THE MILITARY ROLE IN SPACE

Based Upon and Excerpted From a Speech by

Brockway McMillan[1]

United States Air Force, Washington, D. C.

In this discussion of the military role in space, it might be advisable first to make some distinctions. For the purposes of this discussion, a Keplerian orbit about the earth which intersects the surface of the earth we shall call ballistic. Objects in any other kind of orbit will be said to be in space.

The military role of ballistic objects is an established fact which is well understood and needs no elaboration here. The military role of things in space is a more complex subject, one that merits discussion and, as you well know, frequently gets it.

A central issue in this complexity was put before the American Rocket Society at its 16th annual meeting in New York in October, 1961, by Vice President Lyndon B. Johnson, who said: "We want to make the space age an age of peace. We have no desire to convert outer space into a battleground of the cold war. We are thinking of peace, not conflict; of the hope that the gleam of a brighter future may yet fall from the reaches of outer space on our divided and quarrelsome earth.

"As a servant of peace, a satellite can give incomparable service in helping us to interpret and ultimately, perhaps, to control weather conditions. It can link even distant nations in a swift system of communication. It can provide new safety and security for the needs of peaceful commerce.

"But as a weapon of intimidation or blackmail, space vehicles can bring dangers of a new and sinister kind to a world that has no desire to experiment with fresh horrors."

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[1]Assistant Secretary.

The Vice President then turned the coin and pointed out a second crucial issue. "Our knowledge of outer space, and of activities in space, allows us to say with sad conviction that space systems can be of direct defense importance. Indeed, some defense functions can be conducted with unique advantage in space."

We are, nationally, concerned lest man's exploitation of space be turned against him to his destruction, and eager to seek effective agreement to use this new realm of man's endeavor not only peacefully but cooperatively. We seek this agreement not only for its own sake, but in the hope that success in such agreement may show the way to other agreements.

But here we are also faced with the undoubted fact that there is military value to objects in space, and we know that we are not alone in our recognition of this fact. Some years ago, Soviet Major General Pokrovskii said, "The development of technology...has...led to artificial earth satellites which, together with their scientific value, also have military significance. From them, it is possible to observe the opponent's territory and to throw atomic bombs on that territory."

What we have is a dilemma. It might not appear so sharp a dilemma, were it not for our recent sad experience with the Soviets on nuclear testing. But the Soviet record on test ban negotiations makes it clear that, though we may earnestly hope that space will be used only for peaceful purposes, we cannot base our national security on hope alone.

The resolution of this dilemma depends on three elements: First, continued full pursuit by the military of those missions in space which are intrinsically peaceful and stabilizing; second, development by the military of the basic building blocks of further space capability as insurance against contingencies; and third, continued pursuit of a broadly based national program in space technology.

To elaborate briefly on the first of the three elements, it recently was pointed out by spokesmen for the Administration that our policy of peaceful use of outer space has never been intended or interpreted to deny the military the use of space for peaceful or for stabilizing purposes. The President, in his press conference on June 14, 1962, reiterated that our policy in this regard has never varied.

The second point has been very clearly stated by Dr. Harold Brown, Director, Defense Research and Engineering. In testimony before the Senate Committee on Aeronautics and Space Science, Dr. Brown said, "We must, therefore, engage in a broad program covering basic building blocks which will develop technological capabilities to meet many possible contingencies. In this way, we will provide necessary insurance against military surprise in space by advancing our knowledge on a systematic basis so as to permit the shortest possible time lag in undertaking full scale development programs as specific needs are identified."

The third point hardly needs emphasis. It is the simple fact that technology knows no boundaries. The establishment of a broadly based national space effort has stimulated all areas of space technology. The attainment of a lunar landing requires certain basic elements, such as large boosters, life support subsystems, re-entry vehicles and rendezvous, docking and transfer capabilities. These are indeed basis elements of any space mission; their mastery is as important to the military as it is to the scientific exploitation of space. These elements, in turn, require the broad base of research, technology, and testing, as well as the launch, range, and industrial facilities, that are all part of our present national effort.

With this description, in terms of intent and policy, of the military role in space, let us now turn to a discussion of this role in terms of interest to us as engineers.

First, what are the peaceful and stabilizing activities in space that are of military importance? Vice President Johnson enumerated some of them in the address already referred to. He mentioned, "early warning of ballistic missile attack, various kinds of surveillance and reconnaissance, communications of a secure and invulnerable kind, and navigation." As Roswell L. Gilpatric, Deputy Secretary of Defense, has noted, the list also includes defensive missions and missions "to inspect and verify that unidentified space vehicles are in fact peaceful. If they are proven hostile, they will be neutralized before they can do harm to mankind."

Now let us consider those basic building blocks that Dr. Brown spoke of as leading to a military capability in space. You can think of many of these, and some obvious and significant ones have already been mentioned: large boosters, life support subsystems, re-entry vehicles, and techniques for rendezvous, docking, and transfer. There is no need to break these down into their manifold technical elements. Instead, let us consider three other building blocks even more basic to a military capability in space. In fact, they are so basic that they have not previously been mentioned even as building blocks.

These are - and they are rather closely related to the other - simplicity, reliability, and propulsion. Why are these called building blocks to a military capability? Consider: can a launch vehicle which must stand on the pad for six weeks of prelaunch checkout support a military capability for anything? Probably not. The essence of any military capability, be it in the Armed Forces Police or in the strategic retaliatory force, is readiness, responsiveness to command, and adaptability to the changing needs of policy or the fickle fortunes of war.

This means that military vehicles must be simple, reliable, dependable, and flexible. These are virtues which, like all virtue, are more often found in conversation than in fact. They differ from some other virtues, however, in that they are easy to identify once you have found them. Therefore, we know how rare they really are.

The creative engineers and scientists who have been responsible for this country's accomplishments with ballistic missiles and in space are to be saluted for their impressive and unprecedented achievements. But in the process of their achievements, they have created some of the most intricate and delicate machines of war or peace that man has ever devised.

Many of the hard problems have now been solved, however. It is time that we, as engineers, went back to engineering. It is time to look again at the whole picture, to consider whether the technically optimum design is really the one that will work best in the field environment, to trade maximized performance in a favorable environment against guaranteed performance in the likely environment, to consider the impact of complexity upon operational readiness and mission reliability.

The engineer, because he is an engineer, has a professional responsibility to himself, to his employer, and, in this context, to his country to consider all the factors that bear on the performance and operability of his product. It is his responsibility to deliver a product that fulfills its whole mission; not a product with the greatest mass fraction, or the lightest autopilot, or the most transistors, but a product that does what it is supposed to do, when it is supposed to do it, when it is called upon to do it, without special care from a hundred technicians for six weeks.

After this polemic for simplicity and reliability, we come to propulsion. Why propulsion? For two reasons. First because it relates to simplicity and reliability. There is no doubt that the pressure forcing us to intricate and delicate designs originated in our fear that weight would outrun propulsion and leave us without payload. This fear was once well founded, but the problem is now behind us. We can now engineer to a payload; in the process, enough propulsion should be put in to carry along some margins in the rest of the system.

There is a second reason for talking about propulsion; it bears on another quality essential to a military capability a quality already mentioned - flexibility, and flexibility in a very fundamental sense. It is not merely that a military inventory cannot include vehicles differently optimized for each possible mission, so that vehicles must be flexible for planning purposes. It is more basic than that: if space vehicles are ever to support military missions in the same sense that air vehicles, ground vehicles, and marine vehicles now do, they must be capable of flexibility during the mission. They must be capable of responding to circumstances which were not known at the time the mission originated, by maneuver, by change of attitude, by shift of orbit, and by re-entry at a time and place determined by a military commander, not by an astrologer.

Of course, there are laws of physics which control the degree to which the flexibility just described can be achieved, and fix the minimum price thereof. At the moment, we also have many other engineering problems to think about, but in the long run the usefulness of space vehicles to the military, if they are useful at all, will be limited by the efficiency and capability of their propulsion systems. High energy fuels, storable in orbit, techniques of refueling, restartable and throttleable engines that realize the maximum specific impulse from their fuels, nuclear engines, nuclear impulse engines, electric engines, and radiation engines, must all be considered for their practicability and applicability to maneuvering vehicles. There is nothing you cannot do if you have enough propulsion. On the other hand, you do not have many options in free fall.

We should not leave this matter of building blocks without touching on a related subject, rather more frequently discussed than the three items just mentioned. This is the question of the military man in space. We all know the arguments: man is a flexible, adaptable computer with built-in sensors of high acuity and great capacity, he is easy to program - in fact largely self-programming - and he only weighs 180 pounds ... if you forget the 2000 pounds of gear it takes to keep him alive and happy. And let us forget that he is also rather slow, makes mistakes, gets bored and inattentive, and sleeps about a third of the time. All in all, he is a fairly useful subsystem.

There has been some pretty careless talk about man in space from engineers. This starts with the argument that we need man in the flight test phase because, being the adaptable fellow that he is, he can recover vehicles that otherwise would be lost by failure in flight. It is hard to believe that this argument applies to vehicles destined for unmanned missions -- the engineering and other costs of adding a manned capability would far outweigh the savings realized by recovering a few flight test articles. And the argument has no force when applied to manned vehicles; it goes without saying that the man will participate in the flight test phase as soon as safety permits.

It would appear that secretly some engineers feel that the presence of the man can simplify the engineering of the vehicle. It may simplify the flight control system, but it surely does not simplify the life support system! Nor can the adaptability of the man be used as an excuse to relax engineering attention to details of safety and reliability. You just cannot abdicate engineering responsibilities in favor of the pilot; his presence actually increases these responsibilities.

There is no doubt that we are all really in agreement on this matter of safety and reliability. There is in fact another engineering issue that is much more basic in relation to manned military missions. Great point is made, and validly, of the flexibility and adaptability of the man as a military subsystem. He can sense new situations, and he can react to them with judgment, which is to say that he need not be programmed in detail. But let us recall our discussion of propulsion. Unless the man can do something about the new situation he senses, his acuity and judgment are not of much military use. And this is an engineering challenge. Until we can supply our military man with propulsion and maneuverability, with a choice of re-entry trajectories, with communications tying him to his command, and with military equipment responsive to his control, he cannot perform a useful military mission. About all he can do is carry the flag.

It is for this reason that the present military program in space, as it relates to manned operations, is concentrating on the kind of basic elements and building blocks mentioned earlier. These must be mastered and welded into systems before any useful manned mission can result.

Although this discussion has centered primarily on how things ought to be, it is time to take a brief look at how they are. What are we really doing?

The satellite program of the Air Force, the first launch of which occurred in February 1959, is undoubtedly well known to you.

This program has increased our scientific knowledge and has strengthened our military capabilities. The program has provided us improved techniques of orbital injection, re-entry, and recovery, all of which may have application to future military systems. Our capability for successful re-entry and recovery of payloads from orbit is steadily increasing.

We are proceeding with work which will demonstrate techniques for unmanned rendezvous with an uncooperative target. The importance of such techniques to maintaining peace in space already has been noted.

Equally significant to the maintenance of stability and peace is early warning of hostile actions. We are experimenting with satellites for this purpose. The Navy is carrying out a program to develop an operational navigation satellite. Two satellites now in orbit are transmitting continuously. Ground stations are in operation and experimental equipment aboard several vessels is now demonstrating the performance of the system. Soon accurate navigation may be available at all times to vessels throughout the world.

Military communication satellites are also important space efforts. We have recently reoriented our development approach in this area. We are working on both synchronous and nonsynchronous types, using the Atlas-Agena booster for each. It is believed that the low orbit system, which will have a small channel capacity and can be relatively simple, can be operational earlier than the synchronous system. It may be superseded when the latter becomes operational.

We have several times mentioned building blocks to a space capability, and participation by the Department of Defense in the National Space Program. We should not forget that, with the exception of some launches of very small payloads, every orbital launch undertaken by this country has been lofted by a booster developed in the military program. It was Atlas that boosted "Friendship 7" into orbit for Lt. Col. John Glenn, and "Aurora 7" for Lt. Cmdr. Scott Carpenter; Atlas will serve again for the next orbital flight.

Titan III is under study by the Department of Defense as an addition to the national booster program. This is another basic building block growing out of a military program. Starting from a Titan II booster, it adds a solid fueled first stage, strapped on, and a simple fourth stage, to make a larger booster of versatile capabilities. It is Titan III which will put the Dyna-Soar vehicle into orbit; Titan III can also boost a heavy payload into synchronous orbit. This will be of value for future communication satellites of high capacity.

Perhaps in the glare of more highly publicized programs, the X-15 has lost some of its early glitter. Nevertheless, this program is providing us with significant knowledge about controlled and powered flight at the outer fringes of the atmosphere, about the performance of men and of bioastronautics equipment, and about the durability of materials at high temperatures. With funds provided primarily by the Air Force, this project is conducted jointly with NASA and the Navy.

Major Robert White recently flew 50 miles high in the X-15 rocket plane. When he did, he became the fifth man in America entitled to wear the wings of an astronaut. He followed Alan Shepard, Virgil Grissom, John Glenn, and Scott Carpenter.

Dyna-Soar, recently designated the X-20, is another program with which you are familiar. This is primarily an Air Force program. It has been oriented to emphasize early attainment of manned orbital flight. It is an experimental program to explore the problems of re-entry from orbit in a vehicle of high aerodynamic maneuverability. Such a vehicle would allow a wide selection of re-entry trajectories and landing points, leading to the kind of flexibility of mission stressed above. It incidently also then provides, as a by-product, the convenience of a conventional aircraft landing. The X-20 will use the Titan III booster, as already noted.

The specific accomplishments and programs listed must be examined against a background of many supporting activities and projects. Included are operational support to NASA in such programs as Mercury and Gemini, and the operation of the national ranges, but these are only the visible part of the iceberg. Beneath them lie a complex of facilities and programs.

Perhaps you are aware of the extensive background of the Air Force and Navy in aerospace medicine and the fact that project Mercury depended completely upon the Armed Services for the selection and training of its astronauts and for most of the medical experts who monitor the astronauts' performance during flight. The Air Force's Aerospace Medical Division conducts a broad program covering all aspects of bioastronautics, from selection of personnel to engineering and test of life support system.

Applied research on propulsion in the Department of Defense, most of it done by the Air Force, ranges from the proposed development of giant solid boosters having five to six million pounds of thrust to the development and test of ion engines whose thrust will be measured in fractions of an ounce. The whole domain of chemical technology is being searched for new fuels and for methods to synthesize and control them. Exotic engines for possible air-breathing boosters are under study.

Guidance need hardly be mentioned as a basic building block. The Air Force is spending over $200 million yearly in research on and development of new guidance techniques and systems. But there are many other subsystems as essential to space missions as propulsion and guidance; for example, sensors, secondary power sources, actuators, thrust vector controls, communications, telemetry, and re-entry heat protectors. These too are the subject of vigorous programs of research within the Air Force.

Finally, programs to explore the environment of space and determine the radiation and physical hazards that threaten vehicles and occupants should be mentioned.

Altogether, the Department of Defense is spending upwards of one and one-half billions of dollars annually in support of the National Space Program and in related military space activities. That is the military role in space -- pervasive, complex, diverse in objectives, and defying summary. However, we should once again recall its three primary elements: continued full pursuit of those military missions which are peaceful and stabilizing, development of the basic building blocks of a broad capability as insurance against contingencies or technological surprise, and full participation in a national program to realize man's primordial aspirations to explore the universe.