Space INTELLIGENCE NOTES

SPACE SYSTEMS INFORMATION BRANCH, GEORGE C. MARSHALL SPACE FLIGHT CENTER

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FROM THE WORLD PRESS

TEXT OF PRESIDENT'S LETTER ON U.S.-SOVIET SPACE WORK. Following is the text of a letter on space cooperation sent March 7, 1962, by President Kennedy to Premier Khrushchev, Chairman of the Council of Ministers of the Soviet Union:

"On February twenty-second last, I wrote you that I was instructing appropriate officers of this Government to prepare concrete proposals for immediate projects of common action in the exploration of space. I now present such proposals to you.

"The exploration of space is a broad and varied activity and the possibilities for cooperation are many. In suggesting the possible first steps which are set out below, I do not intend to limit our mutual consideration of desirable cooperative activities. On the contrary, I will welcome your concrete suggestions along these or other lines.

"1--Perhaps we could render no greater service to mankind through our space programs than by the joint establishment of an early operational weather satellite system. Such a system would be designed to provide global weather data for prompt use by any nation. To initiate this service, I propose that the United States and the Soviet Union each launch a satellite to photograph cloud covers and provide other agreed meteorological services for all nations. The two satellites would be placed in near-polar orbits in planes approximately perpendicular to each other, thus providing regular coverage of all areas. This immensely valuable data would then be disseminated through normal international meteorological channels and would make a significant contribution to the research and service programs now under study by the World Meteorological Organization in response to Resolution 1721 (XVI) adopted by the United Nations General Assembly on December 20, 1961.

"2--It would be of great interest to those responsible for the conduct of our respective space programs if they could obtain operational tracking services from each other's territories. Accordingly, I propose that each of our countries establish and operate a radio tracking station to provide tracking services to the other, utilizing equipment which we would each provide to the other. Thus, the United States would provide the technical equipment for a tracking station to be established in the Soviet Union and to be operated by Soviet technicians. The United States would in turn establish and operate a radio tracking station utilizing Soviet equipment. Each country would train the other's technicians in the operation of its equipment, would utilize the station located on its territory to provide tracking services to the other, and would afford such access as may be necessary to accommodate modifications and maintenance of equipment from time to time.

"3--In the field of the Earth sciences, the precise character of the Earth's magnetic field is central to many scientific problems. I propose therefore that we cooperate in mapping the Earth's magnetic field in space by utilizing two satellites, one in a near-Earth orbit and the second in a more distant orbit. The United States would launch one of these satellites, while the Soviet Union would launch the other. The data would be exchanged throughout the World scientific community, and opportunities for correlation of supporting data obtained on the ground would be arranged.

"4--In the field of experimental communications by satellite, the United States has already undertaken arrangements to test and demonstrate the feasibility of intercontinental transmissions. A number of countries are constructing equipment suitable for participation in such testing. I would welcome the Soviet Union's joining in this cooperative effort, which will be a step toward meeting the objective, contained in United Nations General Assembly Resolution 1721 (XVI), that communications by means of satellites should be available to the nations of the World as soon as practicable on a global and non-discriminatory basis. I note also that Secretary (Dean) Rusk has broached the subject of cooperation in this field with Minister (Andrei A.) Gromyko and that Mr. Gromyko has expressed some interest. Our technical representatives might now discuss specific possibilities in this field.

"5--Given our common interest in manned space flights and in insuring man's ability to survive in space and return safely, I propose that we pool our efforts and exchange our knowledge in the field of space medicine, where future research can be pursued in cooperation with scientists from various countries.

"Beyond these specific projects we are prepared now to discuss broader cooperation in the still more challenging projects which must be undertaken in the exploration of outer space. The tasks are so challenging, the cost so great, and the risks to the brave men who engage in space exploration so grave, that we must in all good conscience try every possibility of sharing these tasks and costs and of minimizing these risks. Leaders of the United States space program have developed detailed plans for an orderly sequence of manned and unmanned flights for exploration of space and the planets. Out of discussion of these plans, and of your own, for undertaking the tasks of this decade would undoubtedly emerge possibilities for substantative scientific and technical cooperation in manned and unmanned space investigations. Some possibilities are not yet precisely identifiable, but should become clear as the space programs of our two countries proceed.

"In the case of others, it may be possible to start planning together now. For example, we might cooperate in unmanned exploration of the lunar surface, or we might commence now the mutual definition of steps to be taken

in sequence for an exhaustive scientific investigation of the planets Mars or Venus, including consideration of the possible utility of manned flight in such programs. When a proper sequence for experiments has been determined, we might share responsibility for the necessary projects. All data would be made freely available.

"I believe it is both appropriate and desirable that we take full cognizance of the scientific and other contributions which other states the world over might be able to make in such programs. As agreements are reached between us on any parts of these or similar programs, I propose that we report them to the United Nations Committee on the Peaceful Uses of Outer Space. The committee offers a variety of additional opportunities for joint cooperative efforts within the framework of its mandate as set forth in General Assembly Resolutions 1472 (XIV) and 1721 (XVI).

"I am designating technical representatives who will be prepared to meet and discuss with your representatives our ideas and yours in a spirit of practical cooperation. In order to accomplish this at an early date, I suggest that the representatives of our two countries who will be coming to New York to take part in the United Nations Outer Space Committee meet privately to discuss the proposals set forth in this letter."

KHRUSHCHEV'S REPLY ON SPACE COOPERATION. Following is the text of Premier Khrushchev's message to President Kennedy on the exploration and use of outer space, as distributed on March 21, 1962, in English by Tass, the Soviet press agency. The letter is date-lined Moscow, March 20, 1962.

"Esteemed Mr. President,

"Acquainting myself attentively with your message of March 7 of this year, I note with satisfaction that my appeal to you of February 21 with a proposal that both countries should pool their efforts to explore outer space, has been met with the necessary understanding of the United States Government.

"Advancing this proposal, we proceeded from the premise that all the peoples, all mankind, are interested in solving the problem of exploration and peaceful uses of outer space, and that the huge dimensions of this problem as well as the difficulties which are to be overcome, imperatively demand an extensive pooling of scientific, technical and material opportunities, and resources by states.

"Now that the space age is just dawning, one sees how much man yet has to do. If today human genius has created spaceships capable of reaching the surface of the Moon most accurately and putting the first cosmonauts into round-the-Earth orbits, tomorrow spaceships controlled by man would be able to soar towards Mars and Venus, and the farther, the wider and more immense will be the prospects of man's penetration into the depths of the universe.

"The conquest of space in the interests of all humanity will be the more rapid, the greater the number of countries making their contribution to this highly complex matter which, incidentally, is quite costly.

"And this means that equal opportunities should be opened to all states for participation in international cooperation in this sphere. This is precisely the international cooperation that the Soviet Union is steadfastly advocating, loyal to its policy of developing and consolidating international friendship. Early in 1958, the Soviet Government moved to conclude an extensive international agreement on cooperation in the exploration and peaceful use of outer space, has displayed initiative in submitting this question for the consideration of the United Nations. In 1961, immediately after the first manned space flight was accomplished in the Soviet Union, we again confirmed our readiness to cooperate and pool efforts with other countries, above all with your country, which was then preparing for similar flights. My message to you of February 21 of this year was dictated by the same designs and directed towards the same goal.

"The Soviet Government has always regarded, as it does now, the successes of our country in space exploration not only as the achievements of the Soviet people but as the achievements of all humanity. The Soviet Union is taking practical steps to make the fruits of the work of the Soviet scientists and cosmonauts the property to all countries. We widely announce all launchings of our sputniks, spaceships, and cosmic rockets, incidentally reporting the elements of their orbits, the weight of the space vehicles launched, radio frequencies, etc.

"Soviet scientists have established fruitful, businesslike contacts with their foreign colleagues, including scientists of your country, in such international organizations as the Committee for Space Research and the International Astronautical Federation.

"It seems to me, Mr. President, that in general it is now being recognized increasingly that practical steps are needed in the noble cause of developing international cooperation in space research for peaceful purposes. Your message shows that your trend of mind actually does not differ from our idea of practical measures in the field of this cooperation. What should we start from?

"I should like to point out in this connection several problems of exploration and peaceful uses of outer space, for whose solution, in our view, the pooling of efforts by states is required. Some of them, envisaged in the recent decisions of the United Nations General Assembly, adopted on the initiative of our two countries, are mentioned in your message.

"1. Scientists believe that at the modern stage of space exploration it is quite possible to use artificial Earth satellites for creating international networks of super long distance communications. The implementation of these projects can lead to a considerably improvement of means of

communications and television on the Earth. People will get reliable means of communications and new unprecedented possibilities will arise for expanding contacts between the peoples. So let us begin with finding out the condition for the possibilities for the solution of this problem. As I have understood from your message, the United States is also ready for this.

"2. It is difficult to overestimate the benefit which could be brought to mankind by organizing a World weather observation service with the aid of artificial Earth satellites. Precise and timely weather forecasts will be another important step along the way to man's conquering of nature, and will help him still more successfully cope with natural calamities and open up new prospects for improving the well-being of mankind. Let us cooperate in this field, too.

"3. We believe it would be expedient to reach agreement on the organization of observations with the help of radio-technical and optical means, under a joint program, of objects launched in the direction of the Moon, Mars, Venus and other planets of the solar system. Our scientists hold that the pooling of efforts by states for the purpose of expediting scientific progress in the studies of the physics of interplanetary space and celestial bodies would be of unquestionable advantage.

"4. At the present stage of man's inroads into outer space, it is very desirable to draft and conclude an international agreement providing for assistance in the search for and rescue of spaceships, sputniks, and capsules that descend to the Earth due to accident. Such an agreement seems even more necessary because the point in question here is the saving of the lives of cosmonauts, these intrepid explorers of universal space.

"5. Your message contains a proposal for cooperation of our countries in compiling charts of the Earth's magnetic field in outer space with the aid of sputniks, as well as exchange of knowledge in the field of space medicine. I can say that Soviet scientists are ready for such cooperation and exchange of data on these questions with the scientists of other countries.

"6. I think, Mr. President, that the time has come also for our two countries, which have advanced more than the others in space exploration, to try to find a common approach to the settlement of important legal problems that life itself sets before states in the age of space. In this connection I regard as a positive fact that at the United Nations General Assembly session, the Soviet Union and the United States found it possible to agree on the proposal about the initial principles of space legislation, which was then unanimously approved by all the member states of the United Nations: about the spread of international law, including the United Nations Charter, to outer space and the celestial bodies, and that the outer space and celestial bodies are accessible to all for research and use by all states in accordance with international law and cannot be annexed by any states.

"In our opinion, we should go even further now.

"The expansion of space explorations, carried out by the states, definitely gives rise to the need of also reaching agreement that no one should create obstacles, during space experiments, to the study and use of outer space for peaceful purposes by other nations. Maybe it is necessary to make provisions that the experiments in outer space, which may render difficult the exploration of outer space by other countries, should be the subject of preliminary discussion and agreement on a proper international basis.

"Mr. President, I have stated only several of the questions, the solution of which, in our point of view, has become ripe already now and demands cooperation between our countries. In the future international cooperation in space exploration, if we can now lay a firm basis for it, will doubtlessly spread to every new field of research. We hope that the scientists of the U.S.S.R. and the U.S.A. will be able, hand in hand with the scientists of other countries, to take up the elaboration and implementation of many projects for space exploration.

"The Soviet representatives in the United Nations Space Committee will be instructed to meet with United States representatives to discuss the concrete questions of cooperation in the exploration and peaceful use of outer space, that are of interest to our two countries.

"These, Mr. President, are our considerations about the, so to say, heavenly affairs. We sincerely want the establishment of cooperation in the field of peaceful uses of outer space to facilitate the improvement of relations between our countries, the easing of international tensions, and the creation of a situation favorable for the peaceful settlement of the problems that have become ripe here on Earth.

"At the same time it seems obvious to me that the scope of our cooperation in the peaceful exploration of space, just as the choice of the directions themselves, along which such cooperation will be possible, depend to some extent on the settlement of the disarmament problem. Prior to achievement of agreement on general and complete disarmament both our countries would still be limited in their possibilities to cooperate in the field of the peaceful use of military missiles and space ships, which are launched for peaceful purposes, are based on the same achievements of science and technology.

"True, there already exist some differences here as well: Space rockets require more powerful engines as they have to lift bigger loads to greater heights, whereas military rockets do not, in general, require such powerful boosters--engines already in existence are capable of lifting warheads of great destructive potential and delivering them to any part of the globe. But you, Mr. President, know as well as we do that the principles of designing and production are the same for both military and space rockets.

"I am expressing all these considerations for the simple reason that it would be better if we had a clear picture of all aspects of the matter. It is necessary to try to overcome the obstacles which may arise in the way of international cooperation in the peaceful exploration of space. It may be that we shall succeed in doing this, and this will be useful. The prospects for cooperation, for pooling out scientific and technological achievements up to and including joint development of space ships for reaching other planets--the Moon, Venus, Mars, will be considerably greater when agreement on disarmament is reached.

"We hope that agreement on general and complete disarmament will be achieved. We are exerting and will exert every effort to this end. I should like to trust that you, too, Mr. President, will spare no effort to act in the same direction.

Yours respectfully,

N. KHRUSHCHEV."

USSR MAY ESTABLISH ROCKET MAIL SERVICE. Soviet officials are studying the possible use of rockets for postal communications purposes by 1980 or "even considerably earlier," General Eugeni Lgginov, head of the Soviet airline Aeroflot, told a Moscow meeting reported by radio Moscow recently. (Source: Washington Post, January 15, 1962)

REPORT ON BIOLOGICAL ASPECTS OF SPACE FLIGHT. Experiments with animal rocket flights, artificial satellites carrying biological material, and other space-physiological research conducted by Soviet scientists are described in a recent article appearing in Priroda and entitled "Biology and Space Flight." Author N. M. Sisakian states that studies of the biochemical effects of cosmic radiation suggest no lasting changes in the nuleic acid metabolism. In the case of the orbited dogs Strelka and Belka, abnormally high quantities of alpha globulin, serum mucoid, and general protein were noted a few days after their return to Earth.

In respect to manned space flights, the article states that human resistance to gravitational stress was the highest when the forces were directed in a chest-back, back-chest, left-right, or right-left direction with the man in a semi-prone position. Prolonged weightlessness reduced acceleration tolerance. (Source: Aerospace Medicine, January 1962, p. 122)

FROM SEMI-TECHNICAL LITERATURE

SOVIET MISSILES PHASING IN? "Air Force intelligence officers say the cross-over point in Soviet strategic reliance on missiles from aircraft now is expected to be reached in the mid-1960's. Manned aircraft are

expected to remain an important element in the Russian striking force for the rest of the decade, however. Congressmen, meanwhile, are wondering about the value of our military intelligence. They say Air Force estimates of Soviet missile strength they received last September were only 3.5 percent of those in 1959." (Source: Missiles and Rockets, March 19, 1962, p. 9)

SPACE WEIGHTLESSNESS EFFECT DISCUSSED. Although the human nervous system is highly adaptable and has considerable compensating ability to restore normal contact with the outside world, it is not known how much it can compensate for deleterious effects of weightlessness, Soviet scientists reported recently.

At a meeting of the USSR Academy of Medical Sciences, Vasili Parin, Vladimir Yazdovsky, and Dr. Oleg Gazenko presented a report on ground experiments and the flights of Majors Yuri Gagarin and Gherman Titov as an extension of a report presented at the 12th International Astronautical Congress last October in Washington.

They contend that these factors dictate effects on the nervous system in any space venture:

1. Low barometric pressures, altered gaseous composition marked by absense of molecular oxygen, ionizing radiation, heat loads, meteoroid impact, and other physical factors in a spacecraft.

2. Rocket flight noise, accelerations, and weightlessness.

3. Environmental system, food, workrest cycles, complete isolation, and emotional tension.

While ground centrifuge experiments obtained complete data on the boost phase of the Gagarin and Titov flights, the physiological reactions of the cosmonauts "were somewhat more pronounced" during actual flight, the report said. This was attributed primarily to emotional stress.

Scientists were said to have established that weightlessness induced functional changes of the heart, but cardiac disturbances disappeared after the first two hours of space flight.

The absence of gravity excludes the activity of the otilith receptor of the inner ear, according to the report. This apparently resulted in a distinct feeling of nausea reportedly experienced by Titov. (Source: Aviation Week, February 26, 1962, p. 57)

SOVIET SCIENTIST POSTULATES THAT LIFE FORMS ARE COMMONPLACE IN SPACE. V. F. Kuprevich, President of the Academy of Sciences of the Belorussian SSR, defines the primary objective of space research to be the solution of

the problem of the distribution of forms of life on the planets and in space itself. "We firmly believe," he states, "that life is present everywhere that conditions are suitable for it to develop and exist. It is not necessary that it assume terrestrial forms. Life forms are possible in which carbon is replaced by some other element, such as silicon.... We will undoubtedly find life forms on the planets which are unknown to us, in their historical development possibly being far ahead of us by hundreds of millions of years, or, on the other hand, being in the first stages of evolution.... The study and utilization by man of the resources of living matter in space promises fantastic opportunities for enriching the Earth with useful flora, and possibly fauna.... Life on Earth is disseminated everywhere, even in places which would seem less suitable for life than conditions prevailing on neighboring planets.... Satellites should carry special devices for trapping...particles in space to reveal the possibilities of dissemination in space of the simplest forms of life and organic matter." (Source: Joint Publications Research Service, No. 11281, December 1, 1961, p. 27)

USSR ACADEMY OF SCIENCES ANNOUNCES NEW "SPACE" SERIES. The Publishing House of the USSR Academy of Sciences has announced the planned release of a considerable number of books in 1962 in a new series devoted to space problems. These include: "Soviet Satellites and Spaceships," by S. G. Aleksandrov and R. Ye. Fedorov, which will cover the entire history of Soviet space research; "Motors for Galactic Ships," by R. G. Perel'man; the selected works of K. E. Tsiolkovskiy; "Manned Flights in Space," which will be devoted to the flights of the two Vostoks; "Life in Space," by Academician N. M. Sisakyan and O. G. Gazenko; and "Investigation of the Ionosphere and Interplanetary Plasma by Rockets and Artificial Satellites," by K. I. Gringauz. Other monographs will treat cosmic rays, the upper layers of the atmosphere, and the dynamics of space flight; plans call for a total of 33 books in this "Kosmos" series. (Source: Joint Publications Research Service, No. 11281, December 1, 1961, p. 28).

FROM TECHNICAL LITERATURE

ASTRONOMY

SATELLITE "CLOUDS". Two faintly luminescent "clouds" were recently discovered by the Polish astronomer K. Kordylewski, reports V. G. Demin in Nauka i Zhizn'. Kordylewski's investigations in April 1961 showed that these clouds, which basically follow the apparent path of the Moon and make one revolution per month, are located 400,000 km from the Earth at one apex of the equilateral triangle Earth-Moon-clouds. Since they are situated at an angular distance of only 6 to 7 deg (40,000 km), the clouds are considered to occupy the same place in interplanetary space. Their combined effect creates a "pocket" which traps and accumulates cosmic dust

particles and gas molecules passing through or near it. This is the second instance of Lagrange motion observed among celestial bodies. The clouds are best observed during periods when the Moon is far below the horizon and the clouds still above it. Kordylewski believes that the apex of a second equilateral triangle on the other side of the line between the center of the Earth and the Moon will also be found to be "filled" with cosmic dust. (Source: Dept. of Commerce, A.I.D. Press, No. 663, March 13, 1962, p. 6)

COSMIC ELECTRICITY. Academician B. P. Konstantinov has advanced a hypothesis to explain the phenomenon of the double-tailed comet observed in 1956, one of whose tails was oriented toward the Sun and the other away from it. Konstantinov suggests that there are enormous electrical forces interacting between celestial bodies. Each body is bombarded by light quanta from the Sun which induce an electrical charge in the body by knocking electrons off its surface. In general, cometary tails contain positive ions and are repelled by the positively charged Sun; this accounts for the usual orientation of the tail away from the Sun. In the case of the comet of 1956, both positive and negative charges must have existed to account for the dual orientation of the two tails. Konstantinov believes that the failure to detect electrons in cosmic rays provides further proof of the existence of electric fields; that is, electrons are repelled by the negative electric field of the Earth, which their relatively low energy is insufficient to overcome. (Source: Dept. of Commerce, A.I.D. Press, No. 660, March 8, 1962, p. 3)

ASTROPHYSICS

SPECTRA OF THE PLANETS DISCUSSED. V. G. Teyfel, Academy of Sciences of the Kazakh SSR, writing in Priroda, No. 6, 1961, discusses some very interesting facts concerning the planets of our Solar System.

He points out that the greater part of the most interesting discoveries in the field of the physics of the planets that have been made in the last few decades have been made by spectral observations. He begins with a discussion of the generally well-known facts concerning carbon dioxide and water vapor in the atmosphere of Venus. He then explains the existence of aurorae on Venus, and how this is evidence of the existence of a magnetic field on that planet. There is evidence, he states, that the luminescence of the night sky on Venus is 50 to 80 times greater than on the Earth. He reviews the evidence for the existence of a vegetation cover on Mars, and states categorically that vegetation exists in the dark regions of that planet.

His next topic is the presence of hydrogen and its compounds on the larger planets--Jupiter, Saturn, Uranus and Neptune--and explains the differences which exist. He examines the meteoric nature of Saturn's rings, but without adding new insight on this problem.

Rather lengthy sections are devoted to the color of the Moon's surface and the varying luminescence of various parts of its surface. The importance of the color variations is that they are indicative of different kinds of rocks and other differences in the surface layer. Colormetric and spectrophotometric observations of the Moon's surface are now being made by N. P. Barabashov, V. I. Yezerskiy, and V. A. Fedorets at Khar'kov; V. V. Sharonov at Leningrad; A. N. Sergeyeva at Kiyev; T. A. Polozhentsevaya at Pulkovo; and the author at Alma-Ata. It appears that color differences actually exist on the Moon although they are much less pronounced than the color differences in rocks on the Earth and in meteorites. He then tells how the Sun's rays are polarized when reflected from the Moon's surface, and the significance of this phenomenon. The luminescence of the various parts of the Moon's surface may not be due so much to the ultraviolet radiation of the Sun as to the influences of streams of solar corpuscles. Finally, the author discusses the spectra of the asteroids, particularly Vesta. The spectra of only 15 out of the more than 1,600 asteroids have been studied. (Source: Joint Publications Research Service, No. 8807, September 1, 1961, p. 4)

GEOPHYSICS

SOVIET PLANS FOR BORING SUPER-DEEP HOLES. The average thickness of the Earth's crust has been established by seismic waves as being about 35 km. The crust is 6 to 7 km thick under the oceans and from 15 to 70 km under the continents. The boundary between the Earth's crust and mantle is indicated by a discontinuity in the passage of seismic waves through the Earth, evidence of a significant difference in properties. Still another sharper discontinuity is observed at a depth of 2,900 km, indicating the boundary between the Earth's mantle and core. The radius of the Earth's core is about 3,500 km. The mantle is subdivided, again by seismic indications, into an upper zone about 1,000 km thick and a lower zone about 1,900 km thick. Foci for earthquakes, volcanos, and mountain-forming processes are located on the boundary of the mantle and the crust. There are grounds for believing that metal ores, diamonds, and other useful minerals which are gradually introduced into the Earth's crust are formed on this boundary.

Soviet Earth scientists believe it is now necessary to probe the Earth directly with super-deep wells piercing the crust of the Earth and at least entering the upper zone of the mantle. Not only might new raw materials be found but, of greater importance, also basic scientific facts concerning the Earth's interior.

Fundementally new methods for destroying rock are being developed in the Soviet Union. Rock is exploded by high-frequency electric current and gas jets. Depths of several tens of kilometers can be achieved with the help of these and other methods along with the use of high-strength tools. (Source: Joint Publications Research Service, No. 61-11-147-20, October 2, 1961, p. 32)

RADAR OBSERVATIONS OF AURORAS AT SOVIET ANTARCTIC STATIONS IN 1959. Radar observations of auroras, carried out at the Mirnyy and Vostok Antarctic stations in 1959, have been analyzed; perculiarities of seasonal variations of the number of reflections at Mirnyy are included in the results. A locator operating on a frequency of 72 Mc, with an impulse capacity of 75 kw, an impulse duration of 10 μ sec, and an impulse recurrence frequency of 50 cycles was used at the Mirnyy Observatory. The receiver had a sensitivity of $\sim 5 \cdot 10^{-14}$ w. The screen of the locator with an A-indicator was designed for a range up to 1,000 km. The unit had a 2-stage Yagi-type revolving antenna with a basic lobe ~40° wide.

The diurnal rate at this station is characterized by two maxima created by reflections received from various directions and probably connected with the basic and the inner zones of the auroras; a similar conclusion can be drawn from the observations made at the Dumont-Durville station. An absence of correlation between radar reflections and magnetic activity was found to be characteristic of the intrazonal stations (e.g. Mirnyy). The observations made at the Vostok station do not show any clear-cut division into two maxima; the diurnal variation is characterized by a minimum, with almost total absence of reflections, during the morning hours (local time; 0000-0500 UT). The number of reflections increases during the day, reaching a maximum in the afternoon and early evening (0800 to 1000 UT) and later decreasing.

Certain characteristic features of the geophysical phenomena of the region established from the radar observations not only support the hypothesis of the existence of an inner zone of auroras, but also reveal certain of its properties, such as the increased activity during the diurnal hours. The observations are continuing. (Source: Dept. of Commerce, A.I.D. Press, No. 649, February 20, 1962, p. 4)

MATERIALS

SEPARATION OF ZIRCONIUM AND HAFNIUM. Appearing in the Soviet Journal of Applied Chemistry recently was a report by V. M. Kolikov and A. P. Perovskiy pertaining to the above elements.

The separation of zirconium and hafnium in the process of the extraction of their nitrates by organic solvents has been studied for the purpose of comparing the effectiveness of certain organic solvents, i.e., amyl acetate, butyl acetate, and isoamyl alcohol. The experiments were conducted at room temperature. The contents of both components in all cases were traced and checked by gravimetric and colorimetric analysis. The efficiency of the extraction separation was defined as the coefficient of separation and expressed as a ratio of the coefficient of distribution: $\alpha = D_{Zr}/D_{Hf}$.

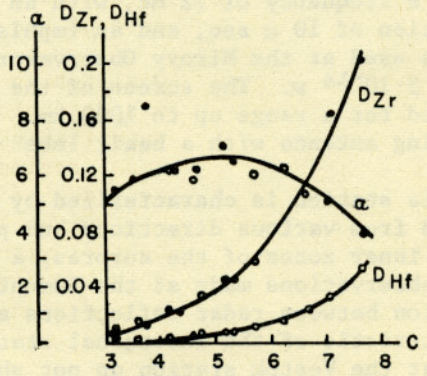

Fig. 1. Dependence of D_{Zr}, D_{Hf}, and α on the concentration of nitric acid C (mol/lit) in the equilibrium water phase.

Data obtained from the experiments show:

1. The coefficient of distribution of zirconium and hafnium increases with the concentration of acid in the equilibrium water phase, while the coefficient of separation decreases after attaining maximum value.

2. Zirconium in aqueous nitric acid solutions (in concentrations of 0.08 mol/liter and higher) occurs in the form of the complex $(ZrO)_n(NO_3)_{2n}$ and -Zr-O-Zr-O-Zr-O-Zr-, as shown previously.

3. The growth of NO_3- and H-ion concentrations leads to the building of polymers and formation of a polymer chain of higher molecular weight. These polymers have a lower solubility in the organic phase than the complex referred to above, a fact which explains the change in the coefficient of separation. A typical example is seen in Fig. 1 for the case where isoamyl alcohol is the organic phase. (Source: Dept. of Commerce, A.I.D. Press, No. 652, February 26, 1962, p. 5)

CORROSION RESISTANCE OF ZIRCONIUM. V. V. Gerasimov, A. I. Gromova, and E. T. Shapovalov reported recently in the Zhurnal Prikladnoy Khimii on their work with zirconium. They stated that the corrosion resistance of

zirconium in distilled water at 85°C was investigated for two cases: (1) where the Zr was in contact with Zr, 1X18H 9T (AISI 321) stainless steel, or aluminum; and (2) where the Zr was separated from the same metals by a 0.1-mm gap, maintained with mica 0.1 mm thick in the case of the steel and aluminum.

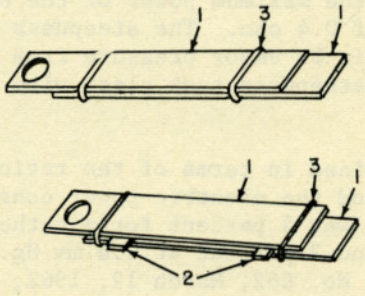

Fig. 2. 1 - specimens; 2 - mica; 3 - fastening wire

Qualitative corrosion resistance was determined visually, and quantitative measurements were made gravimetrically with an accuracy of 0.001 g. The maximum weight loss of samples in contact with the steel for 100 hr was 0.815 g/m^2, representing a corrosion rate of 0.008 $g/m^2 \cdot hr$.

Figure 2 indicates that, under the conditions given, Zr falls in the group of completely stable materials; on the basis of 1000-hr tests it falls in the group which corresponds to point 1 on the 10-point ГОСТ-1272-50 scale. In contact with stainless steel and aluminum, Zr acts as the anode and cathode, respectively, but this does not vary its corrosion rate; the 0.1-mm gap between Zr and these metals also causes no change in its corrosion behavior. The high-corrosion resistance of Zr in distilled water at 85°C depends upon its passivity under these conditions, which is characterized clearly by the anodic polarization curve. (Source: Dept. of Commerce, A.I.D. Press, No. 642, February 9, 1962, p. 2)

PHYSICS

THERMIONIC ENERGY CONVERTER. An article in Teploenergetika, No. 3, 1962, by I. I. Damaskina and G. A. Chetverikova discusses an investigation carried out on a thermionic energy converter in the shape of a glass tube in which a tungsten cathode (10 x 1 x 0.05 mm) and a nickel plate (internal diameter 2.5 mm, length 6 mm) were coaxially placed. The average distance between cathode and plate was 1.3 mm. Cesium, obtained through reduction of a heated mixture of cesium chloride with metallic calcium, was introduced into the tube in a quantity sufficient to insure equilibrium between the saturated Cs vapor and its liquid phase. The pressure of the Cs vapor was fixed by the temperature of the walls of the tube, which was placed in a thermostat.

Cs performed the following functions: (1) it was the source of the positive ions required for neutralizing the negative space charge, and it gave rise to surface ionization; and (2) its deposition on the plate surface formed a film which reduced the work of the plate input. Under high Cs vapor pressure and at relatively low cathode temperatures, the current emitted from the cathode was high compared with emissions from pure tungsten. The converter operated at tube-wall temperatures of 150° to 290°C, corresponding to Cs vapor pressures of 10^{-2} to 1.5 mm Hg. The maximum power yielded by the converter amounted to 3.27w at a current of 1 amp and a cathode temperature of 2900°K. Under a pressure of 0.6 mm Hg and a cathode temperature of $\sim$ 2500°K, the maximum power of the converter corresponded to a load resistance of 0.4 ohm. The steepness of the v-a curves increased with an increase in Cs vapor pressure from 10^{-2} mm Hg to 0.6 mm Hg. A certain decline in steepness took place with a further rise in pressure.

The efficiency of the converter was determined in terms of the ratio between the power consumed by resistance and the electric power consumed by the heating of the cathode. Efficiency was 4 percent for a cathode operating under a pressure of 10^{-2} mm Hg and 3 percent at 0.6 mm Hg. (Source: Dept. of Commerce, A.I.D. Press, No. 662, March 12, 1962, p. 2)

ELASTIC SCATTERING OF NEUTRONS BY NUCLEI OF TITANIUM AND CALCIUM. This note was abstracted from an article appearing in Atomnaya Energiya, Vol. 12, No. 1, January 1962, by G. N. Lovchikova.

Figure 3 and Table 1 show the angular distribution and cross sections of neutrons scattered by titanium and calcium nuclei at a neutron energy of

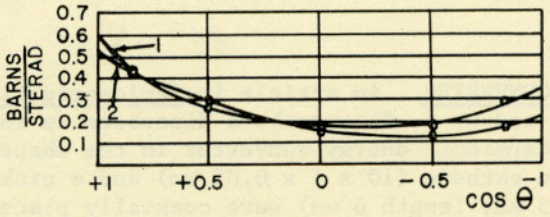

Fig. 3. Angular distribution of neutrons scattered by titanium 1 and calcium 2 at a neutron energy of E_n = 900 kev.

900 kev obtained with $T(p,n)He^3$ reaction as the neutron source. A spherical ionization chamber with an electrode 90 mm in diameter and filled with a mixture of hydrogen and argon was used as the neutron detector. Five different scattering angles were measured in the 30 to 150 deg range by moving the detector in a horizontal direction only. The angular resolution was varied from ±3 to ±5 deg. The results were corrected to compensate for the anisotropy of the neutron source.

Table 1. Cross sections of elastic scattering of neutrons by titanium and calcium at an energy of E_n = 900 kev

	Total cross sec- σ_s, barns	Mean cosine of the scattering angle, cos Θ	Transport cross section δ_{trs}, barns
Ti	3.25 ± 0.13	0.124 ± 0.02	2.85 ± 0.15
Ca	2.62 ± 0.14	0.201 ± 0.05	2.09 ± 0.24

(Source: Dept. of Commerce, A.I.D. Press, No. 655, March 1, 1962, p. 1)

PRODUCTION ENGINEERING

COMBINED PRODUCTION OPERATIONS IN METALLURGY (USSR). Much Russian research is simple and direct, for its aim, more often than not, is to select processes and to design equipment that can be understood and used by the less highly trained technician. This trend is followed by those Russian metallurgists who have suggested that certain steel components (ball-bearing and roller bearing races, for example) should be carburized--given a hard wear-resistant outer casing of iron carbide--at the same time that they are actually being forged in a closed die. This would save their having to be subjected to expensive and time-consuming heat treatments afterwards.

The idea is interesting for it presupposes that it is possible to produce these and similar components in a form that requires little or no machining. It is the machining operation that makes it necessary to produce relatively soft material. In most conventional practices, parts are given their case-hardening treatment only after the rough edges have been removed and after they have been trimmed to the correct tolerance.

As some recent Russian reports have mentioned techniques that have been specifically designed to produce only a limited amount of surplus metal on components, it seems at least possible that the new idea might be put to practical use in the Soviet Union, if only in a limited way. The

danger of grain growth which often accompanies high-temperature carburization, would be avoided, say the metallurgists, since subsequent plastic deformation would help to refine the grain and would give it strength. (Source: New Scientist, Vol. 12, No. 267, December 28, 1961, p. 789)

SINTERING OF TITANIUM CARBIDE. G. A. Meyerson, S. S. Kiparisov, and Ch'en Shao-luan reported recently in Izvestiya-Metallurgiya i Toplivo on cyclic sintering research of titanium carbide compacts. This research has been conducted to find a method of intensifying and accelerating the sintering process. Compacts with a density of 3.27 to 3.28 g/cm^3, made of titanium carbide powder with a grain size not exceeding 5 μ, were sintered under conditions of cyclic temperature changes with cooling and heating rates of approximately 500°C/min.

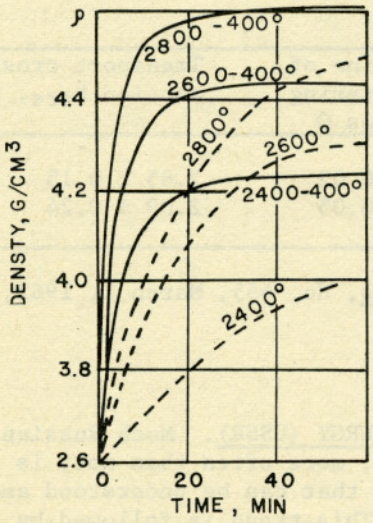

Fig. 4. Density of TiC compacts versus sintering time in cyclic (solid lines) and isothermal (broken lines) sintering.

Chemical analyses before and after continuous (up to 10 hr) isothermal sintering at temperatures in the 2400° to 2800°C range, i.e., slightly below the melting point of titanium carbide, showed that such high temperatures do not affect the composition of the specimens. The best results with cyclic sintering were obtained when specimens were held at maximum temperatures of 2400°, 2600°, and 2800°C for 3 min and cooled at 400°C. The cyclic method greatly intensifies and accelerates the sintering process (see Fig. 4); it also promotes the growth of titanium carbide grains and the coagulation and spheroidization of pores. The effect of the surface state of the powder particles was also studied.

TiC powder was pickled in a mixture of hydrofluoric and nitric acids, compacted, and sintered under isothermal conditions at 2600°C and 2900° to 2950°C. It was found that the pickling greatly intensifies the sintering process, reduces porosity, and promotes grain growth. By sintering pickled powder compacts for 7 to 10 min at temperatures approaching the melting point of titanium carbide, the residual porosity was lowered to 4 percent. The density of these compacts approaches that which can be obtained by hot compacting. (Source: Dept. of Commerce, A.I.D. Press, No. 660, March 8, 1962, p. 6)

SPACECRAFT

THE PROBLEM OF MOON SATELLITES AND MOON LANDINGS. N. Varvarov, writing in the May 1961 edition of Ekonomicheskaya Gazeta, presented a discussion of the problems involved in creating satellites to circle the Moon and the difficulties in making soft landings on the Moon.

If a satellite is to circle the Moon at an altitude of 200 km above its surface, the rocket must have a velocity of 1,590 m/sec. An error in velocity of only a few meters per second too little will result in the rocket falling to the surface of the Moon rather than circling it. There must be special rocket engines on such a vehicle if it is to assume the necessary direction of motion in its flight around the Moon, as well as a fuel supply, a system for the orientation of the rocket relative to the Moon's surface, and its stabilization in space. At a height of 200 km above the Moon's surface, the satellite would revolve around it in 2 hr 7 min and 38 sec, covering a path of 12,177 km. Because of the Moon's smaller size and considerably weaker attraction, the satellite would move approximately five times more slowly than the same satellite would move around the Earth. This fact, in conjunction with the absence of an atmosphere on the Moon, would create favorable conditions for its study from a satellite.

Because the moon lacks an atmosphere that could be employed in braking a space vehicle, it would be necessary that a space station have rocket engines if it is to make a soft landing. Such stations, to be truly effective, should be mobile and capable of operating autonomously or by Earth control. There is little doubt, continues the author, that a manned landing on the Moon will be preceded by flight by man around the Moon, with subsequent return to Earth, because the latter possibility requires less fuel, besides being less complex in general.

For a flight to the Moon and back, the ship should have a supply of fuel which would propel it on launching from the Earth to a velocity of no less than 11 km/sec; for braking, on landing on the Moon, at about 3 km/sec; for launching the ship to a velocity of no less than 2.4 km/sec during launching from the Moon; and for cutting down the velocity of approximately 11 km/sec on its return to Earth (assuming rocket engines are used during landing). Thus, the total supply of fuel is equivalent to the needs for attaining a total velocity of no less than 27 km/sec. When using rocket fuel, the total weight of the ship would be more than 10,000 tons, and the launching of such a ship is presently impossible. That is why scientists are studying the possibility of using satellites as intermediate fueling points. The best solution, he concludes, is to develop more efficient and powerful propulsion systems, such as atomic or electrical. (Source: Joint Publications Research Service, No. 8807, September 1, 1961, p. 29)

THERMODYNAMICS

OPTIMUM SPEEDS OF HEATING OF SOLIDS OF VARIOUS SHAPES. The optimum heating speeds of solids have been investigated in terms of permissible thermal stresses, according to A. A. Shevelev in Energetika. The heating process in plates, cylinders, and spheres was analyzed; the maximum thermal stresses were taken into account at ambient temperature as a linear function of time. Relationships were found which make it possible to determine optimum heating speeds according to the permissible values of maximum thermal stresses at any value of Biot's criterion.

Two graphs are given in Shevelev's report which could be used to evaluate the moments of appearance of the maximum thermal stresses in plates, spheres, and any intermediate geometric shapes. The graphs are based on approximate calculations for plates, cylinders, and spheres. In order to determine thermal stresses in these bodies, the equations used to define thermal stresses and temperature changes include Poisson's ratio and Biot's, Fourier's, and Predvoditelev's criteria. Graphs are also given for calculating maximum thermal stresses in plates, cylinders, and spheres at points $\xi \doteq R$, where ξ is the moving coordinate and R the characteristic dimension of a solid. (Source: Dept. of Commerce, A.I.D. Press, No. 652, February 26, 1962, p. 2)

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Japanese Science and Technology Bibliography. Published by the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. (OTS 62-183/010).

A new bibliography covering Japanese research in science and technology, the first compiled by OTS on this country, is now available to the public. It is divided into eleven categories: biological and behavioral sciences; chemistry; chemical engineering; Earth sciences; engineering; food, fish, and agriculture; machinery; materials; metallurgy; physics; and mathematics. Eighty-five references are cited in a separate section on patents.

The bibliography lists 703 reports added to the OTS collection from January 1959 through July 1961, which covers research in Japan for the last 20 years. (Source: Office of Technical Services, Department of Commerce, Publication Release Notice, March 1962)

Prechistenskii, S. A., Radioactive Venting to the Atmosphere, Moscow: Gosatomizdat. 1961.

This book reviews new techniques for decontamination of radioactive aerosols and toxic fumes in the air. Practical information of use in the planning and design of air decontamination apparatus is given. In the chapter devoted to filtration of aerosols, a procedure for designing filters of fiberglass, thin-fiber materials, and FP fabrics is outlined and recommendations on filter installation are given. The chapter on absorption of vapors and aerosols reviews the design and performance of foaming equipments of various types, cites the basic equations describing foaming performance, and hints on design techniques for such equipment. A chapter illuminating problems of aerosol centrifugation describes the rotor design for a centrifugal rotary dust separator. This chapter also provides data on industrial tests for centrifugal dust separators which might prove useful in the design of industrial models.

A special chapter takes up combined decontamination methods. Here are described the decontamination of gases exiting from waste incinerator furnaces, decontamination of fumes from evaporators, sulfur oxide hood fumes, discharge from vacuum pumps, decontamination of process gases by cold trapping, venting of purified air to the atmosphere by high stacks, and new electrophysical techniques for removing fine aerosols from air.

Appendices cite critical tolerance concentration for toxic fumes and dust in the air environment of work sites.

The book is written for engineering and technical workers responsible for the design and maintenance of air clean-up equipment. (Source: Soviet Journal of Atomic Energy, Vol. 10, No. 4, January 1962, p. 418)

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