INTRODUCTORY REMARKS BY

ROBERT R. GILRUTH
DIRECTOR, NASA SPACE TASK GROUP

For Panel Discussion:

"Present and Future of Manned Space Flight"

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The potential of space flight for extensions of man's scientific knowledge about his celestial environment, and for achievement of many advanced missions in the fields of communications, meteorology, navigation, search, and the like, are profound. It is clear that man himself must, and will, play a basic role in the advanced exploration and uses of space.

While it is true that we are now only at the fringe of the space flight frontier, the magnitude of the job ahead is already clear. We must proceed to attack space flight problems, therefore, with the same kind of rationality, seriousness and dedication that has dominated our approach in aircraft development, where the risk of human life was also involved.

It is evident that launch vehicles strongly dominate our ability to perform space missions. The majority of our space accomplishments thus far have reflected our ability to convert ballistic weapon boosters to a new and challenging service - one for which they were often not best suited. Certainly the use of modified Redstone and Atlas launch vehicles in Project Mercury has imposed severe constraints in the manned spacecraft design and operation because of limitations on weightlifting ability and reliability. Project Apollo and other advanced manned spacecraft will require large increases in launch vehicle capabilities; and the rate of attainment of such capabilities will control the pacing of our achievements along these directions.

What is of prime importance, however, in the development of advanced boosters for future space flight programs, is a clear appreciation that man is to be a vital component of those missions. This should dictate that these launch vehicles be tailored from the start, in the most fundamental ways, to the accommodation of man and other dictates of manned missions. This will require that we face up to such challenging tasks as providing vehicles with trajectory parameters that reflect man's physiological limitations; prelaunch procedures that facilitate late insertion of man into the spacecraft; a simplification of operations that will give significant improvement in the ability to launch at a specified time; and a new high order of safety and reliability. In the latter regard, greater emphasis must be placed on the application of redundancy concepts to critical launch vehicle components in a manner that has served eminently in the aircraft field. Detailed consideration must also be given to the use of flight crew monitoring and control, where such measures can improve the launch phase reliability.

As for the spacecraft itself, it is similarly clear that a broad attack on the complete frontier of applicable technologies should be the order of the day; and the problems are manifold and complex. Space presents a peculiar and hostile environment to manned space flight operations. Spacecraft, therefore, have their own special requirements, just as ships have for the sea, and aircraft for the air. We are only beginning to learn about spacecraft requirements. But it is already evident that in one important respect, spacecraft can have the most difficult challenge: that of providing for satisfactory operation in space, in the air, and on the water. The Mercury capsule, for example, had to be designed for exit through the atmosphere on the booster, for operation in space, for reentry flight through the atmosphere, and for impact and survival in the high seas or on land. Some future vehicles, in addition, will be required to penetrate planetary atmospheres, and land on, and take off from, lunar or planetary surfaces. The provision of such a combination of capabilities in one vehicle will surely tax man's ingenuity to the fullest.

While some may assume that the provision of advanced launch vehicles with greatly increased weightlifting capabilities will provide for easy, brute-force solutions to future problems, there is really little room for such hopes. Experience has shown that the desire to undertake more advanced missions will probably always place a very high premium on weight control and system sophistication.

In the development of the Mercury system, for example, the capsule configuration was basically designed for good reentry performance, while its compact, symmetrical shape was readily adaptable to the booster geometry. Its upper structure was arranged to contain the parachute systems and support their loads. The landing bag was included to attenuate ground or water impact shock, and to stabilize the capsule on the water. The problems of providing all these capabilities, together with a launch escape method, separation motors, retrorockets, life support equipment, stabilization and control systems, communication gear, and other crew requirements within the allowable weight limits, was extremely challenging. If the Mercury capsule were to be redesigned today, there is very little in its basic concepts that we would or could change.

In the development of Apollo concepts, we again face a weight limitation problem that forces us to take a hard look at the primary objectives to determine, in a rational manner, what compromises must be made. It is again clear that we cannot permit old concepts to dominate the configuration design, unless they can pay their way in the accomplishment of the basic space mission. Regardless of how we examine the problem, the conclusion remains, that, within the dictates of practicability, safety and reliability, the maximum performance and operational capabilities in space are the real fundamental requirements to which other desires must be subservient.

The Apollo design must therefore cater to the maximum of space mission capability, incorporating only an optimum configuration compromise for launch, reentry and landing requirements. We therefore are compelled to relegate conventional landing capabilities to a lesser importance, unless they can be provided with little penalty to overall mission performance.

One concept that offers promise for the controlled landing of spacecraft is the Rogallo "Flexiwing" or paraglider. With this device, which is basically a stowable wing of the same order of weight as a parachute system, it may be possible to utilize an optimum configuration for the space and reentry operations, and still provide a horizontal pilot controlled landing capability on the ground or at sea. Such a wing, with a lift-to-drag ratio of about 5, could be deployed after the reentry maneuver has been completed, to permit final selection of the landing area.

Intensive research and development efforts in a wide variety of such fields are accordingly necessary for maximizing space flight capabilities within allowable weight limits. It is obvious that there is an open field for the evolution of a whole host of new concepts and techniques to speed us toward our long-range objectives.

The space flight program objectives themselves need to be most carefully selected. Each of two extremes should be avoided. The selection of complex projects that achieve only a small improvement in space capabilities are prone to early obsolescence, and dissipate too much of our manpower and financial resources. On the other hand, the selection of project goals that require technological advances far beyond those that are clearly within the realm of concerted development effort, can long delay the availability of useful improvements in space capabilities, or even defeat practical accomplishment of the project in a timely manner.

In meeting our national needs, our space flight programs should strive for a middle course. While each step should be sufficiently large to tax our ingenuity to the utmost without predicating success on a technological breakthrough, the projects should be devised with sufficient scope and flexibility that we may capitalize on the ensuing technical and scientific growth and thereby facilitate timely and efficient advances in our space flight capabilities.

We hope that we may be able to follow such a middle course in the Apollo program. As an initial step, the Apollo vehicle should provide a significant advance over Mercury for earth orbital operations. We expect that the incorporation of a larger crew, the extended mission duration, the maneuverability capabilities, and accommodations for special purpose equipment, will provide for immediate conduct of a wide variety of scientific, technological and special civilian services.

At a later date, when the erection of large manned permanent space stations in orbit may be undertaken, the Apollo vehicle could serve eminently in the construction and supply of such a station. The Apollo vehicle itself will also act as a test bed for the orbital development and qualification of techniques and hardware for manned lunar missions. As the growth of technology permits, the Apollo spacecraft would then form the nucleus of a manned circumlunar and lunar-orbiting vehicle for scientific observations of the earth-moon system. Further extensions of the Apollo capabilities to permit actual manned lunar landing, exploration and return, may be feasible.

In the conduct of this nation's space flight program there is much to be done and much to be learned. In any advanced project, it is expected that mistakes will be made. This is a natural part of the business of learning. What is vitally important to our moving ahead in a mature fashion, however, is that we not make the same mistakes twice. In the complex operations with booster and space vehicle projects, we must take appropriate steps to share the detailed lessons of their successes and failures. There is a wealth of valuable experience that could do much to increase the pace and success of the national space flight program if it could be ferreted from the unreported recesses of our many projects and effectively disseminated to other project groups. This is not to suggest that there has been a willful withholding of such information, or to pretend that project personnel are not already overburdened with the primary tasks of sweating out each day's direct project problems. It is felt, however, that many of those problems might be alleviated, if each man could share the benefits of the sweat of others who had already labored through a similar problem, and thereby gain the time to pass his new experiences on to others. On the other hand, a flood of additional documents beyond the deluge which already exists, does not seem to be the right answer.

Perhaps what is really needed, as a start, is a mechanism similar to that employed in the aircraft field, for specifying the detailed design requirements that have been learned through our past experience, and is kept up to date as additional knowledge is acquired. This might be a space counterpart to the old handbook of instructions for aircraft designers. A skillful and adequate group of specialists working full time on such an activity is badly needed, and could pay rich rewards in the progressing of the nation's space flight programs. Much room exists for invention of more effective methods for interchange of vital experience, and the problem should be attacked with a real sense of urgency.

In summary, I would like to highlight the following needs of our space flight programs:

First, the aggressive development of large launch vehicles that are specifically tailored to the requirements of advanced manned space flight programs. Aircraft experience in flight worthiness requirements and techniques should be exploited here.

Second, the intensification of research and development efforts on the whole range of technological problems confronting rapid growth of manned space flight capabilities, with special emphasis on the evolution of new concepts and techniques that will minimize compromises dictated by the need for operation in the full spectrum of environmental media.

Third, the selection of goals for space missions that give us a large and rapid reward for our investments, with emphasis on designs that maximize performance and operational capabilities in space, and that can capitalize on breakthroughs when and where they occur.

Fourth, a vigorous attack on practical methods for the pooling of space flight design, development, construction and operational experience for the mutual benefit of all programs.