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RESEARCH PAPER

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IMPLICATIONS OF SPACE ON NAVAL STRATEGY (U)

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ABSTRACT

Space technology began as an offshoot from the basic seed of the science of rocketry. In recent years, space technology and its civilian and military applications have taken a position of exceptional importance in our individual thoughts, our national prestige, our policies and strategy in the furtherance of international relations, our military posture, and currently our national survival. This is evidenced by the tremendous effort being made by this country in space programs, both military and civilian.

The military implications of this national effort are quite obvious. It is the naval implications on which this paper focuses, showing that they are of prime importance in the formulations of strategy, since the Navy can utilize the fruits of this relatively newborn space technology to extend its operating horizons to an unprecedented degree. Today, near-earth satellites are the space tools which have the greatest effect on naval strategy, capabilities, and responsibilities. As time progresses, interplanetary systems will come to the forefront in over-all strategy considerations.

The vast area of this planet covered by water dictates the requirement that the Navy have the ability to project its might anywhere in the world. This in itself justifies the Navy's present and future role in the planning for and development of space systems. A suggested form of naval strategy using space assets such as navigational, meteorological, communications, and reconnaissance satellites has been outlined in this paper as a feasible example of the increased capabilities of fleet operations envisioned by the

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application of these systems. Of course, these same space vehicles, if possessed by the U.S.S.R., can be used to the serious detriment of our naval operations. Therefore, it is mandatory for our versatile space program to proceed at such a pace as to insure that we maintain a comfortable lead in the space science field. It is equally important that the Navy expand its role in the strategic and retaliatory phases of our national defense through space technology, and provide within its unique capability, support of the over-all military posture of this nation.

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INTRODUCTION

> At no time in the nation's history has the United States faced a peacetime security problem as demanding of thought, treasure, and toughness as it does now.[1]

National strategy is unalterably linked with our political, economic, psychological, and military environments; nevertheless, it is believed that the military ingredient of our over-all strategy posture, coupled with positive exploitation of technological competence and industrial potential, is the most urgent and essential factor at this time. In order to maintain a position of leadership among the free nations and to deal effectively with the Sino-Soviet bloc, highly versatile military forces are necessary.

This paper deals with the implications of space on naval strategy, and represents an attempt to analyze potential military effects of space systems on naval strategy and operations. In consideration of these effects, emphasis is placed on the navigation satellite and its ability to provide accurate, all-weather fixes for surface and submarine forces; the communication satellite and its ability to provide a world-wide system of communications with other fleet- and land-based elements; the meteorological satellite and its ability to furnish global weather data and forecasts; and the reconnaissance satellite and its ability as an intelligence-collecting system. No attempt is made to analyze manned and weapon-carrying space systems which will have a decided effect on all aspects of military strategy. However, the development of these sys-

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[1] Committee for Economic Development, The Problem of National Security, Some Economic and Administrative Aspects, p. 4.

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tems by both the United States and the U.S.S.R. will in all probability be perfected within the present decade, which is the time frame for the purposes of this paper.

The Soviet threat in the field of astronautics is quite evident today, and it can be assumed that any advantages that we might gain from the exploitation of these space systems can be used against us or be exposed to severe countermeasures by the U.S.S.R.

The impressive development effort being made by the United States in the field of space vehicles and their military applications and in space science is noteworthy and provides the writer with a versatile base from which to project within the scope of this paper, the implications of space on naval objectives and strategy. Admittedly, the assessment of the role of satellites in naval operations requires a more detailed and technical analysis than has been outlined in this paper. Nevertheless, the writer has striven to outline from an operational point of view the subject matter by a consideration of history, controlling government agencies, space projects, naval requirements, and finally, a suggested future strategy utilizing these space assets in the form of a "packaged task force."

Since ocean areas cover so much of the earth's surface in relation to United States territory--which occupies less than two percent--space operations designed to observe, influence, or control activities on a global scale are seen as a fundamental naval responsibility and of great significance in the furtherance of national security. It is within this area that the Navy's operational capabilities will be extended to an unprecedented degree by utilization of the previously mentioned satellite systems in conjunction with conventional fleet elements. Accordingly, it is in pursuit of this view that the writer explores the implications of space on naval strategy.

IMPLICATIONS OF SPACE ON NAVAL STRATEGY

CHAPTER I

ROCKETS-TO-SATELLITES IN THE SPACE ERA

". . . outer space may well be the proving ground on which the uncommitted people of the world will judge whether the democratic free enterprise system or the communist system is superior."[1]

General. It is this sober thought that stimulates the fantastic tempo of technological progress and military adaptations of advanced weaponry, as the world enters the final known medium--space. Of all the kinds of changes that convulse the world today, including the political, economic and social aspects, none has acquired such "snow-balling" momentum as the arts of war and destruction.[2] The awesome magnitude of the universe with its inherent mysteries and dangers defies yet fires the imagination of mortal beings. Certainly, the age of space exploration has arrived, and through this unlimited medium may be born a common ground of such proportion that mere earth frictions will be completely eclipsed, at least for some time to come. Even though the national interests and objectives of this country will remain basically the same, as long as our democratic system prevails, the means for accomplishment of these objectives will necessitate a compelling extension of our policies and undertakings in order to morally sustain our national and international obligations. Our national survival requires our entrance into the Space Age.

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[1] James M. Gavin, War and Peace in the Space Age, p. 247.

[2] Alastair Buchan, "Missile Age Strategy," NATO Letter, 6, August 1958, p. 24.

The occupancy of space has clear military implications, and we would be committing "military suicide" by a lethargic space program; the field of military operations must be extended in a vertical direction. It is almost impossible to draw a clear, definitive line between military and scientific research. Very worthwhile cultural, commercial, and scientific gains can be obtained at nominal additional cost as by-products of the military space program, since the types of equipment required for military and nonmilitary ventures are frequently identical. The scientist, in his search for knowledge and historical validation, has never failed to better mankind; the realist interested in direct application of space technology to improving man's welfare, the economist thinking of indirect benefits to our industrial complex, the educator envisioning the relationship to student progress, the military planner focusing on applications to defense, the political scientist concerned with position of world leadership and the implications of international relations--all have a specific area of interest which, when combined, portrays a collective front of national strategy.[3]

Rockets-to-Space Era. The present state of the art in rocketry is the result of a combined effort of many nations and peoples. The story of modern rocketry had its beginnings before the birth of Christ; however, the beginning of twentieth century rocket research is connected with the work of Dr. Robert H. Goddard. It was not generally known until 1919 that Dr. Goddard was engaged in

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[3]U.S. Congress, House, Select Committee on Astronautics and Space Exploration, The Next Ten Years in Space (1959-1969), p. 119.

rocket research and development. Known as the creator of the modern science of rocketry, Goddard in his investigations covered almost every essential principle in both the theory and practice of high-power rockets. In 1919, he delivered to the Smithsonian Institute a paper called "A Method of Reaching Extreme Altitudes." It was in this presentation that he showed that a rocket with a gross weight of 22,000 pounds would be capable of escaping from the earth and delivering a small pay load to the moon. In addition to his high altitude research and his development of rockets, Goddard recognized the potential of rocketry in space flight. By 1926 Dr. Goddard's research activities encompassed almost every category of rocket design and culminated in a demonstration of the world's first liquid-propellant rockets. His accomplishments were ahead of their time, and their potential was not recognized during this period. It can be said that Goddard truly is the father of modern rocketry.

In 1922, Professor Hermann Oberth, who could well be classified as the European counterpart of America's Dr. Goddard, requested a copy of Goddard's paper, "A Method of Reaching Extreme Altitudes." In 1923, Prof. Oberth published his book on space travel, Rocket to Interplanetary Space. This book was not widely accepted, and brought many adverse criticisms. In 1929, Hermann Oberth published his most important work, The Roads to Space Travel. In this book Oberth presented a complete analysis of contiguous and interplanetary space flight. It is significant to mention that as a result of his books, the German Rocket Society for the advancement of space travel was organized in 1929. From this organization the German military rocket research program was born. We have much evidence as to the success of this program, and it remained for the German scientists and engineers to master the principles of rocketry and apply them on practically every level of their military weapons systems. Perhaps the prophecy and vision of Hermann Oberth, who has been acclaimed the father of modern astronautics, can be substantiated by the following prediction:

> The present state of science and of technological knowledge permits the building of machines that can rise beyond the limits of the atmosphere of the earth. After further development these machines will be capable of attaining such velocities that they--left undisturbed in the void of ether space--will not fall back to earth; furthermore, they will even be able to leave the zone of terrestrial attraction.[4]

There is little doubt that the development of the rocket as a powerful propulsion device set the stage for the transition into the space medium, and it has been stated with a reasonable degree of prognostication that World War II was the last war of the Machine Age.[5] The Age of Space with all its complexities is before us, challenging our resourcefulness and capabilities in all fields of human intercourse. Therefore, it is considered appropriate to elaborate somewhat on space environment, our own scientific, domestic, and military development, and the ever-present Soviet threat and potential.

Space Environment. This planet is surrounded by shells or layers of atmosphere known as troposphere, stratosphere, chemosphere, ionosphere, mesosphere, and exosphere. Beyond the exosphere is what we call outer space.

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[4]Hermann Oberth, Rocket to Interplanetary Space, p. 1.

[5]James M. Gavin, op. cit., p. 94.

The troposphere is the nearest layer to the earth, and it is this layer that contains the formation of weather. In this envelope of atmosphere both temperature and pressure decrease in a fairly constant ratio with respect to altitude. Since the troposphere is considered to be in thermal equilibrium between the earth and the stratosphere, when more heat is absorbed than is reflected, then this layer is disturbed and this mixing action gives rise to snow, rains, winds, and other phenomena of weather.

As the altitude above the earth's surface increases, even as much as a few miles, life as we know it ends. There is no blanket of atmosphere to protect us. High temperatures exist depending on which side of a body is subjected to the sun's rays, but there would be no sensing of these extreme temperatures because when any body in space intercepts the sun's rays, it is warmed, but since no atmosphere surrounds the body, it quickly loses heat. X-rays and cosmic rays penetrate our bodies and dissociate our cells; the air pressure decreases below our blood pressure until bodily liquids boil. Since the molecules are so closely packed together at sea level, no sooner do they get up speed than they lose it by collisions. In space, they travel many miles before colliding, and, as a result, the temperature of a molecule in outer space is extremely high due to the velocity attained before collisions.

The troposphere, which extends for about seven miles in a vertical direction, has been briefly discussed; now let's discuss the succeeding layers of the atmosphere. The stratosphere extends from the upper limit of the troposphere to a height of about 20 miles. In this layer is found strong air currents, cloud formations, and meteor trails which signify their disintegration. Just recently in the tests of the X-15, man has flown to the upper limit of the stratosphere and possibly the lower section of the chemosphere.

The upper limit of the chemosphere is at 50 miles above the earth. This layer absorbs and processes most of the sun's ultraviolet energy. Because of the electrification of particles in this layer, radio waves are sometimes absorbed, thereby causing complete "fades" in communications. This layer also absorbs some of the infrared radiations which give rise to extremely intense, infrared night air glow radiations, commonly known as "heat lightning."

The next layer, known as the ionosphere, is that portion of our atmosphere capable of conducting electricity. This makes long-distance radio communications possible by the reflection of low-frequency radio waves in this layer which extends to an altitude of 250 miles.

Scientists are just beginning to obtain data on our next layer, the mesosphere. It is known that ionization is very high because it receives the sun's radiations without any filtering process. The air density is extremely low, and therefore the electron density must also be low. This layer extends to an altitude of approximately 600 miles.

Above this is the exosphere which is undefinable in terms of upper limit, since it gradually diffuses into interplanetary space. It is in this layer that we stand on the threshold of outer space.

Scientific and Military Research and Developments. Scientific and military research and developments came to

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a sudden reanalysis and reprogramming very shortly after the launching of the earth's first artificial satellite by the U.S.S.R. on 4 October 1957. This event was without a doubt the most serious blow to its prestige ever suffered by the United States. Vice President Nixon, on 16 October 1957, wisely appraised the situation when he said, "We could make no greater mistake than to brush off this event as a scientific stunt . . . We have had a grim and timely reminder . . . that the Soviet Union has developed a scientific and industrial capacity of great magnitude."

There was a great clamor for this country to achieve startling successes in the satellite field--indeed, this was a military and psychological necessity. The heretofore national complacency began to fade, and our leaders realized that astronautics and space technology forecast capabilities of such magnitude that new concepts of military action would have to be developed to exploit them. Since the relationship between satellite science and the ICBM is so close, the fear of the Soviet ICBM development spurred us to action in the fields of basic and applied research, missile production, strategy and tactics, and educational reform. Needless to say, there was a series of reorganizations in the rocket and satellite efforts of our country; there was the establishment of a Joint Congressional Committee for Astronautics--similar to the one now in being for atomic energy--to keep a constant watch on the nation's progress in space flight. During February 1958, the Advanced Research Projects Agency (ARPA) was formed by the Department of Defense and placed in charge of the country's space program, including the development of military space weapons. This was the beginning of a long-range, centralized planning program necessary for organ-

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ization of our resources and talents for the race in space. In particular, the agency provided the control mechanisms for coordinated effort between the military departments. In order for the agency to accomplish this feat, it was given control of the money, and instead of the services' budgeting for each space project, ARPA was allotted the money. This made review and coordination of the programs possible. In addition, ARPA was in a position to insure that the research and development features of the tremendous missile programs were made available to the space programs in order to preclude duplication of effort. ARPA allocated funds to the services for expenditure after proper justification had been presented and the individual service projects had become coordinated in the national effort. It was soon realized that there were many other interests in space which did not have a military connotation. There existed numerous areas in science and industry which were not directly associated with the development of weapons systems, military operations, or the defense of the United States. The thought of military control over all space programs caused quite a furor in Congress, as well as among many leading scientists. Finally, on 29 July 1958, after much deliberation and study by Congress, a civilian space agency was authorized--the National Aeronautics and Space Agency, commonly referred to as NASA. The National Aeronautics and Space Act of 1958,[6] which established NASA, directed that it perform the following major functions:

1. Plan, direct, and conduct aeronautical and space activities.

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[6] "National Aeronautics and Space Act of 1958," 1958 U.S. Code Congressional and Administrative News, No. 12, (August 5, 1958), p. 2348.

2. Arrange for participation by the scientific community in planning scientific measurements and observations to be made through the use of aeronautical and space vehicles, and conduct and arrange for the carrying out of such measurements and observations.

3. Provide for the widest possible practicable and appropriate dissemination of information concerning its activities and the results thereof.

4. Review Department of Defense space programs and related activities, with the Department of Defense to continue being responsible only for those space activities primarily associated with military weapons systems or military operations.

Under the provisions of the Act, NASA is an independent (and powerful) agency in the executive branch of the government. In addition to the aforementioned responsibilities, NASA absorbed all functions and activities previously performed by the National Advisory Committee for Aeronautics which was disestablished on 1 October 1958 when NASA came into being. The National Aeronautics and Space Agency (NASA) and the Advanced Research Project Agency (ARPA) are the focal points of the United States efforts in space.

The present importance of NASA and ARPA can best be measured when related to the cold war in which the free nations of the West are now competing with Soviet Russia. The fact that the United States was inadequately prepared to accept the advent of Russia's Sputnik I has been evidenced by the national consternation, as well as by the criticism and reorganizing of our own efforts. Since then, it has been fully realized that the Soviet satellite achievements, and the missile competency on which they are based, forecast severe threats to our national security, and also to our international leadership and prestige. The space successes enjoyed by the Soviets have generated into "hard bargaining levers of Communism" at all international conferences and forums, and have become psychological tools in the cold war.

The Utilization of Space for Military Purposes. The utilization of space for military purposes is already apparent with our launching of communication, weather, and reconnaissance type satellites. Such a family of satellites would enable a country to keep extensive areas of the earth under almost constant surveillance. "These orbiting vehicles can help to bring about a universal peace or a universal chaos. We can see them giving us long-range weather forecasts, improving our transportation and communication, discovering underground treasures, influencing military tactics, and questioning many theories."[7]

In addition to aforementioned uses, the first satellites will be used for determining outer atmosphere densities, more accurate measurements of earth's equatorial oblateness, of intercontinental distances and other geodetic data. This means that we shall be able to make accurate maps and construct better navigational devices for our ships and airplanes. The use of satellites and space probes to obtain pure scientific data can be considered both civilian and military in nature, since the data in most cases can be directly applied to further peaceful space development and/or to future military weapons systems development.[8] The efficient utilization of these data is

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[7]E. Bergaust and W. Beller, Satellite, p. 13.

[8]M. Caidin, "The Russian Conquest of Space," Space Age, 1, November 1958, p. 5.

the mandate for both NASA and ARPA, because our progress in space technology is directly related to our ability to cope effectively with cold war problems, and our basic problem of strategy is the ability to make wise and intelligent choices.

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CHAPTER II

SATELLITES, SPACE VEHICLES, AND RELATED PROGRAMS

> The achievement of man's destiny must be earned by the pursuit of objectives fashioned to his most advanced capability.[1]

National Effort. Space exploration, space vehicle applications, and fulfillment of requirements for utilization of space are of necessity a national effort. The execution of most space programs will demand the combination of the unique skills of the various services and civilian agencies to insure success. Although the National Aeronautics and Space Administration (NASA) will have primary responsibility for space exploration, that agency cannot do the job alone, and will require the talents and resources peculiar to the military. The national programs coordinated by NASA have to be bold in design, firm in execution, and supported by sound public understanding in order to provide for this country's needs and surpass the Soviet Union.

The House Select Committee on Astronautics and Space Exploration submitted a final report (H.R.2710) on 3 January 1959. This extremely comprehensive report stressed the urgency of the situation, and summarized the importance and requirements of a strong space program in the following conclusions:

> 1. We are in an age of rapid technological change wherein the strategic balance of power can shift to the nation first achieving operational usability of new scientific developments.

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[1] U.S. Congress, House, Select Committee on Astronautics and Space Exploration, *op. cit.*, p. 28.

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2. The effects of technological advance can be of compelling force, even without resort to war.

3. It would be highly impractical not to face the reality that space technology, like nuclear energy, can be used for war as well as for peace.

4. The military potentialities of space technology, which the United States would prefer to see channeled to peaceful purposes, are greater than general public discussion to date suggests.

5. The decision to undertake a space program cannot be made in the context of domestic conditions alone.

6. A key question is the relative position of the Soviet space accomplishment as compared with that of the United States.

7. Inventions cannot be scheduled in advance.

8. Crash programs are the most expensive kind to undertake.

9. The early design-study phase of research is relatively cheap in money, but it may not be cheap in amount of time required.

10. To start and stop programs is the most expensive and dangerous way to undertake them.

11. The pace of development has been so rapid, as new devices make earlier ones obsolete, that we are pressing hard against the limits of fundamental human knowledge.

12. At the same time that the arrival of new developments is occurring more and more frequently, the complexity of many of these projects is growing so that their planning requires programing of efforts over a longer span of years.

13. Long-range flexible planning should entail approval of programs which are not yet certain in every detail and a system of follow-up and reappraisal leading to a program revision where necessary.

14. Inexorable changes in society and political power will follow the development of space capabilities; failure to take account of them would virtually be to choose the path of national extinction.

15. What program the United States could achieve and what it will in fact achieve may be two very different things.

16. Budget pressures in the short run should not be the primary basis for decisions on space programs which are inherently long range, and which involve the very survival of the nation.

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17. This nation should not make inadequate short-run expenditures on its space program at substantial risk to its survival a few years later.

18. The best advice obtainable by the committee supports the view that within a decade peaceful applications of space development to weather prediction and long-range communication alone will more than pay back to the economy all the funds previously required to achieve these capabilities.

19. The greatest benefits of space development and exploration in all probability cannot even be predicted today.

20. Although engineering secrets related to national defense deserve the utmost protection, the greater part of the space program will progress more rapidly without the shackles of an undue security control.

21. Full scientific and technical cooperation among the nations of the free world is essential to their joint survival and to the fastest growth of the American space program.

22. Scientific education in the United States stands in need of critical review.[2]

Amplification of the foregoing concluding statements is impractical in light of the main theme of this paper. Nevertheless, the logic and objective reasoning portrayed by the declarations of such an important Committee have been incorporated in part, and will continue to serve as a sound policy foundation in our national space program.

At this time, it is believed that a review of the space programs under each cognizant agency would be appropriate to allow the reader to realize the full extent of United States space endeavors.

NASA Satellite Program. The satellite program is one of four major plans NASA has instituted to form the foundation of a strong, long-term effort to achieve United States leadership in astronautics. This program entails bringing

[2]U.S. Congress, House, Select Committee on Astronautics and Space Exploration, House Report 2710, 3 January 1959, pp. 10-15.

into operation satellites, which could aid in accomplishing current tasks or tasks which could not be accomplished without their use. NASA's present endeavors include the development of a meteorological satellite, a geodetic satellite, a communications satellite, and other supporting R&D satellite programs. Of course, there are many booster vehicles being used to place the satellites in orbit around the earth, but these projects will not be discussed, except where related to a particular satellite pay load program.

Communications Satellites. Project ECHO consists of inflatable balloon-type satellites for communication purposes. This particular program deals with the passive communications system and will provide the necessary information for a decision as to the best approach in determining the relative feasibility between passive and active systems. The passive satellite consists of a 100-foot aluminized balloon equipped with a transmitter for tracking purposes.[3] This satellite balloon will be used to reflect signals between east and west coast installations, employing 1000 megacycles from east to west and 2000 megacycles from west to east transmissions. Two launchings, in August and September 1960, have already proved successful. Another test is scheduled for March 1961. The advantages of the passive system lie in the satellite itself, since no electronic equipment for relaying signals is necessary. Also, there is no problem of reliability or equipment malfunctioning

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[3]U.S. Navy, Ad Hoc Committee to Recommend Policy on the Use of Space and Science of Astronautics, The Navy in the Space Age, Vol. II, June 15, 1959, p. B-18. (SECRET) (For Navy eyes only)

within the satellite. The major disadvantage of the system is in the ground or shipboard transmitting and receiving stations. High energy radio signals with accurate directional antennae requiring somewhat elaborate equipment are necessary for transmission purposes, and equally elaborate receiving equipment is needed to receive the relatively weak signals reflected by the satellite. The systems using passive communication satellites are very adaptable in the presence of jamming efforts. Since the satellite itself is inherently linear and broad-band, it would be necessary only to modify the ground or shipboard equipment to shift the operating frequency in the event of concentrated jamming effort.[4] The vulnerability of this type of satellite to antisatellite activity is relatively high, due to the configuration of the large, thin-walled balloons orbiting at low altitudes. These balloons are easy to track and reach with probes, and they cannot maintain their shape if they lose their internal gases by collision with debris from antisatellite vehicles.[5]

Project REBOUND will succeed Project ECHO and will eventually establish a series of passive satellites for global communications. These multiple passive satellites will be much like the ECHO configurations.

Meteorological Satellites. The objective of the meteorological satellite program is to develop the techniques of using satellite-acquired data to improve weather forecasting, by providing information on the nature of weather, and taking pictures of cloud formations and frontal systems. TIROS I

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[4]U.S. Office of Naval Research, Naval Analysis Group, Naval Implications of Earth Satellites, p. 136. (SECRET)

[5]Ibid., p. 138.

was launched 1 April 1960, and made valuable contributions to meteorological research by transmitting 22,952 pictures. TIROS 2 was launched successfully by a THOR-DELTA vehicle and contained infrared photographic equipment. Following the TIROS program will be the meteorological satellite series labeled NIMBUS. This is designed to take television pictures of cloud formations and frontal systems, and will be launched in a polar orbit by a THOR-AGENA-B vehicle. A total of ten satellites will be launched from now through 1965--one every six months. The successor to NIMBUS will be a 24-hour stationary weather satellite named AEROS, presently scheduled for launching in 1964. Its function will be to record pictures of cloud formations and frontal systems.

The foregoing program makes use of television cameras, infrared measurements, and an earth-solar heat radiation balance. The television pictures will be taken by two cameras with fine and coarse resolution respectively, preprogramed to take a series of 32 consecutive pictures, one every 30 seconds. These pictures are recorded on video magnetic tape, and the tape recorder will relay the information on signal from the ground station. This sequence can be repeated by command as soon as the recording tape has been emptied. The pictures are relayed to the data acquisition stations via FM data links, one for the fine resolution and one for the coarse resolution. The pictures are coded for transmission, and upon receipt at the ground station, can either be stored on magnetic video tape or decoded and placed on a television scope to be photographed.[6]

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[6]U.S. Navy, Ad Hoc Committee to Recommend Policy on the Use of Space and Science of Astronautics, op. cit., p. B-19. (SECRET) (For Navy eyes only)

The Naval Photographic Interpretation Center has been given the responsibility of developing techniques for analyzing and interpreting the photographs, and the U.S. Weather Bureau has been given the mission of developing techniques for utilizing the data acquired from the satellites.

Geodetic Satellites. In the field of geodesy, the satellite will help us in two main areas: the more accurate determination of the size and shape of the earth; and the problem of precisely establishing the distances between continents and the position of oceanic islands. The latter area of accuracy with respect to intercontinental distances is extremely important to our ICBM and POLARIS missile systems. The satellite provides us with a powerful tool to determine such distances, since it gives us a triangulation point high up in the sky. This method will allow us to "bridge" continents separated by large bodies of water, thereby establishing interconnecting reference points for accurate mapping, and the "fixing" of strategic coordinates necessary for effective military applications of weapons systems. NASA is responsible for providing a satellite which is capable of producing improved geodetic information, and for providing the means of measuring the propagation characteristics of light and electromagnetic radiation simultaneously. This satellite will require a very precise orbit determination before it can be used for geodetic position-fixing. The future of this program, which is somewhat similar to the Navy's TRANSIT navigation satellite, is not certain at this writing.

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NASA Major Space Projects

Project MERCURY (Man-in-Space) is the prime responsibility of NASA. Close coordination is maintained with ARPA (Advanced Research Projects Agency) and the military services. The objective is to place a manned vehicle safely into orbital flight and to effect a safe recovery of the man and vehicle from orbit. In addition, a study will be made of the capabilities of man in the environments associated with launching, orbital flight, and recovery. It is expected that the first manned orbital flights will be at about 110 miles' altitude and that the capsule will be recovered on the third orbit in the vicinity of the Barbados Islands. This project enjoys the highest national priority, and although not an endeavor specifically within the scope of this paper, it clearly ranks high in its future implications on naval strategy. The first manned orbit shot is scheduled for late 1961.

Space Science Program. The Space Science Program, from the standpoint of the over-all space factors and considerations, is by far the largest enterprise in which NASA has prime responsibility for execution and coordination. It has been established on as broad a basis as possible, and relies on the active participation of the scientific community along with industry and government. This program is of such magnitude and all-encompassing nature that a brief outline of the principal scientific aims and projects is considered important to naval interests. A digest of the objectives of the Space Science Program shows that it provides for researching in order to determine and understand the origins, evolutions, natures, spatial distributions, and dynamical

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behaviors of the atmospheres of various planets--including earth--and their relations to the medium of interplanetary space; to investigate ionospheric phenomena of the earth, moon, and planets; to evaluate possible hazards to life and other effects of energetic particles on instrumented and manned space exploration; to determine and understand interactions of magnetic and electric fields throughout the universe; to determine and understand the effects of gravitational fields throughout the universe; to observe, from above the earth's atmosphere, the spectral distributions of energy radiated from objects in the solar system; to determine the effects on living terrestrial organisms of conditions in the earth's upper atmosphere, in space, and in other planetary atmospheres; and finally, to investigate the existence of life throughout the solar system.

The following space projects under the direction of NASA will initially support the Space Science Program:[7, 8]

> AGENA B - a liquid-fueled upper stage used with ATLAS or THOR boosters for deep space missions. The first shot, scheduled with ATLAS booster for mid-1961, will attempt to take television shots of moon and land instrument capsule.
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> ANNA - a geodetic satellite weighing 50-100 pounds, probably of spherical configuration. The study phase has been completed, and it is now entering the R&D program. The Army, Navy, and Air Force are involved with NASA in this joint project.

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[7]"Datalog of Missile, Space and Detection Projects," Data Magazine, 5, August 1960, p. 42.

[8]"Astrolog," Missiles and Rockets, 7, November 7, 1960, pp. 26-31.

APOLLO - a manned spacecraft capable of orbiting earth or moon as a space laboratory for three men; planned as next step in space exploration to follow Project MERCURY. Boosted by SATURN.

ATLAS-ABLE - a large booster designed to orbit 200-pound satellite around moon or send it into deep space.

CENTAUR - a vehicle designed to land 730-pound pay load on the moon in a soft-landing; also, for heavy earth satellites and probes to Mars and Venus. Full firing is due early 1961.

IRIS - a low cost, sounding rocket designed to put 100-pound pay load at 200 miles' altitude. Last July it lifted 150 pounds to an altitude of 140 miles.

JUNO II - a large booster designed to put small pay loads in space.

MARINER - a space vehicle for planetary missions subsequent to Project MERCURY. It may weigh close to 50,000 pounds and will boost 600-1200-pound unmanned spacecraft for interplanetary missions. Seven shots are planned, the first during the third quarter of 1962.

NERV - a nuclear emulsion recovery vehicle for obtaining measurements of Van Allen radiation belts; designed to place 75-pound pay load to an altitude of 10,000 miles with SCOUT booster.

NOVA - a large booster of between 6-12 million pounds' thrust for outer space travel. It will consist of a cluster of four to six 1.5 million-pound-thrust engines, and is scheduled for operation in 1965.

OAO - a 3500-pound orbiting astronomical satellite observatory equipped with telescope and boosted by ATLAS-AGENA B. First flight is scheduled in late 1963.

OGO - a 1000-pound satellite with instruments for geophysical measurements boosted by ATLAS-AGENA B. First flight is scheduled in 1963.

OSO - a 350-pound orbiting solar observatory boosted by THOR-DELTA. First flight is planned in early 1961.

PROJECT RANGER - a 300-pound lunar probe for hard-landing of instruments on the moon, with ATLAS-AGENA B as booster. First flight is planned in 1961, and first lunar landing is planned in 1962.

PROJECT ROVER - a nuclear rocket research and development to prove feasibility of nuclear power plant. Power plant completion is scheduled for 1963; rocket by 1966.

PROSPECTOR and SURVEYOR - a lunar probe for soft-landing of instruments on the moon, boosted by SATURN or ATLAS-CENTAUR. First lunar flights are planned with SURVEYOR vehicle for 1963-1964, followed by PROSPECTOR in 1965.

SATURN - a large cluster of boosters for outer space vehicles developing 1.5 million-pounds' thrust. Early models will orbit 20,000-pound pay load. First flight test of clustered boosters is scheduled for 1961, with upper stages scheduled in 1963.

SCOUT - a solid four-stage satellite launching vehicle designed to place 200-300 pounds in orbit. It uses existing hardware from POLARIS, SERGEANT, and VANGUARD missiles. Successful flight was obtained in October 1960; orbital shot failed in December 1960.

THOR-ABLE STAR - a three-stage vehicle with orbital capacity of 200 pounds. The new upper stage has restart engine and boosts heavier pay load. It is used for boosting TRANSIT and COURIER satellites. The Air Force is also involved in the development of this vehicle.

THOR-DELTA - a satellite-launching vehicle designed to put satellites of 480 pounds into orbit. It will be used to launch TIROS and ECHO programs.

VOYAGER - an advanced unmanned spacecraft for planetary missions subsequent to MARINER vehicle. It will use SATURN booster. First flight is planned by 1965.

The Advanced Research Projects Agency (ARPA). As stated in Chapter I, ARPA was created in early 1958 to guide the entire Department of Defense Space Program. ARPA has done much to reconcile the rivalries and struggles for funds among the services. In this respect ARPA has adopted the policy of issuing orders, together with funding, to the services or civilian laboratories to finance specific work. As the coordinating agency for the Department of Defense, it has general cognizance and funding review responsibilities over all military projects. In administering military astronautics and space programs, ARPA's program is based primarily on the operational requirements of the various services; therefore, most of the projects with finite military applications have been delegated to service management. The Air Force has been given responsibility for development of early warning satellites and reconnaissance satellites, the Navy for navigational satellites, and the Army for communications (active type) satellites. In order to fulfill commitments for a consolidated defense program within its purview, ARPA has retained directional control over certain projects, mainly in the advanced study and R&D categories. As previously stated, ARPA is involved directly or indirectly in all the service space programs; however, the following are major projects which it sponsors in the space field:[9]

<u>MRS. V</u> - a maneuverable, recoverable, manned space vehicle designed to place in orbit, maneuver same out of original orbit in space, then return safely to earth. It will weigh in excess of 20,000 pounds and may be launched from or to space.

<u>PONTUS</u> - a material research program for experimentation and development of better structural and power conversion materials for military requirements in space and missile projects.

<u>PRINCIPIA</u> - a solid propellant study for developing new solid propellants with 10-20% higher specific impulses.

<u>PROJECT DEFENDER</u> - a ballistic missile defense system including advanced warning radar projects, coupled with a study group for missile defense designed to work on future ICBM defense.

<u>PROJECT NOTUS</u> - a communications satellite program which will lead to a global system in 1965. A network of 24-hour equatorial satellites at 19,400-mile altitude and satellites in polar orbits at 5600-mile altitude will provide instantaneous global communications for ships, aircraft, submarines, land forces and later for spacecraft.

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[9] "Datalog of Missile, Space and Detection Projects," <u>Data Magazine</u>, 5, August 1960, p. 42.

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PROJECT SPASUR - a space surveillance system capable of detecting, identifying, and determining orbits of nonradiating objects in space. The feasibility and operational capability have been demonstrated. The Navy is involved with this program through the Naval Research Laboratory participation.

PROJECT TRIBE - a research, experimentation, and systems development designed to obtain at the earliest practicable date a family of military space vehicles capable of satisfying the needs for space missions as may be determined by the Secretary of Defense. The SATURN and AGENA projects are part of this program.

SHEPARD - a tracking system for detecting and tracking satellites from a Space Surveillance Control Center; includes capability for data reduction.

SUNRISE - a study of advanced military weapons with special concentration on space delivery.

Air Force, Army, Navy Satellite and Space Programs

Air Force

AGENA - a liquid-fueled upper stage designed for use with ATLAS and THOR boosters in connection with Projects MIDAS and DISCOVERER. A 1700-pound satellite after burnout.

ASTROBEE - a space probe rocket for short-range space research missions.

BLUE SCOUT - a solid multi-stage booster similar to SCOUT. This had partially successful launching September 1960.

DISCOVERER - a stabilized satellite program for testing techniques for SAMOS, and a test program to

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achieve orbital capabilities of large satellite vehicles, together with the development of techniques for operational military systems including recovery of capsules.

DYNA-SOAR - a manned boost-glide orbital spacecraft designed for re-entry; boosted by TITAN missile. Launching is expected in 1965.

MIDAS - an early warning satellite designed to detect ICBM launchings by infrared means. This would double our warning time of enemy ICBM launchings by detecting heat from exhaust of missile as it is launched. It had a partially successful launching in May 1960. Operational system will have 12-15 satellites.

ORION - a rocket propelled by nuclear pulses for ultimate launching of space station; presently in the advanced engineering study stage.

SAINT - an antisatellite satellite system for both inspection and interception; presently in the study stage.

SAMOS - a reconnaissance satellite using TV techniques; scheduled to be operational in late 1962 or early 1963.

THOR-AGENA - a two-stage vehicle capable of orbiting more than 300 pounds. With the restartable AGENA B upper stage, the pay load capacity is boosted to 1250 pounds. NASA will use this combination extensively beginning in late 1961.

X-15 - a rocket-powered, manned aircraft designed to take man to fringes of outer space, developing speed of 3600 m.p.h. at 250,000-foot altitude. NASA and the Navy are also participating in this program.

Army

COURIER - a communications satellite designed to be a delayed repeater, weighing about 500 pounds--part of Project NOTUS. It was launched into orbit 4 October 1960, and successfully transmitted messages.

PROJECT ADVENT - an advanced communications satellite program designed to be a global real-time repeater. It is the new over-all name for advanced communications satellites STEER, TACKLE and DECREE.

Navy

CALEB - an astronautics vehicle with a range of 13,000 miles (horizontal) and 2000 miles (vertical), now entering instrumented test firing stage. Launched from F4D or F4H fighter aircraft, it then boosts itself into orbit. It is planned for operational use in the Fleet for reconnaissance, meteorological, and other military missions.

GREB - a satellite solar radiation measuring system designed to measure solar emissions. GREB was launched into orbit with TRANSIT 2 on 22 June 1960, and separated by spring action after orbit was established.

PROJECT SPASUR - See under ARPA program.

PROJECT TEEPEE - a long-range high-frequency radar to provide ICBM detection.

TRANSIT - a navigation satellite intended to provide an earth satellite system for accurate all-weather navigation for ships, aircraft, and submarines. The operational system will consist of four satellites in precise orbits. The satellite will continually transmit stable radio frequencies, a reference time standard signal, and also its own orbital information. Two vehicles are presently in orbit: TRANSIT 1 launched 13 April 1960 and TRANSIT 2 launched 22 June 1960. The schedule calls for this project to be operational in 1962.

An essential ingredient in the discussion of the impact of space on naval strategy is a listing of the "tools of the trade" in space and their capabilities. The aforementioned projects and studies are indicative of the tremendous effort being made in this field. Although for purposes of this paper, only a few of these projects will be directly relative to naval objectives and strategy, it was considered appropriate to present this enumeration to assist in visualizing the enormous potential of space systems under development or study for possible application to naval operations.

<u>Status of Space Program</u>. No one can give final answers as to the exact timetables by which the United States and the Soviet Union, in particular, will attain an operational status for their respective weapons systems. A few years at most will bring new weapons and new space capabilities for exploration and for utilization which must make profound alterations in our ideas and our strategy. Every branch of the armed forces, and all the departments of government concerned with science, technology, and defense are properly cognizant of our needs.[10] The need and urgency are borne out by the testimony of Dr. T. Keith Glennan, who when Administrator of NASA, stated:

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[10] U.S. Congress, House, Committee on Science and Astronautics, <u>Report</u>, 28 May 1959, p. 3. (<u>Status of Missile and Space Program</u>)

I think we are agreed that the United States has the resources, the knowledge, the will--and the duty--to pioneer in the space age. If the rewards of space research are to be realized for the benefit of all mankind, it is imperative that this country lead the way. Our free society has paced the development of science and technology for the benefit of mankind for decades. Challenged now by a totalitarian and determined competitor, we have added reason to pursue vigorously a well-planned and broadly conceived research and development program on a continuing basis of urgency.[11]

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[11] U.S. Congress, Senate, Hearings Before the NASA Authorization Subcommittee of the Committee on Aeronautical and Space Sciences, April 1959, p. 5.

CHAPTER III

NAVAL REQUIREMENTS AND U.S.S.R. THREAT

The U.S. Navy looks at space from a military point of view as affecting both world power positions and as offering distinct advantages to the side that exploits it vigorously and intelligently.[1] The militarily important capabilities of space vehicles already within the realm of technical feasibility will directly influence the manner in which the Navy performs its primary task of controlling the seas. In order to fulfill this basic mission, astronautics programs carried out either directly by the Navy or under its control are necessary so that modern weapons can be utilized to maximum efficiency. This is vividly demonstrated by the interlocking of the POLARIS submarine system and the navigation satellite TRANSIT, to achieve an accurate weapons system under all-weather conditions.

The evolution of new weapons and technology necessitate that policy decisions and plans be extremely flexible and reactive to all circumstances. The inherent flexibility and mobility of the Navy fits in well with this concept, set forth in CNO's policy for the use of space, as follows:

> Space is a medium that holds great promise and, at the same time, great threat for the U.S. and the Free World. The Navy will use space to accomplish naval objectives and to prevent space from being used to the detriment of those objectives. Specifically, the Navy will pursue the necessary research and technological developments which will enhance its ability to conduct operations in space which are in support of roles and missions presently assigned to the Navy.

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[1] CNO letter of 13 June 1960; subject, Trends in U.S. and USSR Space Programs. Encl (1), "Trends in the Exploration and Exploitation of Space," p. 3. (SECRET)

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The Navy will participate fully in space technology in order to contribute the tremendous resources of the Navy to the national effort, including the logistical and operational advantages which can be gained by maritime support to space operations and development programs. In the interest of economy and efficiency, it will pursue, in partnership with the other services, the technological developments which will permit the defeat of space operations of other nations which threaten the U.S. The Navy will also vigorously support national civilian space programs, to which the Navy's unique capabilities can provide significant contributions.

The Navy astronautics program will receive high priority in the overall Navy research and development program.[2]

Prior to the summer of 1959 the Navy lagged in exhibiting a pronounced interest in space; however, at present it is asserting itself very strongly in establishing requirements for astronautics systems which will increase the combat capabilities of the naval forces. The compelling need for available money for more immediate requirements was the main reason for this slow start in initiating specific space projects. The Navy's responsibility to the Marine Corps, to naval aviation, and to ships at sea, demanded a broad, diverse development program. One of the Navy's toughest financial problems is the maintenance of its carrier strength in the face of increasing opposition from many quarters. To sustain and maintain this carrier force with its supporting ships, the Navy has been forced to spread its budget thinly among all agencies in order to uphold its limited war potential and primary mission regarding control of the seas. Mainly, because of insufficient "dollar support," the Navy is devoting considerable "in-house" abilities to the develop-

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[2]"Mission, Budget, Policy and Message from Admiral Martell," Data, 5, August 1960, p. 11.

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ment of equipment for operations in space, rather than to development of equipment for getting into space.

The strategic, tactical, logistical, technical, and security aspects of doing ballistic missile and space vehicle work at sea are obvious.[3] Thus, the Navy is already participating in many phases of military space technology, and will be able to make significant contributions to the scientific and military developments in the space age, as well as to benefit from the utilization of satellite and interplanetary operations.

In considering satellite systems designed to meet specific objectives, it must be recognized that the Navy has its own unique requirements, related to its special roles and missions, which frequently differ markedly from those of the other services. As early as November 1957, the Navy defined military operational requirements for the following major satellite systems: Reconnaissance/Surveillance, Navigation, Communications, and Meteorological. A more detailed examination of these requirements in light of our underlying operational concepts and the ever-present Soviet threat is considered appropriate.

Reconnaissance-Surveillance. A satellite flies in a reasonably stabilized orbit in inertial space while the earth rotates under it, thus exposing its entire surface to the view of the satellite twice per day. The objective of such a system of satellites would be to obtain constantly and instantaneously reconnaissance and surveillance data and relay them by photographic, video, or other

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[3]U.S. Navy, Ad Hoc Committee to Recommend Policy on the Use of Space and Science of Astronautics, op. cit., Vol. I, p. 5. (SECRET) (For Navy eyes only)

electrical transmissions and recording techniques to surface ships, submarines, aircraft, and shore stations in order to permit tactical and strategic use of this information. Since naval striking forces will be directed towards both the conduct and deterrence of limited war and general war, the early warning, deployment control, force inventory, and damage assessment gained from such a reconnaissance satellite system, will provide essential intelligence to naval commanders. In most reconnaissance applications, a satellite has the advantage of being able to survey territory from which our aircraft are excluded. This presupposes that the orbiting of an observation satellite would not be regarded as a provocative act in the same way that a flight of a photo-reconnaissance plane over unfriendly territory would be viewed, since it would be impossible to positively determine the true nature (reconnaissance, meteorological, navigation, etc.) of the satellite without a detailed inspection and assessment of the actual mission.

In addition to enhancing fleet operational capabilities, a system comprised of observation and detection satellites (SAMOS and MIDAS), transmitting intelligence to anti-missile missile submarines located strategically with respect to enemy launch sites could have many advantages, such as early detection, anti-missile missile interception possibly over enemy territory, and avoidance of the decoy problem, since no decoys are likely during the launch phase of the trajectory.[4] Such an anti-missile missile subma-

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[4]U.S. Office of Naval Research, Naval Analysis Group, op. cit., p. 163. (SECRET)

rine system linked with the POLARIS submarine capability could conceivably be developed into a "packaged task force" of enormous potential, offensively and defensively. Amplification of this concept will be included in a later chapter.

Navigation. Naval objectives in the navigation field are reflected by the current experimental TRANSIT navigational satellite launched into orbit 22 June 1960 by the THOR-ABLE STAR booster. It is giving a new meaning to space and will contribute immensely to aerial and maritime navigation accuracies under all-weather conditions. It has demonstrated the feasibility of using artificial satellites to obtain position "fixes" for aircraft, ships at sea, and submarines. Using its precise navigational data, the accuracy of the ballistic missile submarines (POLARIS) will be greatly improved. It is believed that this system, utilizing a very intense radio point source, will meet the Navy's requirement for a world-wide, all-weather navigational network achieving accuracies of plus or minus .1 mile. The incorporation of this satellite into the anti-missile missile submarine and POLARIS submarine "task force" is visualized, and for that matter is mandatory for a completely effective "package." In addition to the above accuracy requirement, the Navy desires the useful life of these navigational satellites to be five years or more, during which they would give forth information at time intervals not exceeding two hours. Since the satellite transmits continuously on two related frequencies, navigators will need only special receiving equipment to obtain their positions from the satellite. There will be no need to trigger or interrogate the satellite.

Communications. It is quite apparent that in order to operate effectively, the Navy depends on reliable long-distance communications. Besides the control features involved in the direction of naval forces throughout the world, the increasing enemy potential makes it mandatory for all elements of the Navy to be immediately reactive and informed regardless of their locations. Heretofore, the curvature of the earth has been to some degree a limiting factor in naval communication, but now by virtue of their relative height, satellites are capable of furnishing line-of-sight communication to deployed fleet units anywhere in the world. Global communications can be attained by the satellite-transport of stored information between widely separated points or by a series of relay satellites. The size and complexity of modern fleet units have increased the amount of communications flow and data handling to the point of continuous circuit saturation. Presently, the Navy's very low frequency fleet broadcast provides reliable radio communications over long distances, and is the only known means for long-distance communications to submerged submarines. Since most of the world's long-distance radio communications operate within a comparatively narrow frequency band, this band is highly susceptible to jamming or unintentional interference. If for no other reason, an alternate communication link for the fleet and shore installations is needed, especially during critical periods of a hostile threat. The need for a large communication capacity within the tactical fleet becomes a decided reality in connection with enemy air or missile operations. During this critical period of operations, both defensively and offensively, the communications activity can reach extreme proportions and so saturate our present circuits that coordinated control and information-passing could be greatly reduced and ineffective. The development of long-distance communication systems utilizing satellites could eliminate or relieve these inadequacies on a global scale. Both active and passive (radio reflectors) satellites can support a large number of simultaneous communication channels without causing mutual interference.

Meteorological. Similar to the data provided by the foregoing categories of satellites, and equally important, weather analysis and prediction are vital to naval operations. Knowledge of the present weather and accurate forecasting of the future weather over the entire naval theater of operations would be of inestimable value to the Navy in convoy routing, mission planning, and tactical operations in general.[5] In this respect, the satellite promises to be the biggest means of improving weather forecasts that has been developed for generations. Also, measurements of thermal radiation of the earth and its cloud cover could lead to a better understanding of the heat distribution of the atmosphere in relation to the generation of wind conditions.

Navy operational problems are peculiar to naval commitments, which are widely displaced over water areas accounting for approximately three fourths of the earth's surface. In order to fulfill these commitments on a priority basis, it is essential that the Navy control its own weather service. A naval meteorological satellite system

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[5] Ibid., p. 87.

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is visualized, furnishing weather observations and measurements to designated centers around the earth for military assessment and subsequent distribution of information to all ships, aircraft, and stations on a priority basis.

The capability of weather observations/measurements over the oceans and land areas of the world in the furtherance of naval missions is considered a major "break-through" in the field of naval operations and planning, defensively and offensively. Weather information provides great tactical and strategic advantages to fleet operations; therefore, the usefulness of satellite weather data depends upon its timeliness, accuracy, and completeness. The TIROS meteorological satellite program has proved the feasibility of such an endeavor and has made valuable contributions to meteorological research.

The following areas of naval warfare are particularly dependent upon adequate current and predicted weather information, such as may be ultimately realized from meteorological satellites: special weapons delivery by manned aircraft, barrier operations, antisubmarine warfare, amphibious operations, arctic operations, photographic reconnaissance, convoy routing, and sustained operations at sea.[6]

The previous discussion considered certain naval requirements and fields of interest concerning satellite systems in space. Fully realizing that such developments in enemy hands could be used to the detriment of naval operations, let us take a brief look at U.S.S.R. capabilities in this respect.

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[6]U.S. Navy Ad Hoc Committee to Recommend Policy on the Use of Space and Science of Astronautics, op. cit., p. 45. (SECRET) (For Navy eyes only)

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U.S.S.R. Space Threat. Russia's demonstrated capability to get heavy, well-instrumented satellites into orbit indicates that the threat of Soviet military use of satellites must be anticipated. Reconnaissance, communication, navigation, and meteorological satellites to support their submarine fleet are also programs within their capability. Presently, the U.S.S.R. is ahead in the development of large boosters, and it is considered safe to assume that passive and active counterspace systems will be made operational in the future. The Soviets can be expected to take passive, active, and psychological counteraction to prevent effective United States surveillance of their territory. At the same time, the primary objectives of U.S.S.R. space reconnaissance probably will be directed at the U.S. Fleet. The use of manned satellites by the Soviets could give them a distinct advantage in solving the problem of sea-surveillance. In the field of space communications, we can certainly foresee U.S.S.R. countermeasures against our systems by both jamming and anti-satellite procedures. It is felt that the U.S.S.R. will use international pressure to reduce United States military and scientific satellite effectiveness by arguments of violation of their territory and other discrediting issues.[7]

The power of the Soviet Union has been growing both absolutely and relatively vis-à-vis that of the United States, until today it constitutes a grave threat.[8] Heretofore, we have tended to underestimate the military technology of the U.S.S.R. The Soviet weapons program has

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[7]CNO letter of 13 June 1960, p. 17. (SECRET)

[8]Rockefeller Brothers Fund, International Security--The Military Aspect, Special Studies Report II, p. 10.

given high priority to the development of rockets, missiles, and space vehicles including satellites. It is the last-named device which presents the most serious menace to naval operations, particularly in the form of the reconnaissance satellite.[9] In the near future reconnaissance vehicles should be able to carry one- to five-ton pay loads and could be employed either as permanent satellites or as recoverable spacecraft. The Soviets may also have vehicles of up to 50-100 tons' pay load during the 1965-1970 period. The most significant threat is to easily identifiable targets such as convoys. Naval task forces in dispersed formations will be more difficult to assess by means of early type Soviet optical reconnaissance satellites; however, normal developments in the state of the art should ultimately give them ground resolutions of the order of a few feet. Presently, in order to obtain a finely detailed picture, the physical recovery of the data or photographs recorded by the satellite is required. Physically recovered data do not pose a great danger to moving naval targets because of the time element involved in the recovery process; the ultimate Soviet capability of quickly telemetered data via satellite is the important menace to undisclosed naval operations of surface elements. In terms of the immediate future, snorkeling submarines should be practically immune to satellite reconnaissance until such time as a high-resolution, sophisticated system is developed.

Theoretically, a Soviet listening or ECM satellite could systematically cover the entire ocean area; however, its

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[9] Naval Warfare Analysis Group Study No. 13 (U), The Threat from Enemy Spacecraft Reconnaissance to Naval Operations, 17 May 1960, p. 11. (SECRET)

listening period is comparatively short and requires frequent adjustments to maintain peak sensitivity in order to pick up low-powered signals. Nevertheless, the fact remains that these satellites will have the potential of listening to samples of all our high-powered radio and radar transmissions.[10]

Infrared reconnaissance satellites may be used to pick up targets at night adequately enough to give rough fixes on formation positions. In addition, ships and their wakes may be more sharply differentiated from the sea background than they are in visible light. Infrared sensing, unaffected by weather or time of day, would also give the Soviets rapid notice of our ICBM and FBM launchings, including a rough location of the launch point.

The meteorological satellite in Soviet hands will give them an improved intelligence picture of the weather in the naval force operating area. Their estimate of the situation will be more accurate as to our capabilities and possible intentions in view of the prevailing weather conditions. They can then better plan their courses of action and employment of forces.

Due to the mobility and dispersal of naval forces, the threat to these elements by Soviet ballistic missiles is considered remote, and the use of a bombardment type satellite platform for this purpose is even more remote.

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[10] *Ibid.*, p. 17.

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CHAPTER IV

NAVAL STRATEGY IN THE SPACE AGE

> Our space program has an importance far beyond the field of activity itself, /In/ that it bears on almost every aspect of our relations with people of other countries and on their view of us as compared with the USSR. Our space program may be considered as a measure of our vitality and our ability to compete with a formidable rival, and as a criterion of our ability to maintain technological eminence worthy of emulation by other peoples.[1]

G <u>General</u>. Sometime within this decade, "invulnerable" deterrent powers of the United States and of the U.S.S.R. will reach a balance, unless a major break-through in technology is realized by one side or the other. Our strategy or courses of action may develop into a contest for attaining perfection in warning systems, and for gaining loyalties of new states born of intense nationalism; or possibly we may be involved in limited conflict, at worst. In this respect and in all categories of international relations during this period, our relative military strength compared to that of the U.S.S.R. is the most essential item of influence. It is firmly believed that our relative military posture is <u>today</u> our most important organ of collective strategy (political, socio-psychological, economic, military). At the meeting tables and international forums, these other factors of national strategy revolve about military posture like supporting satellites, useful at times, but not as persuasive and forceful in the furtherance of our national and international interests.

[1] George V. Allen, Director, U.S. Information Agency, in a statement before House Committee on Science and Astronautics, 22 January 1960, <u>Air Force</u>, 43, March 1960, p. 65.

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The United States, with global responsibilities that are vast as compared to those of the World War II era and the period immediately thereafter, has not found it easy to adjust to the rapidly changing world conditions characteristic of the present-day atmosphere. The nucleus of United States policy and strategy lies in the creation of a common front with like-minded nations through the formation of a Western bloc series of alliances and collective security groupings. As the strongest power, and the only one participating in all these alliances and collective security pacts, the United States became the leader of a world-wide coalition. The difficulties and dilemmas that a democracy faces in assuming a role of leadership in the world are quite apparent. Unlike the U.S.S.R., the United States has no rigid doctrine, no dreams of empire, and no dynamic strategy of expansion by force or subversion. Its concept of legal, international order justifies the use of force to resist aggression but not to engage it. Concern for the opinion of other free nations makes the United States rely on persuasion and consent in order to obtain cooperation from others. It is in this sphere that a relatively strong military posture would give this country the greatest influence.

Military Strategy. The most basic and impelling ingredient in the formulation of national military courses of action is survival--survival of people and survival of governmental system. Survival depends upon victory in battle, which from an operational viewpoint depends upon a strong will to win, mobility, flexibility, and freedom of action of forces. This will permit the most effective decisions and undertakings during the course of any engagement. In this context, it is imperative that we attain and preserve an extremely strong power status relative to the U.S.S.R. The oceans of the world provide us with a natural, global platform on which to position our deterrent assets, absorb enemy destructive devices, and sustain an offensive military posture. Naval forces, aided by space technology, will maximize our chances for survival and ultimate victory in case of actual conflict, and act as a powerful deterrent during the cold war phase. Strategic naval forces properly constituted and equipped to engage in ICBM-type exchanges would tend to draw the fire of missiles from the continental United States to the ocean areas, where their effectiveness diminishes greatly. Nuclear missiles are highly destructive against known, well-located, fixed targets, but the mobility and secrecy of fleet movements almost completely counter this powerful weapon. Airfields housing our strategic retaliatory bomber force and our ICBM centers also draw the fire of enemy missiles. The more we harden these bases and centers, the greater the size and numbers of missiles which will be hurled by the U.S.S.R. to accomplish destruction in our heartland. The opportunities offered by the free oceans of the world, coupled with our superior and versatile naval forces are immense. It would appear that our main task is to blend naval assets with space accomplishments in order to obtain a retaliatory/offensive military posture so overwhelming that the U.S.S.R. would never dare risk an engagement with this country. The possession of such a force would also have its effects registered in our favor as regards the political and psychological factors of influence in our game of international "bargaining."

Since the U.S.S.R. is practically landlocked, it would be most difficult for them to duplicate our naval assets embodied in the inherent capabilities of our seagoing forces. This gives us a decided advantage in the formulation and prosecution of naval strategy. Within this spectrum of world power considerations, control of the seas is the most dominant factor. The Navy's progressive extension of its operational capabilities in the fields of reconnaissance, communications, meteorology, and navigation by spatial systems in order to exploit its numerous strategic advantages is the main theme of this paper. It is felt that the nation which has the technological knowledge to adapt space and space supporting systems to earth-bound military machines will have accomplished a feat of tremendous proportion, and one which will have a definite impact on military strategy. An important fact which applies to all proposals in the development of future systems and strategies is that progress must be made toward solving the problem of countering and destroying the enemy's military threat--it is toward this end that our naval strategy, supported by space technology, should be directed. The number and wide variety of space projects and related systems listed in Chapter II give us an expansive field from which to draw in formulating future military strategy and operations. The historical analysis, including the development of naval requirements in space, contained in the previous chapters provides a background on which to base more definitive suggestions regarding naval strategy utilizing space systems and technology.

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"Packaged Task Force." This term was referred to earlier in this paper relating to a discussion of naval objectives and requirements. The "packaged task force" implies a small, powerful, compact naval force with the capability of performing a versatile array of offensive and defensive naval missions. This force does not exist at this writing; however, certain elements are currently operational, and within the time frame of this paper, the evolution of the other elements is feasible. The major components of this force include nuclear-powered POLARIS submarines, anti-missile missile submarines, and guided missile destroyers/cruisers supported by reconnaissance, communications, navigation, and meteorological satellites. The actual number of submarines and ships in each category would be flexible and would depend on the task assigned. The destroyers/cruisers, in addition to their normally designed mission, would act in the capacity of control and electronic surveillance centers. The submarines would be capable of operating independently of the surface ships, having a lesser degree of reliability in electronic surveillance and warning only. The resupply aspects of this strategic force would conceivably be less demanding than that of our present-day naval groups, and mainly consist of missiles and special spare parts. In order for this "packaged task force" to be of maximum strategic value, several such forces would have to be positioned in ocean areas around the earth, be relieved on station, and be tightly controlled by centralized authority. This is quite a formidable undertaking, particularly the latter requirement. The reliability of the entire force to react efficiently and effectively is dependent on accurate posi-

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tioning, immediate communications, and credible intelligence collection. These are the areas in which our space assets begin to extend our operational capabilities, which in turn broaden our strategic concepts involving naval forces.

Accurate Positioning. The accuracies expected of the TRANSIT navigation satellite system, as indicated previously in Chapter II, will satisfy this exacting requirement. This system will enhance the ability of POLARIS submarines and anti-missile missile submarines to obtain more accurate firing data with reference to land target locations and enemy ICBM trajectories respectively.

Immediate Communications. This factor, which is so essential in effecting positive control, has plagued the military services for many years. A world-wide, real-time, communication system such as Project ADVENT, supplemented by the passive, reflector type satellite ECHO and delayed repeater satellite COURIER, should give our naval forces dispersed on a global scale a multiplicity of communications channels to attain near perfect reliability under all-weather conditions.

Credible Intelligence Collection. This segment of the over-all reliability picture includes reconnaissance, early warning, and meteorology factors. The military connotations of a reconnaissance-type satellite are obvious. It would be extremely advantageous to view the entire navigable waters of the globe at a resolution adequate to detect the presence of enemy shipping, unusual activity in port areas, and strategic target locations inland; and to obtain damage assessment information subsequent to air

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or missile attacks. The satellite project SAMOS is designed for this reconnaissance mission and should satisfy both land and sea surveillance requirements. Early warning of aircraft or ICBM attack is a definite form of intelligence. The MIDAS satellite infrared detection program is aimed at solving this problem by sensing missile launches and jet bomber intentions. In conjunction with our electronic warning nets, the early warning satellite system should be able to feed sufficient tracking data to our control centers afloat for relay to the POLARIS submarines so that they could retaliate, and to our anti-missile missile submarines for early interception of the enemy missile trajectories. The "packaged task force" in this case would have to be positioned at strategic points in the vicinity of the most probable enemy missile tracks. Automatic command features and instantaneous communications are a must in order for the system to react in time. Detection, tracking, computation, and decision must be resolved in about seven minutes to insure successful interception. Meteorology and weather forecasting complete the "intelligence-by-satellite" triangle. The well-known TIROS satellite and the more advanced weather satellite NIMBUS lead the way in establishing background data to achieve this capability. The consideration of weather and subsequent accurate military weather analysis are such a basic element to naval operations that they need not be amplified. You can imagine the advantages gained by a commander's being able to make tactical decisions derived from timely and accurate weather interpretation. In fact, the commander may possibly be able to see the weather in the target and sea maneuver areas delivered by a television presentation, photographs relayed by radio links, or an ejected capsule of current photographs recovered at sea.

As previously stated, due to the bulkiness of the gear necessary to accomplish the task, the guided missile destroyers/cruisers in this strategic naval force would act as control and electronic surveillance and warning centers. These ships would also be responsible for their designed close- and medium-range antiaircraft mission, using TERRIER, TALOS, and SUPER TALOS missiles. Too, they would have an ASW capability, be utilized in recovering ejected information capsules from satellites, and serve a limited resupply function to elements of the force. The recovery of information at sea from satellites and other space vehicles has decided naval implications. The vast free ocean areas are available in obtaining optimum recovery positions for pick-up vessels, the security problem is at a minimum, and sensitive equipment (including humans) has greater chance to survive water landing, to mention several advantages.

Economics and Naval Strategy. Throughout this paper the all-powerful economic factor has been ignored by choice. Technological advancement is geared directly with the dollar, and for that matter, so is national strategy. In our society, economic considerations influence military courses of action to such an extent that diversification of forces to attain balance is extremely difficult. On the other hand, the tightly controlled economy of the Soviets allows for more freedom of action and allocation of resources in support of military decisions. Nevertheless, it is firmly believed that the economic stature of this country could sustain much more emphasis on the development of sophisticated weapons systems so necessary in achieving a relatively

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superior military posture to that of the U.S.S.R. True, this may have some effect on our standard of living; however, this sacrifice will be offset by the psychological relief made possible through the knowledge that our military superiority and credible ability can effectively counter threats of annihilation and piecemeal attacks on weaker nations in the free world. Certainly, there is a limit to expenditure of funds on weapons systems in the furtherance of military strategy. However, it is not believed that we have reached or are near that limit as of this writing. Therefore, the implications of space on naval strategy were not considered within the boundaries of economic restraints so prevalent in all government departments.

Future Considerations. At the beginning of the last decade our present capabilities in space technology would have been considered fantastic. In orderly succession to our present-day research and experimentation will be our exploration of the planets in order to establish control and increase our national prestige, military posture, and economic base by the development of natural resources. As previously indicated throughout this paper, space technology will serve to enhance naval operations, and in the distant future will foreseeably change the character of naval strategy in national defense operations. When manned satellites or space vehicles, together with their weapon-dropping potential, become commonplace, it will be imperative that we possess an anti-satellite capability. The Navy's future considerations should include this type of endeavor in order to take advantage of the mobility and global spread of naval forces in establishing optimum posi-

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tions for interception. Within the purview of national effort, the Navy should take its rightful place in the development of planetary bases and in charting the planetary waters for instituting sea-launch and recovery systems involving space vehicles. Many of the highly sophisticated projects under development and study, as enumerated in Chapter II of this paper, suggest space vehicles of such size that sea-launch and recovery are the most economical and secure means of operation. Also, by virtue of its previous background in nuclear power plants, the Navy should assume an active role in the field of nuclear propulsion, which is so essential for sustained outer space exploration. The constructing of artificial islands offshore for the launching of rockets with pay loads of 100,000 pounds or more is certainly a possibility. This would eliminate many of the hazards involving highly energetic chemical fuels of tremendous thrust, and would afford a more secure installation than presently obtainable at similar land-based systems. A satellite for detection of submerged submarines would be a real "break-through" in the area of antisubmarine warfare. Actually, if you let your imagination run down the "road of future considerations," there would be an infinite number of military requirements which conceivably could be satisfied by space technology <u>in time</u>. During this period of scientific prominence, it is hard to disbelieve that anything can be accomplished <u>in time</u>--the comic strips of some years ago coupled imagination and time into a pattern which is about to become a reality.

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CHAPTER V

SUMMARY AND CONCLUSIONS

This paper has attempted to outline the implications of space to the Navy by a consideration of history, controlling government space agencies, programs, naval requirements, and, finally, effects on naval strategy. Suggestions were made regarding those areas of interest which should be exploited by the Navy in order to extend its present capabilities and assimilate these capabilities into its operating media--land, sea, air. Space encompasses all of the conventional media, and, because of this fact alone, projects its vast potentialities across the entire spectrum of weaponry, supporting systems, and scientific research. Space technology has launched this nation into the preliminary stages of a new era and has stimulated the interest and imagination of industry, military, and government. Utilization of space by the Navy offers tremendous advantages in the accomplishment of its basic mission--control of the seas. Space is not the exclusive area of operation of any military service, and the role of the Navy in space is primarily justified by its historical and current ability to project naval might anywhere in the world. The extension of this ability by space systems is a natural outgrowth of the versatile and balanced powers inherent in our naval force structure.

In this paper, Navy requirements that might be served by space operations have been suggested. The fulfillment of these requirements will expand the Navy's role in the strategic and retaliatory phases of our national defense and contribute greatly to our national posture. The supporting

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satellite systems in the fields of communications, navigation, meteorology and reconnaissance are but a portion of over-all space implications for naval pursuits. These programs were considered to have a more immediate application to essential naval problems, and therefore have been emphasized as a departure point for the development of naval requirements. The "packaged task force" concept expressed by the writer is undoubtedly one of many combinations of naval power which could be utilized in strategic offensive or defensive capacities for the furtherance of our national defense on this planet.

It is evident that many of the space systems discussed in this paper would have an adverse effect on our naval operations, if they were held by the U.S.S.R. This is one of the undeniable facts of life applicable to all phases of national strategy. Effective counteraction weaponry and strategy are major military requirements that must be fulfilled in order to maximize the vast potential of our mobile naval forces. The primary U.S.S.R. threat in this connection is obviously satellite surveillance of the ocean areas. For this reason, the main attack elements of the "packaged task force" are submarines which can operate independently of surface ships, if necessary.

During the course of this research, the writer was so impressed with the magnitude of the space programs and related projects being undertaken by this nation that an entire chapter was devoted to this field of endeavor. This display of current and future "tools of the trade" forms an extremely versatile technological base of departure for our military authorities in the generation of relevant military requirements. The House Select Committee on Astronautics and Space Exploration in their very comprehensive report, H.R. 2710, summarized the impact of space on national strategy as follows: "We are in an age of rapid technological change wherein the strategic balance of power can shift to the nation first achieving operational usability of new scientific developments." Maintaining this balance of power in our favor is the motivating principle of all national strategy. The attainment of operational usability of new scientific developments by the Navy will enhance its ability to support this principle, and at the same time insure a role in space for naval strategy.

As a result of this investigation into the significance of space to naval strategy, the writer submits the following major conclusions:

1. There has been no marked change in basic naval strategy caused by space technology--the capability to use the seas in support of the national interests and deny their use to our enemies remains a fundamental Navy mission.
2. The Navy can extend its operational capabilities to an unprecedented degree by the employment of near-earth space systems, such as navigation, communications, reconnaissance, and meteorological satellites.
3. The Navy has the capacity now to assume a greater role in the over-all strategic responsibilities of the nation's military services.
4. Strong mobile naval units at sea, capable of missile and anti-missile warfare, enhance the invulnerability of our strike and/or retaliatory forces.
5. Though NASA and ARPA administer the national and military space programs respectively, the Navy has

the responsibility and obligation to utilize the space environment to its fullest in the accomplishment of offensive and defensive missions.

6. The Navy's ability to operate for the most part undetected over the ocean areas will be considerably hindered by observation satellites possessed by the U.S.S.R.

7. The magnitude and diversity of the national effort in the space science program will form a well-balanced foundation from which the Navy can pursue space projects which are peculiar to its responsibilities and interests.

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