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Panel Session - "Manned And Unmanned Space Exploration"

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SYNOPSIS

MANNED VS UNMANNED SPACE EXPLORATION*

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THE PANEL

Moderator

The Honorable George P. Miller, Chairman of the House Committee on Science and Astronautics. Congressman Miller had been a member of the Committee on Merchant Marine and Fisheries until 1961, serving as Chairman of the Subcommittee on Oceanography. He had previously been a member of the Post Office and Civil Service Committee and the Armed Services Committee. Congressman Miller also served as an official observer at the Second United Nations Conference on the Law of the Sea, and in 1962 was appointed to represent the House of Representatives as a special Congressional advisor to the United States Ambassador to the United Nations for peaceful uses of outer space.

Panelists (in order of introduction)

Major General Joseph S. Bleymaier, Deputy Director, MOL Program, Office of the Secretary of the Air Force. General Bleymaier's previous responsibilities in the aerospace field include service as Commander, Western Air Force Test Range; Deputy Commander for Manned Space Systems, Space Systems Division; System Program Director for Titan III, and numerous prior assignments in research and development of missiles and launch vehicles. Cited by President Johnson for his work on Titan III, General Bleymaier also holds the Legion of Merit and the Air Medal with Oak Leaf Cluster.

Major Donald (Deke) Slayton, Director Flight Crew Operations, NASA. Major Slayton, who resigned his Air Force commission to assume his present position, had previously served as Coordinator of Aeronautics Activities. Prior to the discovery of a heart condition which removed him from flying status, Major Slayton was one of the original seven Mercury astronauts. A test pilot and the holder of a degree in aeronautical engineering, he had seen service in the Air Force during World War II and the Korean War. He has received honorary doctorates in science and in in engineering, and was awarded the NASA Distinguished Service Medal.

Dr. Robert V. Meghreblian, Deputy Assistant Laboratory Director for Technical Divisions, Jet Propulsion Laboratory. Dr. Meghreblian was Manager, Space Science Division from 1962 to 1968, when he assumed his present position. From 1960 to 1962 he organized and directed the Physical Science Division at JPL, which he joined as Chief, Physics Section, in 1958. He also served as Assistant Professor, Applied Mechanics at the California Institute of Technology. Dr. Meghreblian came to JPL from Oak Ridge National Laboratory, where he had been Associate Director, Gas Cooled Power Reactor Project. A fellow of the American Nuclear Society, and member of the American Astronautical Society, N. Y. Academy of Science, and AIAA, he did his graduate work under a Guggenheim Fellowship at California Institute of Technology, and received his Ph.D. magna cum laude in Aeronautics and Mathematics.

Dr. S. Fred Singer, Deputy Assistant Secretary for Scientific Programs, Department of the Interior. Dr. Singer served as the chief scientific evaluator for the House Select Committee on Astronautics and Space Exploration. He was formerly Director of the National Weather Satellite Center, and the Dean of the School of Environmental and Planetary Sciences of the University of Miami. Much of Dr. Singer's pioneering space research concerned atmospheric physics, the origin of meteorites, and the moon's surface.

AUTHOR'S INTRODUCTION

Miles Ross, General Chairman of the Sixth Space Congress, introduced Congressman Miller. The Congressman then introduced the panelists. The panel session proper began with each member of the panel making an opening statement. These were followed by a question and answer period, with written questions from the audience submitted to the panelists. Questions directed to a named panelist were so submitted; otherwise, questions were assigned to the most appropriate panelist. On each question, however, the other panelists were encouraged to contribute answers.

The summaries presented below are condensed interpretations of each speaker's opening statement, and are not a verbatim transcript.

OPENING STATEMENTS

General Bleymaier: Noted the tremendous improvements in reliability achieved in the space systems used today, but agreed that the addition of man entails a much greater emphasis on

*This panel session was sponsored and organized by the Program Committee of the Sixth Space Congress.

reliability. He emphasized that, while every vehicle launching involved meticulous attention to reliability because of the tremendous costs involved, the effort concentrated on a manned vehicle's reliability was aimed at achieving a level of safety for the astronaut comparable to that of commercial airplane travel. In return, however, man supplies a measure of redundancy that may spell the difference between success and failure. The General pointed out that both the Mercury and Gemini programs contained valid examples of mission success having resulted from the presence of men on board, and stated his belief that this experience would be repeated in the future.

General Bleymaier commented on the efforts expended in the additional testing and evaluation performed to establish man-rating, and pointed to the over-all improvements in realibility of all classes of space systems as attributable, at least in part, to these efforts. He then cited the safety and reliability achieved by Thor, Atlas, Titan and Saturn systems as proof that the risk factor of manned flight is a question that can safely be ignored. He also argued that the long life and high reliability demonstrated by a wide variety of unmanned space systems proves that the same level of reliability can be achieved for manned systems.

The General agreed that many functions can be accomplished quite satisfactorily with unmanned systems, and for such functions, manned space missions may be unnecessary. But the capabilities of man functioning in space are still relatively unknown, and we must therefore learn how to ensure that man can function efficiently in space for extended periods of time. His position was that the exploration and efficient exploitation of space required capabilities that only man in space could provide.

General Bleymaier contended that the comparison of man versus machine has been carefully analyzed, and, while in certain cases the machine is a better instrument, from a military standpoint the unique unprogrammed capability of man to react to the unexpected and unforeseeable is a major area for exploration.

The General concluded his remarks with the prediction that the presence of man aboard the complex and sophisticated space systems of the future would ensure a fuller realization of their objectives than unmanned evolution, and that a judicious and balanced man-machine mix, with the reasoning and judgment of the man on the spot as a final backup, is the ideal approach.

Dr. Meghreblian: Agreed that a balanced program of manned and unmanned space exploration was the ideal solution. He contended, however, that the present mix was overbalanced in favor of manned flight. He further claimed that a substantial portion even of the funds allocated to unmanned activity was actually in support of the manned flight program. He touched on scientific, political, military and public appeal objectives which tend to determine allocation mix.

Dr. Meghreblian noted that the increasing attention now being paid to other social and political requirements should probably result in a different distribution in the coming decade. In this light, he emphasized that the scientific objectives of interplanetary research include a broader understanding of the origin of our solar system, the search for life elsewhere in the system, and increased knowledge of our terrestrial environment. Of these, the third objective has resulted in significant progress, but the other two have had much less success.

It is Dr. Meghreblian's opinion that, with the resources presently available, the greatest return would result from an increased emphasis on unmanned systems for deep space exploration, with man's role in space for the near future limited to earth-orbital activity. This, he feels, would permit us to enlarge, improve and refine our knowledge and skills with respect to survival and prolonged operations in space, a necessary prelude to any extended operations beyond the earth.

To sum up his position, Dr. Meghreblian believes that the unmanned planetary program, now scheduled for an expenditure of approximately 140 million dollars in 1970, could effectively employ double or triple that amount. He feels that such a program should include some of the following major opportunities in the next decade: Extending our knowledge of Venus and Mars, then a series of reconnaissance missions to Mercury, and, late in the decade, to Jupiter and beyond. From this, we could logically evaluate the opportunities of the 1980's, and the best approach to fllow in exploring them.

Major Slayton: Began with the remark that he had no fundamental disagreement with either of the previous speakers. He pointed out that his knowledge of the unmanned program was not detailed or specific, since his field was the manned program. He felt, however, that the basic question was not that of a choice between manned and unmanned flights, since the programs complement each other, but rather, at what point in time should we use more of one or the other. His view was that we should initiate unmanned exploration of all the planets we could reach, as soon as we could reach them. Essentially, the reasons were the same as those applied in the lunar program; we had the capability to initiate the unmanned phase prior to the manned program, and did so. In a similar manner, we should acquire all the information

possible with unmanned payloads before sending out a manned planetary mission.

Slayton pointed out that a major factor in the development of any system is the confidence in the system versus confidence in man. None of the astronauts would fly any system before it had been proven. Even Saturn V, which was designed as a manned system from the very beginning, was not flown manned until its third flight, when it had already been pretty well tested. Eventually, however, manned operation becomes essential. The Mercury and Gemini programs proved conclusively that man can do anything that is necessary in the space environment, and zero gravity conditions are no significant problem. Those involved in space flight feel that it is simply a logical extension of the functions of manned systems in atmospheric flight.

Man's contribution to space flight, Slayton believes, is one that unmanned flight cannot equal. No manned flight to date has been mechanically perfect. Fortunately, most of these malfunctions have been the result of relatively minor anomalies, but the presence of man aboard who could solve the problem and make necessary repairs or adjustments was in a number of cases the difference between a successful and an aborted mission. He pointed out that only one mission to date, the Gemini 8 mission, has had to be terminated because of malfunction.

The point Major Slayton stressed was that man's only contribution to a space system was logic and judgment. If we could anticipate every possible eventuality beforehand, and program for it, man would be unnecessary on a flight. However, with human limitations in prediction as they are, a man in the system, on the scene, able to apply logic and judgment to any situation, will improve significantly the chances of a successful mission.

On the other hand, he agreed that the more the routine tasks and activities are automated, the more man is free to apply himself to the non-routine. An example he cited was the manual temperature control on Mercury, which required far too much time to keep in adjustment. At the opposite extreme are events of too short a duration for judgment to apply, and these, he felt, should also be automated. An example of this is the launch abort systems, whose operation, which must be initiated in split seconds, involves an automated approach.

Slayton agreed that man's requirements do impose a penalty. He requires an environment, including oxygen, water and food, and the routine problems that all of us are involved with every day are still the areas of greatest difficulty. These areas, Slayton noted, will require additional work to make the spacecraft environment more habitable.

He argued that even though man increases the payload, he has resulted in a net gain for unmanned programs as well. Present payload capacity, developed to accommodate man in the system, will benefit unmanned flights by providing boosters with a payload capability beyond anything that would otherwise have been developed to date for unmanned programs alone.

Dr. Singer: Proposed that a new national goal be established, defining the nation's objectives in space exploration in the 1970's. He agreed that a balanced overall space program is needed, but a national goal must be set, he felt, to provide a focus for the programs to be followed in the next ten to fifteen years. Such an overall program should not represent too easy an achievement, but it must be achievable within that period, to sustain interest, without stretching too far into the future.

A manned planetary flyby would be such a reasonable goal. It would be a manned mission, with the men aboard, not to land, but to make observations close to the planets and then return to earth.

Dr. Singer noted that such a program must be justified on the basis of relative cost versus other exploration or scientific effort. Can such a program be justified in comparison with ocean exploration, or research into the secrets of sub-nuclear particles? What in fact are the relative urgencies of the major problems in science? As Dr. Singer admitted, the answer to such questions depends in large part on the bias and background of the individual. However, he felt that, even from a purely objective standpoint, manned flyby could be justified.

From the cost standpoint alone, a flyby is feasible simply because many of the problems will have been solved as the current programs. The major requirements of a flyby mission are: a laboratory, a life-support system, and extra propulsion capability. Dr. Singer pointed out that all three will evolve from the present MOL and AAP programs, and will not add to the cost of a flyby. So, the cost of such a goal will be incremental. MOL and AAP need extended orbit capability because the longer you can keep a man in space, the fewer launches are required. And the longer he is in orbit, the more he needs in the way of facilities. So, both life support and laboratory facilities will result naturally from the current programs. Additional propulsion capability is also needed for earth orbit missions, since added maneuverability contributes directly to the usefulness and versatility of a manned orbital platform. It follows that the addition of a reasonable amount of propulsion capability to present earth orbit criteria brings these system requirements up to reasonable parity with flyby requirements.

With the evolution of these capabilities within the scope of present programs, it is only natural that they be employed for other programs. From this Dr. Singer reasons that problems whose solution would ordinarily make a flyby program prohibitively expensive are the very factors that make such a program reasonable as a long-range goal, since it will employ the solutions that were the outgrowth of other programs. Therefore, within the bounds of a ten-year national goal, a planetary flyby becomes extremely attractive as a natural outgrowth of the present.

Dr. Singer further argues that, for such a program, nothing can beat manned flight. Exploration involves the unexpected, which in turn requires improvisation from what is available. Unmanned probes can establish parameters, but only man on the scene can take maximum advantage of the materials available and conditions prevailing to adapt, improve or improvise experiments to get the data he wants, or change his objectives to meet the observed situation. In such long-term programs, therefore, Dr. Singer believes that man has an innate advantage, and can prove to be more economical in acquiring fundamental data. Of course, each program must be evaluated on its merits, and the cost effectiveness of a manned flyby will have to be examined carefully before a commitment is made.

Dr. Singer concludes with the admission that manned programs involve other considerations than the purely technological. Of course major advances in technology are an important aspect of any national goal. But, in addition, our space goal must include the option of manned planetary landings in the future, and it must appeal to the public, to ensure that space research and exploration continues to get popular support.

Congressman Miller: Added the warning that space program expenditures must more and more be defended in comparison with poverty programs and other public improvement goals here on earth. This is, of course, a hard problem to answer, or to argue. He pointed out that this country had made great scientific progress in the last decade, as the result of cooperation among the universities, the scientific community, our major contractors and our labor force. We are now world leaders and cannot afford to slip backwards.

He emphasized, however, that there were nevertheless many problems. Scientific education is one area of great concern, he felt. In these prosperous times, some of our great universities are in financial difficulty, and many of them have had to dip into endowment funds to maintain ongoing programs. He was deeply concerned about this, because the vitality of our educational system sets the standard for the entire world. The great problems of the future are thus also affected, since many of them must be solved by the application of scientific developments.

Congressman Miller cited waste disposal as an example. He noted that San Francisco is looking into the practicality of hauling its waste by train some 400 miles, and disposing of it in the desert. New York City is studying the possibility of filling abandoned West Virginia mines with its wastes. Waste disposal is a severe problem throughout the United States, and it is getting worse. He emphasized again that this is only one example of the problems we face, and he reiterated that the scientific and engineering community must provide the leadership to help solve these problems.

QUESTION AND ANSWER SESSION

Question: Wouldn't a manned orbiting weather station give more selective information in weather forecasting than an unmanned station?

Answer: The unmanned systems have been effective, but a manned system would provide higher fidelity and be of more value. In short, better weather information.

Question: Please comment on what the U. S. is waiting for to keep the space program going. Is it another kick from Russia?

Answer: Let your representatives in Congress know of your interest in the program. Even the strongest critics of the program are impressed by a visit to NASA facilities and by the sincerity and the work being done.

Question: What are the possibilities of NASA and the Air Force working together on the space laboratories - the MOL?

Answer: Air Force and NASA cooperate quite closely. For example, the Gemini B to be used on the MOL for return from earth orbit, the fuel cells, much of the life support equipment, are derived from the same basic research and development. However, the fact that MOL is a military program and the AAP is a NASA program results in differences of in-use application related to two completely different objectives.

Question: Is there a payoff for man to be in the onboard loop for missions such as Comsat, weather satellites, navigation satellites, earth resources satellites?

Answer: The advances in unmanned capability as epitomized by increases in scanning and transmit rates of the present Mars Mariner probe, which are orders of magnitude faster than the first Mars probe. The present equipment will transmit Mars photos essentially in real time, or minutes per picture versus a day or so for the earlier Mariner IV.

This same great advance in sophistication is evident in guidance and mode choice, etc., permits deployment with a high degree of freedom. The Orbiter mission planned within two years represents an equally great advance over the present Mariner. In effect, then, the present state-of-the-art in automation has not yet been applied to its fullest extent, and it would seem logical that automated capability for earth orbiting satellites should be exploited first.

Question: When Columbus convinced Isabella to explore America, he offered her very definite goals, but couldn't sell the government on exploration for exploration's sake. There was pride of ownership, riches, immigration and colonization, trade, etc.

Answer: Columbus did try to get government approval. The Queen appointed a commission, which turned Columbus down flat. After that he presisted and another commission turned him down, and he finally got the money through a personal contact at court.

Question: What additional information can be obtained from a manned flyby rather than an unmanned flyby?

Answer: A major scientific question is the origin of the universe. Most of our theories are based on scientific induction, reasoning from information available to us here on earth. A flyby of Mars, however, would permit close-up examination of Deimos and Phosos, the two small Martian moons, which may very well have remained almost undisturbed since their formation. Such a study may well provide fresh insight on the origin of the universe. Or, the two moons may be captured asteroids or meteors. In either case, a detailed study would be scientifically profitable.

Question: Would it be good to have a standby rescue system ready to launch in case of catastrophe?

Answer: Not at present. Countdown lead time, etc., needed would preclude arrival of rescuers in time. Later on, with large space stations, multiple missions, etc., such a system would be feasible.

Question: How much further will the manpower level in the space program drop? Present estimates indicate a drop from a peak of 400,000 to less than 200,000 currently.

Answer: No prediction possible.

Question: How deeply is the new administration committed to the space program?

Answer: The new administration seems interested in the space program, and international implications would seem to prevent any crippling cut-backs, especially in weather, communications and navigation satellites. It is difficult to give an accurate estimate, but the feeling is that the program will be maintained.

Question: Can any of you gentlemen on the public payroll show where the money expended on space in the past ten years has given any monetary returns?

Answer: No. But neither did the airlines or railroads at a comparable stage. On the other hand, many of the returns from the space program are hard to evaluate in dollars and cents. A hurricane in 1904 killed between 700 and 3500 people in the Houston area. In 1962, just after the Tiros weather satellite began operation, a hurricane struck the same area. The six days of advance notice provided, and the precautions taken resulted in a death toll of only three; a man, his wife and child, who tried to outrun the hurricane in his car, and were blown off the road. How can you assign a dollar value here?

The location and utilization of earth's resources; fisheries, forests, agriculture, etc., involve tremendous benefit to all mankind. How do you show a dollar return for sewers, fire departments, the military? If the benefits of the space program could be costed, their value would be staggering. And intangibles, like uncensorable communications all over the world; world-wide education, which is the very basis of democracy; all of these benefits can't be price-tagged, but are vitally necessary, and should and must continue.

Incidentally, weather and communications satellites are already cost-effective. Resources and navigation satellites will probably become so. A manned space laboratory will be the best way to study and evaluate instrumentation destined for unmanned space vehicles.