Headquarters	Educational Programs
Bagayoko, Dr. Diola	Southern Univ. and A&M College	Louisiana Consortium (LaSPACE)
Baker, Dr. Doran J.	Utah State Univ.	Rocky Mountain Consortium
Bartlett, Dr. David S.	SERB/Univ. of New Hampshire	New Hampshire Consortium
Bass, Dr. Michael	Univ. of Central Florida	Florida Consortium
Belz, Dr. Ron	Sverdrup Technology Inc.	Alabama Consortium
Birnie, Dr. Richard	Dartmouth College	New Hampshire Consortium
Blair, Mr. Ernie	SCI Systems, Inc.	Alabama Consortium
Brown, Dr. Robert W.	NASA Headquarters	Educational Affairs
Busby, Dr. Michael R.	Tennessee State University	Tennessee Valley Consortium
Carr, Dr. James R.	Univ. of Nevada, Reno	Nevada Consortium
Chen, Dr. Ching-Jen	Univ. of Iowa	Iowa Consortium

Name	Institution, Agency, or Firm	Space Grant Affiliation or Department
Claspy, Dr. Paul	Ohio Aerospace Institute	Ohio Aerospace Consortium
Clark, Mr. Louis P.	NASA Headquarters	Office of Safty & Mission Quality
Classen, Dr. Ronald J.	Northeast Louisiana Univ.	Louisiana Consortium (LaSPACE)
Cohon, Dr. Jared	The Johns Hopkins Univ.	Johns Hopkins Consortium
Colgan, Dr. Mitchell W.	College of Charleston	South Carolina Consortium
Connolly, Dr. John	Univ. of Kentucky	Kentucky Planning Grant
Crabb, Mr. Thomas M.	Ohio Aerospace Institute	Ohio Aerospace Consortium
Criswell, Dr. David R.	Univ. of Houston	Texas Consortium
Cudaback, Dr. David	Univ. of California-Berkeley	California Consortium
Dalton, Mr. Robert L.	Center for Technology Transfer	Maine Consortium
Daniel, Ms. Molly	Univ. of Mississippi	Mississippi Consortium
Darby, Dr. Alvin J.	Univ. of the District of Columbia	District of Columbia Consortium
Dasch, Dr. E. Julius	NASA Headquarters	Space Grant College & Fellowship Program
Devon, Dr. Richard	NASA Headquarters	Space Grant College & Fellowship Program
Dingerson, Dr. Michael R.	Univ. of Mississippi	Mississippi Consortium
Downing, Mr. David R.	Univ. of Kansas	Kansas Consortium
Duca, Dr. Victoria	Univ. of Oklahoma	Oklahoma Consortium
Duncan, Dr. Lewi	Clemson Univ.	South Carolina Consortium

Name	Institution, Agency, or Firm	Space Grant Affiliation or Department
Dunn, Mr. Michael	SCI Systems, Inc.	Alabama Consortium
Durham, Dr. Norman	Oklahoma State Univ.	Oklahoma Consortium
Durig, Dr. James R.	Univ. of South Carolina	South Carolina Consortium
Eisenberg, Dr. Martin A.	Univ. of Florida	Florida Consortium
Eisley, Dr. Joe G.	Univ. of Michigan	Michigan Consortium
El-Genk, Dr. Mohamed S.	Univ. of New Mexico	New Mexico Consortium
Ellis, Ms. Sonia K.	Clarkson Univ.	Cornell Consortium
Foster, Ms. Dandy	Wayne State Univ.	Michigan Consortium
Fowler, Dr. Wallace T.	Univ. of Texas at Austin	Texas Consortium
Freeman, Dr. L. Michael	University of Alabama	Alabama Consortium
Gierasch, Dr. Peter J.	Cornell University	Cornell Consortium
Goldstein, Dr. Stanley	NASA/Johnson Space Center	University Programs
Grandt, Dr. Alten F., Jr.	Purdue Univ.	Indiana Consortium
Green, Dr. Richard	Univ. of Southern Colorado	Colorado Consortium
Gregory, Dr. John C.	Univ. of Alabama in Huntsville	Alabama Consortium
Guyton, Mr. Sidney L.	Jet Propulsion Laboratory	Minority Initiatives Office
Haberman, Mr. David	Astronautics Corp. of America	Wisconsin Consortium
Halpern, Dr. Joshua B.	Howard Univ.	District of Columbia Consortium
Hammargren, Dr. Lonnie	Univ. of Nevada System	Nevada Consortium
Hansen, Ms. Elaine R.	Univ. of Colorado at Boulder	Colorado Consortium

Name	Institution, Agency, or Firm	Space Grant Affiliation or Department
Harris, Dr. J. Milton	Univ. of Alabama in Huntsville	Alabama Consortium
Hatch, Mr. Aaron J.	NASA/Ames Research Center	Equal Oppoptunity Programs Office
Hastings, Dr. Daniel	Massachusetts Inst. of Tech.	Massachusetts Inst. of Tech. Consortium
Hawkins, Dr. Joseph W.	Univ. of Alaska-Fairbanks	Alaska Consortium
Heimsoth, Mr. Jeffrey	NASA Headquarters	Space Grant College & Fellowship Program
Heuermann, Mr. Richard	Washington Univ.	Missouri Consortium
Hiscock, Dr. William A.	Montana State Univ.	Montana Consortium
Hix, Ms. Carol S.	Jet Propulsion Laboratory	University Affairs Office
Holladay, Dr. Kenneth W.	Univ. of New Orleans	Louisiana Consortium (LaSPACE)
Horan, Dr. Stephen	New Mexico State Univ.	New Mexico Consortium
Hoving, Dr. Ken	Oklahoma State Regents	Oklahoma Consortium
Howard, Dr. Ed	NASA Headquarters	Office of Exploration
Hynes, Ms. Pat	New Mexico State Univ.	New Mexico Consortium
Intemann, Dr. Gerald A.	Univ. of Northern Iowa	Iowa Consortium
Jeter, Ms. Wanda	Georgia Instituite of Technology	Georgia Tech. Consortium
Johnson, Dr. Paul E.	Univ. of Wyoming	Wyoming Planning Grant
Jones, Dr. Jeanette	Alabama A&M Univ.	Alabama Consortium
Jurewicz, Dr. John T.	West Virginia Univ.	West Virginia Consortium
Karr, Dr. Gerald	Univ. of Alabama in Huntsville	Alabama Consortium

Name	Institution, Agency, or Firm	Space Grant Affiliation or Department
Kea, Ms. Charlotte G.	NASA Headquarters	Office of Exploration
Keffer, Ms. Lynne	NASA Headquarters	Space Grant C&FP
Keller, Dr. Tony	Vanderbilt Univ.	Tennessee Valley Consortium
Kerrebrock, Dr. Jack L.	Massachusetts Institute of Technology	Massachusetts Inst. of Tech. Consortium
Klein, Dr. Andrew C.	Oregon State Univ.	Oregon Consortium
Knappenberger, Dr. H. Allan	Wayne State Univ.	Michigan Consortium
Krishen, Dr. Kumar	NASA/Johnson Space Center	New Initiatives Office
Kullgren, Dr. Thomas E.	Saginaw Valley State Univ.	Michigan Consortium
Lazar, Mr. James	Argonne National Laboratory	Aerospace Illinois Consortium
Levy, Dr. Eugene H.	Univ. of Arizona	Arizona Consortium
Loretan, Dr. Phil	Tuskegee University	Georgia Tech. Consortium
Lucas, Dr. William R.	Univ. of Alabama in Huntsville	Alabama Consortium
Lupia, Mr. Joseph A.	Wheeling Jesuit College	West Virginia Consortium
Malla, Dr. Ramesh B.	Univ. of Connecticut	Connecticut Consortium
MacGillivray, Ms. Dorian	Wyle Labs	Alabama Consortium
Magee, Dr. Michael	Univ. of Wyoming	Wyoming Planning Grant
Maki, Dr. Gary K.	Univ. of Idaho	Idaho Consortium
Marrs, Dr. Ronald W.	Univ. of Wyoming	Wyoming Planning Grant
Martel, Dr. Joe H.	NASA Headquarters	Educational Affairs Division

Name	Institution, Agency, or Firm	Space Grant Affiliation or Department
Martin, Mr. Bill J.	NASA/Kennedy Space Center	University Liaison
McCarthy, Ms. Liliane	Virginia Space Grant Consortium	Virginia Consortium
McClure, Mr. William H.	Univ. of Florida	Florida Consortium
Miller, Mr. James R.	SD School of Mines & Technology	South Dakota Consortium
Miller, Mr. Sam	NASA/Ames Research Center	Student Programs
Montegani, Dr. Frank J.	NASA/Lewis Research Center	University Affairs
Moore, Dr. Gary T.	Univ. of Wisconsin-Milwaukee	Wisconsin Consortium
Moore, Mr. R. Gilbert	Utah State Univ.	Rocky Mountain Consortium
Morgan, Dr. Steven H.	Fisk Univ.	Tennessee Valley Consortium
Morrow, Dr. Cherilynn A.	Univ. of Colorado at Boulder	Colorado Consortium
Mouginis-Mark, Dr. Peter	Univ. of Hawaii	Hawaii Consortium
Mullan, Dr. Dermott	Univ. of Delaware	Delaware Consortium
Nelson, Dr. George (Pinky)	Univ. of Washington	Washington Consortium
Nichols, Dr. Steven P.	Univ. of Texas at Austin	Texas Consortium
Northrop, Dr. Gaylord M.	Univ. of Arkansas at Little Rock	Arkansas Consortium
Owens, Mr. Frank C.	NASA Headquarters	Educational Affairs
Oxner, Mr. Steven	Rockwell International Corporation	University Research Programs

Name	Institution, Agency, or Firm	Space Grant Affiliation or Department
Pappas, Dr. James P.	Univ. of Oklahoma	Oklahoma Consortium
Parks, Dr. George K.	Univ. of Washington	Washington Consortium
Payne, Dr. Linda L.	South Carolina State College	South Carolina Consortium
Peake, Dr. Jeffrey	Univ. of Nebraska at Omaha	Nebraska Planning Grant
Perkins, Dr. John N.	North Carolina State Univ.	North Carolina Consortium
Peters, Dr. David A.	Georgia Institute of Technology	Georgia Tech Consortium
Peterson, Dr. George D.	Morgan State Univ.	Johns Hopkins Consortium
Peterson, Ms. Lorrie	Western Nevada Comm. College	Nevada Consortium
Pfitzer, Ms. Bonnie	Sverdrup Technology Inc.	Alabama Consortium
Pierce, Ms. Anne L.	Univ. of Hartford	Connecticut Consortium
Pisacane, Dr. Vincent L.	Johns Hopkins Univ.	Johns Hopkins Consortium
Postawko, Dr. Susan	Univ. of Hawaii	Hawaii Consortium
Redd, Dr. Frank J.	Utah State Univ.	Rocky Mountain Consortium
Reddy, Dr. K. C.	Univ. of Tennessee Space Institute	Tennessee Valley Consortium
Richman, Dr. David	Stevens Institute of Technology	New Jersey Consortium
Rochon, Mr. Gilbert L.	NASA/Stennis Space Center	Equal Opportunity Office
Roth, Mr. Volker	McDonnell Douglass Space Systems Co.	Alabama Consortium

Name	Institution, Agency, or Firm	Space Grant Affiliation or Department
Sadeh, Dr. WIlly S.	Colorado State Univ.	Colorado Consortium
Sanders, Dr. Wallace W., Jr.	Iowa State Univ.	Iowa Consortium
Sandy, Ms. Mary L.	Peninsula Graduate Engineering Center	Virginia Consortium
Schultz, Dr. Peter H.	Brown Univ.	Rhode Island Consortium
Schwartz, Ms. Elaine T.	NASA Headquarters	University Programs
Seymour, Dr. Henry A.	Martin Marietta Manned Space Systems	Alabama Consortium
Sharp, Dr. Lonnie	North Carolina A&T State Univ.	North Carolina Consortium
Shea, Dr. William F.	Univ. of Nebraska at Omaha	Nebraska Planning Grant
Sheppard, Dr. Sallie V.	Texas A&M Univ.	Texas Consortium
Six, Dr. Frank	NASA/Marshall Space Flight Center	University Affairs Office
Smith, Dr. Earnestine P.	Georgia State Univ.	Georgia Tech Consortium
Smoot, Dr. Rick	Marshall Univ.	West Virginia Consortium
Soffen, Dr. Gerald	NASA/Goddard Space Flight Center	University Program Office
Solomon, Dr. Wayne C.	Univ. of Illinois	Aerospace Illinois Consortium
Stein, Dr. Sylvia	Penn. State Univ.	Penn. State Consortium
Strauss, Mr. Alvin M.	Vanderbilt Univ.	Tennessee Valley Consortium
Swiden, Mr. LaDell	South Dakota State Univ.	South Dakota Consortium
Taranik, Dr. James V.	Desert Research Institute	Nevada Consortium

Name	Institution, Agency, or Firm	Space Grant Affiliation or Department
Targen, Dr. David	Brown Univ.	Rhode Island Consortium
Teasdale, Dr. Jean A.	Univ. of Idaho	Idaho Consortium
Torbert, Dr. Roy B.	Univ. of New Hampshire	New Hampshire Consortium
Tucker, Mr. Ken	Boeing Aerospace & Electronics	Alabama Consortium
Vedda, Dr. James A.	Univ. of North Dakota	North Dakota Consortium
Ventre, Dr. Gerald G.	Univ. of Central Florida	Florida Consortium
Waltz, Dr. Frederick A.	TGS Technology, Inc.	South Dakota Consortium
Webb, Dr. Randall J.	Northwestern State Univ. of Louisiana	Louisiana Consortium (LaSPACE)
Wefel, Dr. John P.	Louisiana State Univ.	Louisiana Consortium (LaSPACE)
Wehinger, Dr. Peter A.	Arizona State Univ.	Arizona Consortium
Weiblen, Dr. Paul W.	Univ. of Minnesota	Minnesota Consortium
Weistrop, Dr. Donna	Univ. of Nevada, Las Vegas	Nevada Consortium
Westenskow, Dr. Dwayne	Univ. of Utah	Rocky Mountain Consortium
Wiggins, Dr. Kenneth E.	Oklahoma State Univ.	Oklahoma Consortium
Willenberg, Mr. Harvey	Boeing Aerospace & Electronics	Alabama Consortium
Wilson, Dr. Edmond W., Jr.	Harding Univ.	Arkansas Consortium
Wiskerchen, Dr. Michael	Univ. of California-San Diego	California Consortium
Wlezien, Dr. Richard	Illinois Institute of Technology	Aerospace Illinois Consortium

Name	Institution, Agency, or Firm	Space Grant Affiliation or Department
Wood, Dr. Charles A.	Univ. of North Dakota	North Dakota Consortium
Yang, Dr. Robert L.	NASA/Langley Research Center	University Affairs Office
Yost, Dr. Betsy	New Mexico Tech.	New Mexico Consortium
Zebid, Dr. Abdelfattah	Rutgers Univ.	New Jersey Consortium

Speaker Participants:

Dr. Charles R. Chappell,
NASA/Marshall Space Flight Center

Dr. Joseph G. Danek,
National Science Foundation

Dr. Richard Greenberg,
University of Arizona

Mr. Gordon I. Johnston,
NASA Headquarters

Dr. Jeanette Jones,
Alabama A&M University

Dr. J. Wayne Littles,
NASA/Marshall Space Flight Center

Dr. Charles A. Lundquist,
University of Alabama in Huntsville

Dr. Wendell W. Mendell,
NASA/Johnson Space Center

Mr. Richard A. Methia,
The Challenger Center

Dr. Shelby G. Tilford,
NASA Headquarters

Dr. David C. Webb,
University of Central Florida

Dr. John Yost,
University of Alabama in Huntsville

Appendix D. Evaluation of Questionaires Concerning Future Conferences

The following is a synopsis of the comments from the questionnaires completed at the Second National Space Grant Conference. Twenty-six forms were collected.

In general, the respondents were impressed with the overall content, quality, and organization of the conference. Suggestions for future conferences fell generally into a few major categories. These are organized below, in descending order according to the relative frequency of similar responses.

The most consistent comments were related to the length of the conference. The consensus is that a three-day event would be appropriate in the future. Specific suggestions for accomplishing this were to reduce the number of program directors' updates (possibly replace these with simple 'poster session' displays with accompanying printed material), and to shorten the welcoming presentations. Also mentioned was the potential for an electronic network to convey considerable information, thus eliminating the need for some portions of future conferences.

Many of the respondents felt too constrained by the rigid format of the conference, noting that the lectures were too formal, the participants had little choice in the subject matter, and that too little time was allowed for questions. Considerable interest was shown in including topical 'breakout' meetings. The sentiment is that these smaller groups would foster a more intimate and problem-solving atmosphere. These sessions would follow a workshop format, and suggested topics included:

- minority recruitment/retention
- industry support/industry affiliations
- outreach programs
- operational procedures (budget, management, etc.)
- K-12 educational programs
- curriculum development
- Space/aerospace issues
- student research
- fellowships
- research through the Space Grant Program
- NASA Field Center relationships

A number of requests were made that the attendees be given increased networking opportunities. Suggestions for improving this at future conferences were to schedule informal networking sessions, to leave more of the mealtimes free, and to provide a large 'mixing area' for interaction during breaks.

A few made the suggestion that pre-conference input be solicited from the program directors or attendees. A similar suggestion was to collect program summaries, and then evaluate them and distribute the results prior to the conference. The relative strengths and weaknesses could then be discussed during conference sessions. Some made requests that transportation costs be considered in choosing conference locations and dates. A few noted that air fares could be significantly reduced if a Saturday were incorporated. Also, a more easily accessible city, such as an airline 'hub', would reduce fares.

Those who responded to the question of having regional meetings were evenly divided. Perhaps this decision should be left to the members of their respective regions, on an optional basis.

Whether to hold meetings annually was split as well, although a substantial majority did favor this. Other suggestions ranged from 1 1/2- to 3-year intervals.

A few additional individual comments/suggestions were made. These tended to be of a technical nature, and were as follows:

- Increase accessibility to phones, computers, and faxes, and provide more chances for attendees to return to their hotels.
- Provide better and healthier food for meals and breaks.
- Improve the distribution of printed materials, and make hard copies of all presentations available.
- Eliminate visual aids 'bottle-necks'.
- Encourage more corporate participation.

As a final note, the conference attendees gained positive overall experiences, most often noting the value of making contacts and exchanging constructive information regarding their Space Grant programs. Many commented on a job well done.

Any additional comments or suggestions for future Space Grant Conferences are welcomed and encouraged by the Space Grant personnel.

Appendix E. Space Grant Program Directors and Consortia Affiliates

Alabama Space Grant Consortia

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*Alabama A&M University
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Mississippi State University
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University of Alabama
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Alabama Space and Rocket Center
Boeing Aerospace
Martin Marietta Corporation
McDonnell Douglas Corporation
SCI Systems, Inc.
Sverdrup Technology
Teledyne Brown Engineering
Wyle Laboratories

Alaska Space Grant Program

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Arizona Space Grant Consortium

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University of Arizona
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Arkansas Space Grant Consortium

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University of Arkansas Little Rock
Arkansas State University
Harding University
University of Arkansas Fayetteville
University of Arkansas for Medical Sciences
*University of Arkansas Pine Bluff
University of Central Arkansas

California Space Grant Consortium

Dr. James R. Arnold
Department of Chemistry
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University of California at San Diego
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University of California at San Diego
University of California at Berkeley
University of California at Los Angeles

Colorado Space Grant Consortium

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University of Colorado at Boulder
Adams State College
Colorado College
Colorado School of Mines
Colorado State University
Fort Lewis College
Mesa State College
Pikes Peak Community College
United States Air Force Academy
University of Colorado at Colorado Springs
University of Northern Colorado
University of Southern Colorado
Western State College
United States Space Foundation

Connnecticut Space Grant Consortium

Dr. Anne L. Pierce
Scientific and Technological Advancement
University of Hartford
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University of Hartford
Trinity College
University of Connecticut
University of New Haven

Cornell Space Grant Consortium

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Cornell University
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Cornell University
Clarkson University
City College of New York
Polytechnic University
Grumman Corporation
Hughes Aircraft Company
IBM
Ithaco
Rockwell International

Delaware Space Grant Consortium

Dr. Norman F. Ness
President
Bartol Research Institute
University of Delaware
Newark, DE 19716
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University of Delaware
Bartol Research Institute

District of Columbia Space Grant Consortium

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Graduate School of Arts and Sciences
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Howard University
George Washington University
University of the District of Columbia

Florida Space Grant Consortium

Dr. Martin A. Eisenberg
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Fax: (904) 392-7303

University of Florida
*Florida A&M University
Florida State University
University of Central Florida
University of Miami
University of South Florida

Georgia Institute of Technology Space Grant Consortium

Dr. David A. Peters
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Georgia Institue of Technology
*Clark Atlanta University
Georgia State University
*Tuskegee University

Hawaii Space Grant Consortium

Dr. Peter Mouginis-Mark
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Idaho Space Grant Program

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Aerospace Illinois Space Grant Consortium

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University of Illinois at Urbana-Champaign
Illinois Institute of Technology
Illinois Space Institute
Northwestern University
University of Chicago
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McDonnell Douglas Corporation

Indiana Space Grant Consortium

Dr. Alten F. Grandt
Professor and Head
School of Aeronautics and Astronautics
Purdue University
West Lafayette, IN 47907
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Purdue University
Indiana University
Purdue-Calumet
University of Notre Dame

Iowa Space Grant Consortium

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Texas Christian University
Texas Southern University
Texas Technological University
University of Houston, Downtown
University of Houston at Clear Lake
University of Houston at Houston
University of Texas at Arlington
University of Texas at Dallas
University of Texas at El Paso
University of Texas at San Antonio
UT Health Science Center, Houston
UT Health Science Center, San Antonio
UT Medical Branch Galveston
UT Southwestern Medical Center, Dallas
- Texas Higher Education Coordinating Board
- Texas Space Commission
- Barrios Technology, Inc.
- Davis Aerospace
- E-Systems
- Eagle Aerospace, Inc.
- Entech, Inc.
- Ford Aerospace Corporation
- General Dynamics
- Grumman Space Systems
- IBM Corporation
- ILC Space Systems
- Krug International
- LTV Missiles and Electronics
- McDonnell Douglas
- Microelectronics and Computer Technology
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- Southwest Research Institute
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**Denotes Historically Black Colleges/Universities (HBCUs)*

Appendix F. NASA Field Center / Consortia Affiliations

	Designated Colleges/ Consortia	Capability Enhancement Grants	Program Grants
ARC:	CA WA		
GSFC:	NY MA MD	CT ME	DC NH RI
JPL:	AZ CO HI	ID NV	AK DE OR
JSC:	NM TX VT	OK	KS WI
KSC:	FL GA	SC	
LaRC:	IA IL VA	WV	NC NJ
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