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EXTRA-TERRESTRIAL WARFARE (U)

by

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ABSTRACT

(U) The United States may be called upon to wage extra-terrestrial warfare within the next two to three decades. This paper explores the implications of this requirement for the US Army and proposes a program of studies that will enable the Army to meet this requirement.

CONTENTS

SUMMARY

(U) This paper presents briefly some of the problems attendant upon development of an extra-terrestrial warfare capability for the US Army. In the unusual space environment, the development of such a capability poses a large number of complex problems. There is a need for further definition of Army roles and missions in extra-terrestrial warfare, as well as for definition of systems in as much detail as possible so that requirements may be developed. A general study program leading to the achievement of these goals is outlined.

EXTRA-TERRESTRIAL WARFARE (U)

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INTRODUCTION

The Combat Development Objectives Guide states that the US Army will participate in extra-terrestrial exploration, construction and maintenance of extra-terrestrial bases, offensive and defensive warfare on the moon and planets, and the development of the materiel needed to provide these capabilities. (See paras. 110g, 210.b.(10), 810.b.(10), 1412.b.(6), 1710(A)a.(1), 1710(A)a.(2), 1712(A)b.(2).) Extra-terrestrial Army activities appear in these references as projections of the traditional terrestrial roles and missions of the Army.

Present Army space programs, however, are not directed toward developing a manned space-flight capability for the Army. Army effort, since the creation of NASA, has been directed toward the development of unmanned satellites for communications and mapping, and earth-base defense systems against space weapons.

The Air Force has received a manned space mission assignment in the Manned Orbiting Laboratory program. Navy crews may also participate in later MOL flights. Under NASA control, Air Force, Navy and Marine Corps personnel have also participated in Projects Mercury, Gemini, and the X-15 program and will participate in Project Apollo and future NASA manned space flight programs. Three programs are currently under study for the Post-Apollo period, in addition to the Manned Orbiting Laboratory. These include:

1. Apollo "X" - an extension of the Apollo program using Apollo hardware for earth-orbiting space stations and extended lunar exploration.

2. Manned Orbiting Research Laboratory - a 20,000-pound craft, carrying 6 to 9 men. Applications are scientific and military.

3. Large Orbiting Research Laboratory - a 250,000-pound craft, carrying 24 to 36 men. Applications are scientific and military. (See "U.S. Spacecraft." Aviation Week & Space Technology, 15 March 1965.)

Clearly, the programs described above may contribute to a military capability. However, the military applications of any of the programs are subordinated to scientific goals. These programs will ensure the development of military manned space flight capabilities within the Air Force and Navy. Research and development in unmanned space projects by the Air Force and Navy will add to these capabilities.

The Soviets are maintaining their initial lead in the manned space flight field. Their programs are apparently mainly directed toward the achievement of a military capability.

The overall Soviet program appears to be gaining momentum. During 1964, their launch rate was 112 percent over that of 1963. Most of the spacecraft launched were reconnaissance satellites of the Kosmos type (unmanned Vostok spacecraft fitted with cameras, etc). The two Voskhod flights demonstrate impressive increases in capability. While Voskhod I carried three men, it is believed that the capsule has a five-man capacity. As demonstrated in Voskhod II, the capsule also has an air lock and the astronauts are equipped with extra-vehicular suits.

The Polylot spacecraft appears to be a test model for a propulsion system that can be launched separately and rendezvous with one or two space vehicles.

Using this hardware, within the next five years, it is believed that the Soviets may link up two craft in orbit and establish a space station, or make a circumlunar flight. (See: Kolcum, E. "Russia Increases Military Space Tempo." Aviation Week & Space Technology, 15 March 1965.) Therefore, by virtue of their advanced technology and their military orientation, the Soviets are close to achievement of an extra-terrestrial warfare capability that will radically alter the relative power position of the West. Clearly, intensive effort is needed to provide the US with at least an equivalent space flight capability as well as an ability to seize and hold extra-terrestrial positions.

This paper will explore, in a general fashion, the implications of the CDOG objectives relating to US Army extra-terrestrial warfare capabilities. A proposed Combat Developments Study program will then be presented in outline form for consideration. The objective of this study program will be to provide the Army with the requisite knowledge, doctrine, organization, tactics, and materiel to meet the requirements for extra-terrestrial warfare as set forth in CDOG.

DISCUSSION

Extra-terrestrial Combat Environment

The physical environment of space, the planets, asteroids and natural satellites is a major factor to consider in extra-terrestrial combat developments. A brief consideration of pertinent aspects of this extreme environment will be made in order to provide a perspective for discussion of military problems.

Extra-terrestrial combat will occur in the following environments:

1. Interplanetary space. For purposes of this discussion, this includes space in proximity to the planets, such as would be occupied by an orbiting vehicle.

2. Planets. The only planet of this solar system upon which combat is possible under any foreseeable extrapolations of the "state of the art" of life support is Mars. Planets within the orbit of earth are uninhabitable even with highly advanced life support systems. Those planets outside the orbit of Mars have atmospheres of frozen or nearly frozen gases which would be impenetrable by any techniques likely to be devised in the immediate future.

3. The Asteroids. These numerous objects vary considerably in size and shape. They follow a number of orbits within the solar system, sometimes intersecting the orbital paths of the planets.

They are generally concentrated in a broad belt, outside the Martian orbit. In this position, they could become strategically important as military stations from which exploration and surveillance could be conducted. It is believed that these objects are either remnants of a larger planet or planets, destroyed by collision, or unaggregated remnants of the raw material from which the solar system developed. In either case, these objects could have significant quantities of exotic raw materials, making them undesirable from an economic point of view.

4. Natural Satellites. The natural satellites of the planets of this solar system, beginning with our own moon, have potential value for military activities. The following natural satellites are presently known to exist:

Earth	1
Mars	2
Jupiter	12
Saturn	9
Uranus	5
Neptune	2

These satellites could serve as military bases as well as bases from which exploration and economic exploitation of the resources of the various planets could be conducted.

The environments enumerated above differ from each other in terms of the quantitative measurements of their physical characteristics, insofar as they are known. (Little is known about the environments of the asteroids or the majority of the natural satellites.) They do share some general physical similarities however, which have relevance for present tactical and materiel development considerations.

1. Terrain. Terrain on planets and natural satellites is generally likely to be subdued, compared to earth terrain. Recent photographs of the moon, obtained from the Ranger program, indicate the kind of terrain that may be anticipated on the natural satellites. These photographs indicate the possibility of extensive subsurface cavern systems which would provide shelter for visitors, but would also complicate any military offensive or defensive activity on the moon, making warfare in such an environment truely three-dimensional.

The lack of atmosphere and the extremes of heat and cold on the natural satellites and the asteroids will accelerate weathering of exposed rock, resulting in the accumulation of large quantities of surface debris of a rough texture. This debris may seriously hamper mobility by normal means.

The asteroids of larger size appear to be spherical bodies. Others, however, are probably large, assymetrical chunks of material.

2. Light. Lacking the protection of an atmospheric blanket, the direct and reflected light of the sun will be quite powerful in the region within the Martian orbit and possibly beyond. This will require protective measures for personnel and necessitate development of new visual signalling techniques.

3. Temperature. Surface temperatures will be extremely cold, on the planets, asteroids, and natural satellites with the exception of our moon, where the temperature ranges over a span of 400° F during the course of a lunar day (two weeks). Similar temperature ranges will be experienced in space near earth, with temperatures dropping as one proceeds outward toward the edge of the solar system. Protection measures for both men and materiel are clearly required.

4. Gravity. Gravity will be lower than that of earth throughout the extra-terrestrial environments being considered. This fact has important implications for materiel, personal equipment, and weapons.

5. Radiation. Cosmic radiation as well as that derived from sources on the planets, satellites, or asteroids will represent a hazard to personnel and equipment.

6. Meteorites. Meteorites represent another important hazard in the extra-terrestrial environment. The size range of these objects is very broad. They are generally of low density, and travel at high velocities. Their presence in interplanetary space and in the regions surrounding the planets, natural satellites, and asteroids, magnifies the problem of detection of hostile action, as it is conceivable that natural missiles of these types could be confused with man-made and launched missiles.

The Functional Areas in Extra-terrestrial Warfare

Illustrations of the problems that must be dealt with in acquiring an extra-terrestrial warfare capability can be derived by considering the five military functional areas projected into the space environment. Any system of warfare in an extra-terrestrial environment will have to provide capabilities in each of these functional areas.

The discussion below is not a systematic analysis of the possibilities open to the Army in extra-terrestrial warfare. It is a discussion of a number of problem areas selected randomly from among the functional areas. Possible solutions are offered to stimulate interest and discussion, and should not be construed as attempts to provide, at this time, definitive answers to the problems raised. The purpose of this section of the paper is to show that extra-terrestrial warfare is a form of warfare so different from anything previously encountered, and so taxing on both economic and human resources, that planning and analysis must begin now and be carried on with utmost care.

Command, Control and Communications

The organization of any Army extra-terrestrial warfare effort will necessitate a radical departure from any currently existing Army organizations in all respects. Rank systems will probably have to be modified extensively to cope with technical skill and educational requirements. Organizations will have to be tailored around the major items of equipment, such as space vehicles, and fixed installations such as launch facilities and extra-terrestrial bases. The organizations required will probably resemble, in a general structure, those currently in use by the Navy on ships, based on functional operating requirements rather than on adherence to traditional unit organization.

Above the level of the individual operating units, considerable flexibility will probably have to be maintained in order to cope with the variety of missions to be performed in the wide range of space environments. Task force type organizations, assembled for specific missions, would probably be most efficient, at least at the outset.

The existence of a military service conducting both terrestrial and extra-terrestrial operations clearly implies an extensive, complex, and highly sophisticated system of communications that will permit complete coordination of all activities within that service and coordination with the other services and the government.

The extra-terrestrial capabilities of the Army may, and should, be used to support earth warfare, as well as to carry on warfare outside of the earth environment. Reconnaissance satellites will be able to provide land forces with vital intelligence. Communications satellites will be called upon to relay information of all types from field and space units. Space-borne weapons systems may be able to provide support for large scale land actions or to defend land forces and installations against hostile space weapons systems.

The question of the relationship of the Army space effort to those of the other services is one that must be resolved early. Coordination of efforts is clearly imperative due to the extremely high cost of space hardware. Some kind of Joint Command seems indicated. The present Joint Chiefs organization might conceivably expand their scope to include extra-terrestrial operations.

Intelligence

Intelligence requirements will be magnified many fold by the necessity to monitor enemy activities over large areas of the solar system and pinpoint with reasonable accuracy the existence of units or ships that may be millions of miles from earth or from the nearest friendly base.

Firepower

Extensive weapon development will be required to provide a satisfactory extra-terrestrial combat capability. Recoil weapons will be of little use in the free space environment, or on the surface of asteroids, planets or natural satellites with low gravity. For example, the recoil from the discharge of even a small weapon would provide sufficient impulse to alter the course of a maneuverable space vehicle quite substantially, unless counter-recoil impulses were provided. On the moon, the recoil from a hand-held weapon would probably be sufficient to lift a man off of his feet and propel him backwards.

Rockets will be used extensively for extra-terrestrial firepower. Environmental factors such as temperature, radiation, and gravity will complicate the employment of such weapons. Solid propellants are notoriously sensitive to extremes of heat and cold and become unstable when so exposed. Thus, environmental protective measures will have to be developed before solid propellant rocket weapons can be used in space. Solids are the most economical and efficient propellants; however, the use of

liquids involves a number of other problems, such as "boil-off" and the corrosive nature of the agents themselves, against which considerable precautions must be taken.

Direct energy weapons, such as lasers, seem to offer outstanding possibilities for space weaponry but much further research is required to increase the power of these devices and reduce the size of the components to manageable proportions for warfare. Nuclear weapons are generally agreed to have good potential for space application, yet their employment may be restrained by a number of factors such as the effect of nuclear radiation on communications and sensing devices.

The applicability of CW/BW weapons in space appears to be extremely limited. Agents might prove of value in reducing enemy fixed bases or contaminating supplies. Otherwise, the extreme environment will render both BW and CW agents useless by preventing the development of sufficient concentrations and destroying the BW organisms. The possibility of the discovery of viable toxic organisms indigenous to the space environment should not be overlocked, however. The discovery of microscopic organic remains on the Orgeuil meteorite and other meteorites leads to the conclusion that organisms did exist in space at one point and may still be existing there. Should toxic indigenous organisms be discovered, the implications for weapons development are clear.

Mobility

The major problem in mobility is developing the family or families of space vehicles that will be needed for extra-terrestrial warfare. This development process will be constrained by the state of the art of space hardware, particularly propulsion systems. Consideration of possible missions and requirements is certainly not to be excluded in any design process, however. There is a need for different types of vehicles, based on performance and functional considerations.

On the basis of vehicle performance, the following vehicles might be considered.

1. Earth orbital (non-maneuverable)
2. Earth orbital (maneuverable)
3. Deep space voyaging

On the basis of functional requirements, the following types of vehicles may be required for deep space use:

1. Transports
2. Weapons systems carriers
3. Exploration vehicles
4. Communications vehicles
5. Surveillance vehicles

Surface vehicles will be probably required for operations on the planets, asteroids, and natural satellites. These vehicles may be used mainly for protection of personnel, transport of supplies, and manipulation of construction equipment. It is quite conceivable, however, that vehicles might be used for surface warfare, particularly in extra-terrestrial environments where "terrain" features may assume military importance and surface warfare might become more like land warfare on earth. The alternative means of propulsion and locomotion for such vehicles cover a wide range including wheeled vehicles of various types, tracked vehicles, "walking" vehicles, and "ground effect" machines.

In addition to the problems of providing surface mobility for groups of men, equipment, and supplies, there is the problem of providing mobility for the individual in a way that will conserve his strength. Numerous alternative personal propulsion devices and strength-multipliers must be investigated to determine suitability for employment in various space environments.

Personal propulsion devices are also required for extra-vehicular activities in free space. As currently conceived, these activities involve

assembly and maintenance of equipment and other scientific tasks. Some suggestions have been made, however, that boarding parties, demolition teams, etc., could operate outside of their vehicular environment in warfare.

Service Support

The logistics of extra-terrestrial warfare is more complex and costly than that of land warfare and will continue to be so until some radical breakthrough in propulsion decreases costs per pound-in-orbit or pound-on-the-moon and permits launching of large payload vehicles without the extensive preparation presently required.

Assuming that such a breakthrough is forthcoming, the Army supply system will have to be expanded many-fold to accommodate the increased burden placed upon it. An adequate space supply system must be able to anticipate requirements far in advance of their actual appearance due to the time/distance factors involved in resupply of remote units and bases. Such a system would also have to function rapidly to provide items on short notice to units and bases in proximity to earth.

There is considerable need for investigation of techniques of packaging and loading supplies of various types to withstand the accelerations and other unusual features of space flight.

Personal equipment is a major problem. A great deal of research has gone into the development of suits which can be worn within vehicles. Extra-vehicular suits have also been developed and used. However, the problems in designing a suit to be worn while working on the surface of the moon, for example, are very much greater than those previously encountered. The surface material may be so abrasive as to penetrate any known fabric quickly. For prolonged wear, additional radiation protection must be provided in the suit. Requirements for carrying and using combat weapons and equipment will further complicate matters.

Construction equipment will be needed for use on planets, asteroids, and natural satellites. This equipment will of necessity differ radically from any used on earth in configuration, power sources, and in materials used. Construction techniques will also differ radically, for example, in fabricating pressure vessel shelters on the spot from local materials, and of using natural shelter to every extent possible.

Up to this point, the discussion has centered exclusively on hardware, because this is really the most pressing problem. Nevertheless, it would be a grave error to overlook the human requirements of an Army manned space program. Personnel selection techniques have already been developed to a high level of efficiency in previous manned-flight programs. Nevertheless, such techniques may require modification or expansion to provide the Army with personnel suited to their particular needs.

Training is a major expense of any manned-flight program. The high cost of actual flight makes simulator training mandatory as the only economic method of providing the experience necessary to ensure mission success. Simulators require an outlay of funds that appears to be initially quite high, but not in comparison to the cost that would be incurred by real flight training or the loss of one or more manned capsules from inadequate training. Such simulators can only be built when vehicles have been fully developed and missions defined in detail.

The preceding enumeration and discussion of problems to be faced in the development of an extra-terrestrial warfare capability lead to the obvious conclusions that: (a) the problems of space warfare are large and complex, and (b) if a capability for this kind of warfare is to be developed, there is a definite need for immediate initiation of a research and development program that will lead to the achievement of the desired capability at the required time.

Outline of a Proposed Study Program

A brief survey of documents indicates that there is very little official interest and no activity in the field of manned space flight in the US Army today. For this reason, it appears that the first major task is that of achieving and maintaining an acquaintance with the developments in the space flight field. This implies the establishment of some kind of data collection center to survey the field. Following the activation of this basic research tool, a number of substantive projects should be undertaken to develop the organization, equipment, and doctrine that will ultimately be required in the 1970-80 time period.

1. Manned Space Flight Data Center. A center for the collection and organization of data on the general area of manned space flight is envisioned. The selection of data to be collected at this center would naturally be guided by the requirements and interests of the Army. A number of collecting and abstracting services are already available within the government both for domestic and foreign literature.

2. Study program. Simultaneous with the initiation of the Data Center survey activities, a study program should be undertaken to provide the requisite information upon which certain critical decisions can be made and Army policy developed.

a. Definition of Roles and Missions. Army roles and missions in extra-terrestrial warfare must be defined in as much detail as possible. The general objectives stated in CDOG are too broad to be useful in the planning and expansion of a combat developments study program. The first step is, then, to work systematically from the general objectives stated in CDOG to a more detailed statement of roles and missions. This definition should be pushed as far as possible within the current state of the art, and some rough attempts at costing for the various hypothetical systems should be developed. The definitions study should be updated on on a fixed-interval basis in order to ensure that the Army concepts are

congruent with current technological developments as well as with strategic concepts and apportionments of responsibility developed at the national level.

b. Systems Studies. A rigorous systems analysis of major missions should be undertaken, using hypothetical equipment configurations and data developed by reasonable extrapolations of the current state of the art. Mission profiles should be developed and major crew tasks defined in as much detail as possible for each of the subsystems. These analyses will aid in the identification of problem areas for further study. They will also permit development of tentative materiel and personnel requirements. As in the studies of roles and missions, the systems studies should be subjected to periodical updating and revision.

c. Subsystem and Component Studies. Studies will be required for the development of specific subsystems, or systems components, that have been identified as critical in other analyses. A direct-energy weapons system is one example of a possible system study that might be undertaken. Another study might be on personnel requirements for support systems.

3. Hardware Development. The studies outlined above are, of course, only preliminaries to the most important task of determining actual equipment requirements and subsequent design, testing, and production. If Army missions seem to require radically different vehicles and weapons systems than those currently contemplated, the design process must begin as soon as possible. Space systems design is a slow process, particularly in the case of items and systems for which little or no precedent exists.

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