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SCIENTIFIC INTELLIGENCE REPORT 3EP 1959

THE SOVIET SPACE RESEARCH PROGRAM

MONOGRAPH II **OBJECTIVES**



CIA/SI 32-59 21 August 1959

CENTRAL INTELLIGENCE AGENCY

OFFICE OF SCIENTIFIC INTELLIGENCE

Approved for Release by CIA Date SEPTEMBER 2008

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Scientific Intelligence Report

THE SOVIET SPACE RESEARCH PROGRAM

MONOGRAPH II OBJECTIVES

NOTICE

The conclusions, judgments, and opinions contained in this finished intelligence report are based on extensive scientific intelligence research and represent the final and considered views of the Office of Scientific Intelligence.

CIA/SI 32-59 21 August 1959

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PREFACE

The objectives of the Soviet space research program have been obscured by frequent and variant Soviet statements, often by responsible officials. Nevertheless, the immediate and long-range objectives can be determined to a considerable degree by a review and evaluation of Soviet statements and activities relating to principal astronautical goals, the purposes of current space projects, and the political, military, and scientific aims of the USSR. In considering Soviet statements, the greatest weight must be given to those by officials and scientists who are in a position to know Soviet plans and who have proved to be fairly reliable spokesmen in the past.

This monograph is based on information available to 15 May 1959 and is one of 12 monographs (listed below) on the Soviet space research program. Monographs II through XII are designed to support the conclusions found in Monograph I, which will be an overall evaluation of significant Soviet space research capabilities and will be published last.

Monographs on the Soviet Space Research Program:

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- II Objectives
- III Organization, Planning, and Control
- IV Space Vehicles
- V Propulsion System
- VI Guidance and Control

- VII Telemetry, Communications, and Reconnaissance Instrumentation
- VIII Ground Support Facilities
- IX Space Medicine
- X Space Biology and Astrobiology
- XI Astronomical Aspects
- XII Current Status of Progress

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THE SOVIET SPACE RESEARCH PROGRAM

MONOGRAPH II OBJECTIVES

SUMMARY AND CONCLUSIONS

The Soviets are fully aware that their penetration of interplanetary space will present unique opportunities to advance their national objectives, particularly those of a political, military, and scientific nature. At this stage of their conquest of space, they probably have not been able to formulate detailed plans along these lines, but there are indications that they intend to take full advantage of opportunities as they arise. Since there are many unknowns in space research, the Soviets will undoubtedly find it necessary to reexamine their space program from time to time.

One of the objectives of the USSR space program which became apparent at an early date was the use of Soviet accomplishments for political propaganda purposes, especially in an attempt to convince the world of the superiority of the USSR and the Communist system and to intimidate the rest of the world by the missile capabilities implied by space successes.

The Soviets have been cautious in speaking of the military objectives of their space program, but they have discussed them, and it is believed that they will use space vehicles for offensive and defensive purposes and for military communications, electronic countermeasures, navigation, and reconnaissance.

The early Soviet space efforts, particularly Sputniks II and III, demonstrated a strong Soviet desire to advance basic science and to increase knowledge of the earth, the solar system, and the universe. In the fields of astronomy and geophysics, immediate Soviet. objectives include greatly improved observations by means of instrumented satellites and probes; fundamental physical experiments have also been planned. Much of the scientific interest appears to result from Soviet objectives to find methods of tapping new energy sources in space and exploiting the natural resources of the moon and planets. Some of the immediate practical objectives of the scientific program in space include improved communications; weather observations; geodetic measurements; sea-ice and polar surveys; high precision cartography; nuclear test detection, and the determination of environmental radiation hazards.

The principal objective of the USSR in the field of astronautics is to place manned and unmanned controlled vehicles into interplanetary space. For manned controlled ve-

hicles its projects concern: (a) the vehicle recovery problem; (b) space bio-medical problems; (c) protection against radiation hazards; and (d) space environment research. For both manned and unmanned controlled vehicles, the Soviets are developing: (a) space navigation communications, guidance, control, tracking, data handling, and calculating devices and procedures; (b) more powerful propellants and sources of power; (c) lunar and interplanetary probes, with Venus and Mars as the most probable early planetary objectives; and (d) artificial satellites for scientific, communications, and reconnaissance purposes. The Soviets have indicated that some of their current projects will lead eventually to the establishment of multi-purpose stations in space and on the moon and planets.

The Soviets have discussed the problem of sending probes beyond the solar system into interstellar space, but there is no evidence that such a program is being seriously considered at this time.

Indications are that the Soviets intend to continue to use the resources of the entire Bloc area in space research and possibly to encourage some high-altitude-rocket sounding programs in other leading Bloc nations. Communist Chinese reports that they will launch research rockets and artificial earth satellites probably indicate that the Soviets are considering assisting in such a program for political and propaganda purposes.

DISCUSSION

INTRODUCTION

Events leading directly to the Soviet launching of Sputniks I, II, and III and the Lunik/Mechta rocket are generally known. Much less known, however, is the history of astronautics in Russia, which dates from the end of the nineteenth century, when I. V. Mescherskiy investigated theoretically the dynamics of bodies of variable mass and K. E. Tsiolkovskiy began his work on the principles of rocket flight.12 Although Tsiolkovskiy is usually credited by the Soviets as being the founder of scientific astronautics, several of his contemporaries also made fundamental contributions.28 In 1929, Ya. I. Perel'man, I. P. Fortikov, and other followers of Tsiolkovskiy founded a rocket organization known as GIRD (Group for the Study of Reactive Motion). Some of the papers produced by GIRD indicated a high degree of technical competence in the various aspects of rocketry and space exploration.4 Members of GIRD who are still very active include I. A. Merkulov, Yu. A. Pobedonostsev, and M. K. Tikhonravov.

The Soviet Government is reported to have organized a rocket research program in 1934, only five years after Germany had done so.

The Soviets have supported an aggressive rocket research policy since 1945. They appropriated most of the German rocket factories and test facilities and put several hundred German rocket experts to work for them in the USSR. Subsequent developments indicate that the Soviet effort has been more than an extension of the German program and that it is based upon independent thinking and research.

By 27 November 1953, the Soviet program had advanced to such a point that A. N. Nesmeyanov, President of the Academy of Sciences, USSR, was able to make confidently the following public statement: "Science has reached a state when it is feasible to send a stratoplane to the moon, [and] to create an artificial satellite of the earth. . . ."

Soviet interest in space flight was further emphasized by the action of the Presidium of the Academy of Sciences, USSR, on 24 September 1954 in establishing the K. E. Tsiokovskiy Gold Medal for outstanding work in the field of interplanetary communications (travel), to be awarded every three years beginning with 1957.8 The name of the first winner of the award was withheld, probably for security reasons.

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An Astronautics Section of the V. P. Chkalov Central Aeroclub of the USSR was organized early in 1954. Its stated objective was "to facilitate the regulation of cosmic flights for peaceful purposes." Its charter members included chairman N. A. Varvarov, V. V. Dobronravov, I. A. Merkulov, A. D. Seryapin, K. P. Stanyukovich, Yu S. Khlebtsevich, and International Astronautics Prize Winner A. A. Shternfel'd.

In April 1955, the Soviets announced the formation of the Interagency Commission for Interplanetary Communications (ICIC) composed of outstanding Soviet scientists and engineers. L. I. Sedov, a leading hydrodynamicist, was named chairman, and M. K. Tikhonravov, who as early as 1934 designed and successfully launched liquid-propellant atmospheric research rockets, was appointed vice chairman. One of the first tasks assigned to the group was the creation of an "automatic laboratory for scientific research in cosmic space" (an artificiai earth satellite) as the "first step in solving the problems of interplanetary travel." The work in the field of astronautics is on a national scale. The ICIC acts as a coordinating committee to direct the activities of the various insti-

The U.S. announcement of 29 July 1955 that it intended to launch an earth satellite during the International Geophysical Year (1957–58) led to much speculation concerning Soviet capabilities and plans in this field, but the Soviets refused to disclose their intentions at that time. A short time later, on 2 August, Sedov held a press conference in which he made a guarded statement indicating that the Soviets were working on a satellite, possibly larger than that of the United States, to be launched in the "comparatively near future." ¹¹

An active Soviet satellite program was confirmed on 11 September 1956 by Academician I. P. Bardin, chairman of the IGY National Committee of the USSR, during a meeting of the Comite Special de l'Annes Geophysical Internationale (CSAGI) in Barcelona, Spain. Bardin stated that the USSR intended to launch a satellite for upper atmospheric re-

search during the IGY, but he declined to outline the Soviet program or to disclose further details.¹²

In 1956, the Academy of Sciences, USSR, applied for membership in the International Astronautical Federation (IAF) and was accepted during the Seventh International Astronautical Congress in Rome in September of that year. The Soviet's lone delegate, L. I. Sedov, was elected a vice president, but more than a year passed before the USSR complied with the by-laws of the IAF and submitted a description of the Academy's ICIC and a list of members.¹²

In December 1956, the Soviets disclosed details of the extent and nature of their upper atmosphere rocket research program. This came about when a delegation of 13 scientists, headed by Academician A. A. Blagonravov, attended the first International Congress on Rockets and Guided Missiles in Paris. Papers presented by S. M. Poloskov and B. A. Mirtov revealed some unique features of Soviet upperatmosphere research rockets, and the presentation by A. V. Pokrovskiy indicated an extensive Soviet experimental aeromedicine program. Subsequent to the release of this information, various articles appeared in Soviet newspapers and scientific journals supplying additional information on the Soviet rocket effort. Among the significant items was the Soviet admission that rocket studies of the atmosphere had been conducted since about 1947.14 15

The Soviet rocket and satellite program for the IGY was outlined in a general manner in June 1957 in a letter from I. P. Bardin to IGY headquarters (CSAGI), Brussels. The program indicated that the Soviets would fire 125 meteorological research rockets from three different geographical zones and would place into orbit an unspecified number of artificial earth satellites.¹⁶

On 1 June 1957, Nesmeyanov was quoted in the Soviet press as saying that the necessary equipment and apparatus had been created to solve the problem of artificial earth satellites. A week later, Nesmeyanov stated, "Soon, literally within the next months, our

planet will acquire another satellite. . . . The technical difficulties that stood in the way of the solution of this grandiose task have been overcome by our scientists." ¹⁸ Other indications of an impending satellite launching included announcements in Soviet astronomical and radio journals giving instructions on methods of observing satellites and receiving their transmissions. ¹⁹ ²⁰ These indications were available to few people in Western countries.

On 27 August 1957, the Soviet press carried announcements that successful tests of an intercontinental ballistic missile had been carried out "in conformity with the plan of scientific research work in the USSR." Then came the successful orbiting of Sputnik I on 4 October 1957, followed by Sputnik II on 3 November 1957, and Sputnik III on 15 May 1958. These launchings introduced the new space age and impressed the world with Soviet scientific and military accomplishments, thereby scoring a major propaganda and psychological triumph. Sputnik III in particular has been evaluated as a major scientific accomplishment.²²

The next important Soviet step in the space research field was the launching of the socalled cosmic rocket on 2 January 1959. There is little doubt that it was intended as a lunar rocket, considering advance statements by Soviet newspapers and astronautical experts, the 62-hour life of the power supply, the significance of the unofficial name "Lunik," * the scientific experiments planned, and the marker carried for the purpose of leaving evidence of the first rocket to impact on the moon.²⁸⁻²⁶ The Soviets were clever enough to reorient their propaganda line after it became apparent that the rocket would not strike the moon but would be drawn into an orbit around the sun by the gravitational attraction of that body. At first, some began to call it "Mechta." ** Thereafter they referred to it as the first cosmic rocket, the first artificial planet, and the first solar rocket. In spite of

failure to achieve its lunar mission, the rocket demonstrated that the Soviets were making progress in their space flight program.

PRINCIPAL ASTRONAUTICAL OBJECTIVES

Manned Interplanetary Flight

Manned space flight on an interplanetary scale is the announced goal of the Interagency Commission for Interplanetary Communications (ICIC), of the Academy of Sciences, USSR.¹⁰ Various spokesmen have repeatedly confirmed this as a principal Soviet objective.^{26–29} Controlled flight in vehicles capable of returning to earth is implied in the ICIC statement.

Unmanned Controlled Vehicles

A number of leading astronautics experts. have mentioned the desirability of using unmanned controlled vehicles in interplanetary space exploration, pointing out that the use of such devices eliminates many of the basic difficulties - such as biological, shielding, recovery, and excessive weight problems - encountered in manned vehicles. The development of unmanned space vehicles is expected to continue to receive a great deal of attention by the Soviets because their initial investigations of space will be conducted with such vehicles. Highly developed unmanned rockets and satellites, therefore, will be important stepping stones in the accomplishment of manned space flight and, according to some Soviet views, they will always be preferable because of cost and safety factors for certain types of space exploration. A. G. Karpenko,⁸¹ V. I. Krassovskiy,⁸² and Yu. S. Khlebtsevich 88 84 have advocated the use of vehicles of this type. The Institute of Automatics and Telemechanics, of the Academy of Sciences, USSR, reportedly is working on associated problems.85

Interstellar Flight

Responsible Soviet scientists have not encouraged the belief that flight beyond the solar system into interstellar space is attainable in the foreseeable future. Typical of the statements relating to this problem is that by

^{• &}quot;Lunik" is a coined word, a play on the word sputnik, meaning a little moon or a moon satellite. Some Soviets also referred to the rocket as "lunalet" (moonship or moonflight).

^{** &}quot;Mechta" means an unattainable dream.

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V. V. Dobronravov, who said, "Some scientists are even thinking of space ships which will take man to other stars of the galaxy. But this is something for a more distant future." *0

CURRENT SPACE PROJECT OBJECTIVES

Responsible Soviet authorities recognize that their principal astronautical goals can only be attained through a series of developments, each being an important achievement in itself and contributing in a cumulative manner over a number of years to the ultimate objectives — manned and unmanned flight by means of controlled space vehicles. Soviet statements and recent events indicate that the space program is well underway and that current projects probably have the major objectives which are outlined in the following sections.

Recovery Problem

A practical solution to the problem of recovering satellites and other space vehicles is regarded as a prerequisite to sending humans into space, according to A. N. Nesmeyanov, L. I. Sedov, and other leading figures. Several have openly admitted that the USSR is working on a recoverable satellite or a recoverable capsule or glider from a satellite.26 29 88 Other similar indicated objectives may include landings by winged, powered vehicles of the boost-glide type. Retardation by utilizing the resistance of the atmosphere appears to be favored, especially in the early stages. V. V. Dobronravov apparently expressed the opinions of many Soviets in July 1958 when he said, "It is quite possible that the first problem will be that of producing so-called guided or recoverable satellites." 87 41 42 Solution of the vehicle recovery and reentry problems will result in the return of animals and later humans from experimental space flights.

Navigation, Communications, Guidance, Control, Tracking, Data Handling, and Calculations

Yu. S. Khlebtsevitch has pointed to the role that radio-electronics must play in providing improved communications, guidance, control, tracking, data handling, and calcu-

lating devices.³³ Other leading authorities who have indicated similar Soviet aims to provide support to the space program include V. Dobronravov,⁴³ I. Kucherov,⁴⁴ L. Yanitskiy,⁴⁵ and G. V. Petrovich.²⁹ ⁴⁶

A Soviet broadcast of 6 May 1958 stated, "The creation of intercontinental ballistic missiles and the launching of the Soviet artificial earth satellites were made possible to a significant degree by the admirable achievements of our radio-electronics. Applying radio-electronic methods evolved by Soviet scientists, it became possible to launch the satellites with exceptional accuracy on previously calculated orbits." 47

Published orbital calculations and demonstrated ability to compute rapidly the ephemerides of artificial earth satellites indicate the existence of a Soviet objective of some priority to support the space program with adequate tracking, ground communications, and computing devices and procedures. The astronomical approach to the space navigation problem was being considered as early as 1952.48

Propellants and Sources of Power

The Soviets have made many statements indicating a long-standing objective of high priority to find and develop new, more powerful propellants and sources of power. Premier Khrushchev has bragged of the enormous power used to launch the Sputniks. Current Soviet propulsion systems appear to utilize chemical systems based upon conventional liquid bi-propellants. Higher-energy fuel combinations will be required for launching significantly heavier payloads to great distances. The Soviets have expressed interest in fluorine, hydrazine, and boron compounds, all of which have potential applications in the development of high-energy fuels; solid propellant fuels have also received attention. Statements by K. P. Stanyukovich, V. G. Fesenkov, and others indicate high interest in nuclear propulsion.6 7. 21 50 51 180 Plans to develop free-radical fuels and ion, photon, and other so-called exotic propulsion systems are undoubtedly being considered as part of a long-range research program. 52-57 60 Other

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methods, such as utilization of atmospheric energy and fields of force in space, appear to be of only secondary interest at present and probably can be classed as long-term objectives. 58 59 85

Bio-Medical Problems

Current Soviet statements, their prolonged tests of life-sustaining systems under space equivalent conditions, their animal recovery experiments from vertical rocket flights, and the orbital experiment with a dog in Sputnik II, all indicate the wide scope and seriousness of the bio-medical space research effort in the USSR.61 There is no doubt that the Soviets intend to advance their program to the point where they can sustain life and recover man from orbital and powered space flight. Typical of the statements relating to this objective is that of A. D. Seryakin who, after pointing out that much detailed study of the effects of space flight on man was necessary, stated, "One thing is certain: Soviet medicine, in cooperation with Soviet technology, will ensure safe conditions for man's life on a cosmic ship . . ." 62 115

Soviet statements indicate that they are working on the use of algae as food for space vehicle crew members and as the active component in a carbon dioxide-oxygen exchange system.62 In addition, it should be assumed that they are studying the possibilities of use of the same or similar organisms as the active agents in waste disposal systems. In the perfect closed biological system all of the waste materials, including solids, liquids, and gases, enter into the system with the regeneration of useful products. It is not anticipated that biological systems for regeneration of food and oxygen will be used in early flights of comparatively short duration, except for testing purposes. Only with long duration flights can a saving of weight and space be made through the agency of air, algal food, water, and gas cycling systems.

Soviet astrobiological research is aimed at determining whether life exists on other planets of the solar system. Most of the Soviet effort has been expended on a study of the possibility of the existence of plant life

on Mars. There are recent indications that some Soviet facilities and personnel formerly devoted to astrobiology have been transferred to studies of man's survival in space.⁵⁴ It can be assumed that Soviet interest in astrobiology will continue, but probably at lower priority for the time being.

Soviet interest in problems connected with the effect of the different factors of interplanetary travel on the human organism has been expressed by I. S. Balakhovskiy, V. B. Malkin, V. V. Rozenblat, Ye. Yugove (Yugov), A. Serov, and others. 66-69 71 Ye. K. Federov stated in a press conference in Moscow on 16 May 1958 that Soviet space research with live animals will continue. 70

Space Environment Research

In addition to lunar and planetary investigations, the Soviets plan to conduct further studies of the nature and processes of the space environment, mostly in the area of astronomical and geophysical research, in support of the space program. This objective has been clearly defined by Soviet statements and by the rocket and satellite program to date.⁷³⁻⁷⁵

A more complete understanding of the upper atmosphere, including density, temperatures, pressure, winds, chemical composition. and ionospheric properties would be extremely useful for space communications and for the design and operation of space vehicles. Increased knowledge of solar and cosmic radiation, of the earth's magnetic and gravitational fields, and of the distribution of meteors, dust, and other constituents of the upper atmosphere and space are of considerable importance to the development of a space program. 76 2. 26-87 With the U.S. discovery of the Van Allen belts, the radiation problem has become important in the attainment of manned space flight. Much work remains to be done in understanding the processes involved, the spacial boundaries, and variations in intensity and extent as well as in determining means of protection or avoidance of the belts.

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Prominent scientists who have discussed the environmental aspects of the Soviet space program include V. V. Mikhenevich, B. A. Mirtov, B. S. N. Vernov, V. L. Ginsburg, L. V. Kurnosova, S. V. V. Belousov, S. Ye. K. Fedorov, G. A. Skuridin, 116 D. Y. Martynov, 1 V. Fedynskiy, Boris Kukarkin, and V. G. Fesenkov. 50

Radiation Shielding

I. I. Sedov and others have mentioned the protection of life against radiation hazards as another important problem to be solved.²⁶ Shielding and associated weight problems are probably being investigated as the results of space environmental and bio-medical research are analyzed.

Lunar and Interplanetary Probes

The Soviet rocket Lunik/Mechta, launched on 2 January 1959, furnished evidence that the development of lunar probes is high on the list of current Soviet space-project objectives. G. V. Petrovich stated in March 1959 that Lunik was "only the beginning of a study of the closest heavenly body to us, the Moon." He predicted later flights around the moon; an artificial moon satellite; landing of scientific equipment on the moon's surface; and the landing of a manned rocket on the moon, possibly two manned rockets to insure safe return to the earth. He stated that a manned circumlunar flight will precede a manned earth-to-moon flight with landing on the moon.29

Petrovich also stated that flights to the planets Mars and Venus, our closest planets, are now "completely within reach." His comments indicated that exploratory trips, approaching the planets as close as possible for observation, would be undertaken before landings are attempted.²⁹

In his opening address to the annual general assembly of the Academy of Sciences, USSR, on 26 March 1959, A. N. Nesmeyanov said "There is no doubt that such gigantic tasks as the attainment and exploration of the moon and, subsequently, of the nearest planets will be accomplished before the cur-

rent Seven-Year Plan ends. Mesmeyanov's statement is believed to refer to the use of unmanned instrumented satellites or probes.

Many other reputable Soviets have indicated plans to explore the moon and planets, including Yu. S. Klebtsevitch. According to his statements in December 1958, the Soviet conquest of the moon will begin within 10 years and will be accomplished in 3 stages: (1) impact with scientific and reconnaissance instruments: (2) landing of radio-controlled rockets with special apparatus and travelling tank laboratories equipped with television and other complex apparatus; and (3) creation of a permanent, manned station on the moon. In the third stage, preparations and provisions will be made for insuring regular. trips between the moon and the earth, according to this Soviet authority on radio telecontrol.210

Other well-known Soviet scientists who have indicated plans for lunar and interplanetary flights include V. V. Dobronravov, 85-87 Ye. K. Fedorov, 85-89 A. A. Blagonravov, 90 91 Nikolai Varvarov, 92 L. I. Sedov, 30 58 94 V. Kaznevsky, 50 and V. G. Fesenkov, 64 In October 1958, L. I. Sedov predicted unmanned space flights to the Moon, Venus, and Mars "in the nearest future." 96

Artificial Satellites

There are numerous indications that the Soviets are engaged in a program to launch a series of artificial earth satellites for scientific, reconnaissance, communications, and other purposes. These include statements by A. N. Nesmeyanov, 178 V. V. Dobronravov, 97 S. Katayev,98 and others.99 100 In March 1959, G. V. Petrovich stated that Soviet space research is concentrated into three principal areas, one being the creation of a number of artificial earth satellites "of different tonnage and purpose." He continued, "First among these in a group of satellites which will provide constant observation over the whole surface of the earth and the air surrounding it. These are to be equipped with the complex scientific apparatus, both optical and television, necessary for this purpose. . . . Further development in this area will bring about

richly equipped observer satellites, real stations outside the earth, cosmic laboratories and observatories. In time, these stations will fill additional functions connected with servicing the interplanetary flights of cosmic rockets." ¹⁰¹

Solar satellites, lunar satellites, and earthmoon satellites have been mentioned in addition to earth satellites. A. A. Shternfel'd has elaborated on space stations of various kinds, including so-called stationary artificial earth satellites, artificial sun satellites, natural satellites of the planets, and lunar and planetary stations. The Table 1958, speaking of a long-term program, mentioned the establishment of a large "cosmic" station which would serve as an intermediary station in space travel. 102 178

OVERALL NATIONAL OBJECTIVES

It is accepted as axiomatic that the Soviets engage in a space program because they expect to advance their national objectives, especially those of a political, military, and scientific nature. If this were not so, they would not expend the effort which they are putting into the space program. Since there are still many unknowns in space research, the Soviets will undoubtedly find it necessary to reexamine the various phases and time scales of their space program from time to time. A typical finding leading to a reexamination is the recent discovery of the Van Allen radiation belts with their possible hazards to space flight. Present evidence indicates that the USSR is working on a number of problems in the space field and will attempt to exploit each development to the utmost.

Political Objectives

Whether by advance plan or not, the Soviets are using their accomplishments in space research as propaganda instruments (1) to convince the world of the superiority of the USSR and the Communist system, particularly in the development of science and technology and (2) to intimidate the rest of the world by the missile capabilities of the USSR

as implied by accomplishments in the rocket and satellite field.

The launchings of Sputniks I, II, and III and Lunik were accompanied by prolonged and intensive Sino-Soviet Bloc propaganda campaigns. Typical of the statements following Sputnik I was that on 6 October 1957 by Kuo Mo-jo. President of the Communist Chinese Academy of Sciences, who said, "Following the successful manufacture of the inter-continental ballistic missile, the Soviet Union again succeeds in the launching of the first man-made satellite. These are the most precious presents to the commemoration of the 40th anniversary of the great socialist revolution. They have much significance in the safeguarding of world peace and the promotion of welfare of mankind. The Soviet Union's successes in scientific technology since the October revolution 40 years ago has clearly demonstrated that this socialist country is the most advanced in the world. The Soviet success may be attributed to the correct leadership of the Communist Party and the superior nature of the socialist system." 108

Following the same event, Nikita Khrushchev made the following statement, "The United States does not have an ICBM, otherwise it would also have easily launched a satellite of its own. We can launch satellites because we have a carrier for them, namely the ballistic missile." 104

In November 1957, following the launching of Sputnik II, A. N. Nesmeyanov made a characteristic statement, "A second Soviet satellite has been launched into infinite space. The second satellite is carrying more than half a ton of scientific equipment. This figure alone testifies to the extraordinary power of the rocket device which carried it. And the launching itself of the second satellite less than a month after the first, and a second satellite which is more perfect as far as its scientific equipment is concerned, shows that we have really entered the era of the exploration of cosmic space, that we are really rapidly progressing toward interplanetary communications. The whole world sees that the launching of the second satellite is not just

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a piece of luck, but the fruit of a great preparation of mature thinking, and of the perfect technology of the Soviet Union." 105

On 18 May 1958, after the launching of Sputnik III, a *Pravda* editorial stated, "It is with admiration that the entire world speaks of the third Soviet artificial earth satellite. Its successful launching is a new and vivid testimony to constant technical progress; it is the result of the outstanding success of science in our country." The article quoted Khrushchev as saying, "These successes are explained by the character of the socialist order which creates the most favorable conditions for uninterrupted progress in the culture of the entire population, for the growth of scientific cadres, and for the development of scientific and technical thought." 106

Following the firing of the Lunik/Mechta probe, Soviet Defense Minister Rodion Malinovskiy stated in a speech on 3 February 1959, "... intercontinental ballistic rockets... cannot be stopped by any antiaircraft means of defense. They are capable of delivering without fail a hydrogen warhead of colossal power to any point on the globe, or precisely to any point. They are exceedingly accurate. No need to doubt this, for the first rocket of this kind has experimentally risen into the cosmos and is now proudly carrying the Soviet pennant around the sun. What other proof is needed of the rocket might of the Soviet power?" 107

Although all available evidence shows otherwise, prominent Soviet scientists have also claimed that the USSR was the first to discover the belts of radiation now known as the Van Allen belts, after the principal U.S. investigator. 108 This phenomenon is the most important recent geophysical discovery relating to astronautics, and the Soviets undoubtedly would like to assume credit for it.

According to some reports, current Soviet space projects include the development of communications satellites which would solve the problem of simultaneous broadcasting of television programs throughout the world. 100 There is little doubt that the Soviets are working on the problem and that, if success-

ful, they will exploit it to the utmost for propaganda purposes.

Military Objectives

It has been stated that every vehicle invented by man has been used in warfare. It is unlikely that space vehicles will prove to be an exception, therefore it must be assumed that the Soviets will employ them for such purposes.

Soviet officials have made very few statements relating to the military objectives of their space research and development program. The Soviet articles which do mention military objectives usually quote and comment on statements by citizens of Western countries. These Soviet articles are always liberally interspersed with the usual Communist "peace" propaganda.⁷⁶ Pr. 885 –888

Military uses of satellites were considered by Major General G. I. Pokrovskiy in his article "The Role of Science and Technology in Modern War," published in 1957. He wrote, "The development . . . has also led to artificial earth satellites. These satellites, together with their scientific value, also have military significance. From them it is possible to observe the opponents' territory and to throw atomic bombs on that territory." 109

G. V. Petrovich, commenting on the Soviet Lunik/Mechta rocket, stated, "A powerful improved ballistic rocket was used to create the one-and-one-half-ton 'solar' rocket. This rocket can be used to launch earth satellites of any weight up to several tons, or to deliver loads of even greater weight to any point on the earth's surface . . ." Petrovich spoke of "satellites which will provide constant observation over the whole surface of the earth and the air surrounding it" as being among the first of the Soviet objectives. According to him, these satellites will be equipped with both optical and television equipment. Petrovich does not mention the obvious military applicability of these reconnaissance satellites.101

These and other Soviet statements indicate that reconnaissance satellites are being developed in the USSR.¹¹⁰ ¹¹¹ Eventual refine-

ment of these techniques can be expected to permit surveillance of naval movements, airfields, military equipment, nuclear and missile tests, and other activities of considerable military importance. During the East-West Conference on Problems of Detecting Nuclear Explosions, Geneva, July 1958, the Soviets indicated a firm conviction that the use of instrumented satellites for detecting very high altitude nuclear detonations was both feasible and desirable.¹¹³

It is possible that some of the present Soviet emphasis on recovery of satellites or capsules and on landings from powered space vehicles stems from the relation between these problems and the delivery of bombs from space vehicles. Manned, powered space vehicles and space stations for offensive and defensive purposes are probable long-range Soviet objectives.

Other areas in which space vehicles could be used profitably include military communications and navigation. Although Soviet statements usually relate to civil applications, it is evident that the Soviets have the military communications uses well in mind, particularly the receipt by satellites of military messages and their transmission or relay to headquarters, or land, sea, air, or space forces. Intercept of enemy radio transmissions and communications would be of considerable intelligence value and jamming of enemy radios from satellites would be useful for military purposes. 46 98-100

Scientific Objectives

Space research affords new and unique opportunities for scientific observations and experiments which will advance basic science and add greatly to knowledge of the earth, the solar system, and the universe. The Soviets have demonstrated in the early stages of the space age that they intend to use space vehicles as a means of advancing science.

In the field of astronomy, immediate Soviet objectives include greatly improved observations of the solar system by means of instrumented satellites and probes. A. N. Nesmeyanov, in a speech presented on 1 Decem-

ber 1958 relating to the tasks of Soviet science in the next seven-year plan, said, "The seven year plan for the development of science devotes considerable attention to elaborating new means of astronomical investigations both with the aid of new powerful optical and radio-technical instruments and with the use of space rockets and artificial satellites which make it possible to send instruments beyond the earth's atmosphere." Commenting on the significance of astronomical research, Nesmeyanov said, "It should be noted that the very idea of controlled thermonuclear reactions arose in studying the sources of energy of the sun and stars. To day astronomy investigates the nature of physical processes arising in outer space in conditions which still cannot be reproduced in laboratories on earth (super-high pressures and temperatures, super-powerful processes of energy emission, etc.). Of great interest for astrophysics is also the problem of the generation of cosmic particles whose energy is millions of times greater than the energy of particles now obtained with the aid of the most powerful accelerators." 113 Nesmeyanov's remarks and those of other Soviet scientists not only indicate a purely scientific interest but hint at a Soviet objective to tap new energy sources in space and to exploit the natural resources of the moon and planets.50 62 66

Soviet astronomers, biologists, physicists and geophysicists have expressed the intention to conduct fundamental research in space. 49 70 76 80 82 88 V. G. Ginzburg, outstanding theoretician, has advocated the use of space vehicles to obtain further verification of the general theory of relativity.78 Ye. K Fedorov and others have suggested the need for experiments and new theoretical work in the physics of high vacuum, gaseous discharge, electrical plasma, magnetohydrodynamics, low temperature physics, and other fields which space penetration will provide an opportunity to investigate. 78 S. M. Poloskov has reported Soviet plans for improved solar research.88

In the field of geophysics, Fedorov and G. A. Skuridin have outlined problems for investigation which include an explanation of

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changes in the intensity of the earth's magnetic field, of various currents in the atmosphere, the nature of solar corpuscular emissions, the role of ultraviolet and x-ray radiation in the formation of the ionosphere, the influence of cosmic rays on processes in the high atmosphere, the study of the chemical structure of the ionosphere, of the degree of recombination of atoms and molecules in various strata, and the frequency of collision of free electrons.¹¹⁶

Fedorov has indicated that satellites will be used for weather observations; ¹⁹⁸ A. A. Mikhaylov has indicated that geodetic observations will facilitate measurement of the exact shape of the earth; ¹¹⁷ A. A. Shternfel'd has mentioned photosurvey and high precision cartography and polar and sea-ice observations by means of satellites; ⁷⁶ . ³⁵⁸⁻³⁶¹ and other research problems have been proposed. ⁷⁷⁻⁷⁹ 118-121

OBJECTIVES RELATING TO SINO-BLOC PARTICIPATION IN THE SPACE PROGRAM

Communist China

Statements from Communist China, including reported declarations by Kuo Mo-jo, President of the Academy of Sciences, indicate an intent to launch research rockets and artificial earth satellites. A typical statement is one by Kuo, who was quoted in *Pravda* in May 1958 as follows, "Chinese scientists are seriously studying the Soviet Union's most advanced technology so that China may launch her own Sputnik in the nearest future." An expanding satellite tracking program and increased activity in astronomy and other fields related to space research have been noted in Communist China. 122 124-128

If successful in launching a satellite, the Communist Chinese would score a major propaganda coup, especially in Asia. There is no evidence that Communist China itself has such a capability; but, with considerable assistance from the USSR, the orbiting of a satellite from the Chinese mainland is a possibility.

The European Bloc

Most of the European Bloc nations have shown interest in astronautics and some of them, particularly East Germany, Czechoslovakia, and Poland, possess capabilities of some significance in supporting scientific and technical fields. 136-146 146 The Bloc countries have been of considerable assistance to the USSR in satellite tracking, and some Bloc scientists are known to have been invited to the USSR to assist in the space program. 129-135 139 147 Soviet exploitation of German rocket design and propulsion experts since World War II is well known.

Polish statements in 1957 of intent to launch an artificial earth satellite do not appear to be backed by the necessary achievements to date and are therefore discounted insofar as they apply to launching a satellite from Polish territory. 149-151 Yet, Polish enthusiasts appear to be going ahead with a small rocket research program. 144 Undoubtedly groups in other leading European Bloc countries have similar objectives.

From recent trends it appears that the USSR intends to continue to exploit the scientific and technical resources of the European Bloc countries to advance its own space program.

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APPENDIX B

SINO-SOVIET BLOC STATEMENTS RELATING TO THE SPACE PROGRAM

Soviet Statements of Astronautical Objectives

Manned Vehicles, Landings, and Recovery.—Dr. Yevgeni K. Fedorov, Director of the Institute of Applied Geophysics, Academy of Sciences, USSR, and a leading official in the Soviet IGY rocket and satellite program, on 6 October 1957, shortly after the firing into orbit of Sputnik I, wrote in Pravda that his country was working on the problem of designing an artificial satellite able to return to earth undamaged. 151/

In February 1958, Fedorov is quoted as saying, "Soviet physiologists believe it is absolutely necessary to carry out much more numerous and detailed, prolonged experiments with animals before sending a man into cosmic flight. 152/ The next day, he said, "Despite the offers of many Soviet citizens, human beings will not be sent up in a rocket until a number of problems are solved." 36/

In May 1958, Fedorov again admitted that the subject of retrieving a satellite was being studied in the USSR. He added, "The question of the possibility of flights to the moon and of the launching of a satellite carrying a human being is closely connected with this problem." 153/

V. V. Dobromravov, Chair of Theoretical Mechanics, Moscow Higher Technical School, on a visit to Berlin in July 1958, is quoted as follows, "It is quite possible that the first problem will be that of producing so-called guided or recoverable satellites. In such a case...the satellite must be 'oriented' in relation to the earth; i.e., its axis must at all times maintain in cosmic space the same position in relation to the earth... This satellite must hot rotate on its own axis. When it is at point A /apogee/, the power can be turned on for a brief period, and the satellite will come closer to the earth. The propulsion power can also be used as breaking power..."

Another source quoted Professor Dobronravov, on 3 October 1958, as follows, "At the present stage, the most logical thing would be construction of satellites which can return to earth. Such satellites would make it possible to receive the results of observations not only in radio signals but also recorded on tapes and film. Important biological experiments could also be carried out. Scientists would be able to send animals into outer space, knowing that they could come back safely."

Professor Doboronravov continued with the statement that Soviet scientists and engineers were capable of making a satellite which would not burn up when entering the atmosphere or be damaged from the shock of landing on a planet. Doboronravev noted that such a retrievable satellite must have engines with a fuel reserve to help it approach the earth at the appointed time and to help break its speed when it enters the dense layers of the atmosphere to protect it from burning up. 37/

The Moscow publication, "Krasnaya Zvezda," 3 July 1958, contains an article by P. Isakov, Candidate of Biological Sciences and Stalin Prize Winner, on the problem of returning satellite crews. He discussed two possible methods: returning the crew in the satellite and returning the crew in a capsule only. He said, "If the satellite can be slowed down to the desired speed, the currently used methods of ejection can be employed." He stated that problems yet to be solved included: heat due to breaking, the effect of heat on crew and equipment, the G-effect of deceleration, and the effect of rapid rotation on the crew's bodies." 12/

An NBC television program "Youth Wants to Know", shown in the United States on Sunday, 5 October 1958, consisted of an interview with Professor A. A. Blagonravov which had been filmed in Moscow in July 1958. Asked whether a man-carrying satellite would be launched in the "near future," Blagonravov replied: "Sooner or later most probably we will be able to send up a man-carrying sputnik that will be circling the earth. I can't say when that will be at present." 155/

By 28 March 1958, Blagonravov seemed more assured. He is reported to have stated that the Soviet Union was close to sending a man in a rocket out into cosmic space and back. He said that the Soviet single-stage rocket that went about 295 miles into space on 21 February 1958 pointed the way. Asserting that the rocket of more than one-and-a-half tons landed precisely where scientists planned, Blagonravov said that, with the addition of a second stage, one could imagine that the time was quite near for solution of such a problem as cosmic flight of a man in a rocket. 156/

A Tass press review, 16 May 1958, celebrating the launching of Sputnik III, quotes Academician L. I. Sedov, a leading figure in Soviet rocket activities: "The new sputnik...could easily carry a man with a stock of food and supplementary equipment. However, such an experiment would have been premature. Before it is attempted, more knowledge must be gained about the conditions of man's existence in cosmic space, and the basic problem of the return to earth must be solved." 38/

Sedov, stated on 3 October 1958 that the standards of rocketry today are so high that automatic flying laboratories, manned earth satellites, and cosmic rocket ships should be regarded as distinctly realistic prospects. He said that there are two main difficulties in the realization of these projects. The first is protection of living organisms against certain radiation during long flights in cosmic space, and the second is the problem of safe return. He expressed the hope that these difficulties would not put off for long the conquest of cosmic space. 26/

A Soviet scientific spokesman (believed to be Sedov) stated, during the 9th Congress of the International Astronautical Federation at Amsterdam, 25-30 August 1958, that the USSR was giving top priority to something more important than a moon probe. Western scientists attending the Congress believed he referred to a project to send a man into space. 157/

In an interview with the U.S. publication <u>Missiles and Rockets</u> during the 9th IAF Congress, professor K. F. Ogorodnikov, of the University of Leningrad and one of the foremost astronomers in the USSR, is reported to have said, "We are pushing the man-in-space program hard. This is the big thing; we are making fine progress. The re-entry problem has been solved." 27/

The magazine Sovetskaya Aviatsiya (Soviet Aviation), 1 December 1958, contains an article by Professor V. V. Alexandrov, a Soviet scientist, disclosing that the USSR is working on a "rocket plane" that looks like a combination of jet fighter and space ship, in its campaign to be the first nation to achieve space flight by man.

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i ;**ly** ilexandrov said it would be built in the shape of a jet plane, but with folding wings. It would blast off into space and then continue its flight in a trajectory "like an artillery shell." The wings would be folded against the plane for the flight in space. Returning, the wings would be extended on reaching the earth's atmosphere, enabling the plane to slow down and glide back to its base. 158

A broadcast by Radio Moscow, 15 April 1958, describes a talk given by N. A. Varvarov, Chairman of the Astronautics Section of IDSAAF, in which he discusses two possible methods of recovering a scientific package from a satellite: (1) return of the package only, or (2) use of a rocket plane type apparatus. He stated, "Manned flight will only be possible when return can be assured."

Joseph Sinka, Secretary of the Hungarian Space Travel Committee, told newspapers on 7 August 1958 that he had learned from a prominent Soviet scientist that the USSR plans three new satellites, one of which would bring a test animal back to a pre-selected area on the earth's surface. 159/

Professor Pyshnov, writing in Soviet aviation on 20 July 1958, stated, "Soviet scientists are preparing to release a glider from the upper layers of the atmosphere having a speed of some kilometers per second." Pyshnov indicated that wings can insure smooth and prolonged gliding for a cosmic rocket after entering the atmosphere. The glider, during the approach to earth, will be subjected to so-called wave resistance which he said was a more convenient means of braking than friction because a considerable part of the energy is thus transferred to the air medium through a shock wave. The machine must be stable, controlled, and protected from such phenomena as corkscrew and vibration, according to the professor. 160/

A U. S. citizen, an Officer of the International Astronautical Federation, after contacts with Soviet Bloc officials, said in November 1958 that he doubted that Soviet missilemen are overly interested in shooting at the moon; instead, they are working on extremely high-thrust rocket engines in the multi-million pound range and on carefully instrumented animal flights aimed at putting a man into orbit and bringing him back to earth. 161/

Professor A. C. B. Lovell, Director of Britain's radioastronomy work at Jodrell Bank, University of Manchester, Cheshire, after a visit to Moscow, said on 29 August 1958 that he believes the Soviets are planning to send up a manned satellite. His belief was based upon "definite information" from several