Space INTELLIGENCE NOTES

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FROM THE WORLD PRESS

RUSSIANS SAY TWO ASTRONAUTS ORBITED 6.5 KILOMETERS (4 MILES) APART.

Pravda published a long and detailed summary on October 22 of the results of the twin space flights last August of Andrian Nikolayev and Pavel Popovich.

The Soviet communist party organ said that all the research tasks of the flights had been carried out successfully, and both space cabins landed undamaged. One of the main objects was to determine the physical and psychological effects of prolonged space flight on humans.

Maj. Nikolayeve, who took off August 11, spent 94 hours in space. His "space twin," Lt. Col. Popovich, joined him on the second day for a 70-hour sojourn.

The report said that both men experienced no ill effects from their flight. They worked, ate, exercised and rested normally.

It said one of their tasks was to determine whether pain in the inner ear experienced last year by Maj. Gherman Titov was a general phenomenon or one peculiar to Titov. It said neither Nikolayev nor Popovich reported such discomfort.

The report said the spaceships maintained radio and television contact with the ground and spoke to one another every hour. They reported good radio contact between the spaceships, which flew as close together as 6.5 kilometers (4 miles). They ended their flights 3000 kilometers (1864 miles) apart.

The report said the cosmonauts had been subjected to insignificant dosages of radiation. It said the cabins "had necessary construction protection" against death dealing radiation. In addition, the cosmonauts were equipped with "special radio-protective chemical preparations."

Both cosmonauts were said to have spent more than three hours during their flight drifting around their space cabins in a state of weightlessness.

"They obtained data that permits one to hope that in future flights a man will be able to work for extended periods of time normally without strapping himself to his seat," it said.

The two men reported they had clearly observed the Earth's surface, rivers, mountains, and cities.

The report said both spaceships were brought back to Earth with the aid of automatic devices. The two cosmonauts were ejected from their cabins and parachuted to Earth.

The cabins also were parachuted to the ground. The report said that they were undamaged and could be used again for space flights. (Source: Chicago Tribune, October 23, 1962)

Rockets

SOVIETS CLAIM FIRST WITH MILITARY ROCKETS. The Soviet Union's official military newspaper, Krsnaya zvezda (Red Star), recently stated that they had been the first country to use rockets in combat. They claim to have fired rockets from Soviet planes at Japanese planes in August, 1939, during fighting in Mongolia. (Source: Associated Press, October 13, 1962)

European Space Research Org.

PROGRESS REPORTED ON WEST EUROPE'S SPACE VEHICLE. The Atom Affairs Ministry stated on October 21 that work will begin shortly in Germany on the third stage for Western Europe's first space rocket.

The first stage of the rocket will be developed from Britain's Blue Streak missile and the second stage from the French Veronique. Germany will build the third stage and Italy the satellite.

A ministry announcement said West German firms will be invited shortly to place bids to build the third stage.

Germany will produce eight missiles. The first will be ready in 1966, the Ministry said, and the last one a year later. (Source: New York Times, October 21, 1962)

Photography

SOVIETS TAKE THERMAL RADIATION PHOTOS. Tass reported on October 17 that Soviet scientists have developed an instrument that can photograph any object by its own invisible thermal radiation.

"Nature knows of no creatures, except snakes, which sense such weak thermal radiation," the agency said in describing the instrument, which resembles a television set.

Citing one experiment, Tass said a scientist placed his hand on a notebook and then put the notebook before the lens of the apparatus and the image of the hand appeared on the screen. (Source: Minneapolis Star, October 17, 1962)

meteorology

BETTER WEATHER FROM SPACE RESEARCH IS HOPE OF U.S.S.R. AGRICULTURE HEAD. Secrets of the weather may be learned from the current space endeavour by the United States and the Soviet Union.

So, hopefully thinks a Russian whose life has been made or marred by the weather, who was one of six guests of honor last night at the Soviet Embassy. He is K. G. Pysin, Minister of Agriculture of the Soviet Union.

"Control of the weather is being researched way up there in outer space," he said last night when someone asked him about recent droughts in the Soviet Union. (Source: Washington Post, October 6, 1962)

mercury

SHIRRA FLIGHT ANNOUNCED ON MOSCOW RADIO. Following the 6 orbit flight of astronaut Walter M. Shirra, Moscow radio reviewed the happening for the Soviet people.

As in most Soviet news broadcasts, the report was filled with propaganda. A New York dispatch by Vitaly Zhurkin, emphasized that the flight was frequently postponed, but had finally been accomplished. Zhurkin said that Shirra set a new record for American spacemen. "The launch this morning was postponed for only 15 minutes--as a result of the unexpected discovery of radar failures." (Source: Washington Post, October 4, 1962)

satellites, Soviet

RUSSIANS LAUNCH COSMOS 10. On October 17 the Soviet news agency Tass announced that they had launched the tenth geophysical satellite of the Cosmos series in a space study program that began last March.

The program is designed to study radiation belts, their effect on radio-wave propagation and the impact of meteorites on the structural elements of spaceships.

The latest satellite, Cosmos 10, has an initial orbital period of 90.2 minutes and is traveling in an orbit that forms an angle of 65 degrees with the Earth's equatorial plane.

The orbit's maximum distance from Earth is 236 miles and the minimum 130 miles. (Source: Washington Post, October 18, 1962)

space flight X

FROM THE SEMITECHNICAL LITERATURE

A FAMILIAR STORY. Several Soviet scientists have expressed what is considered to be an official opinion on the purpose of space flight. This was in answer to complaints that too much money was being spent on the project, while the Russian people had a very low standard of living. It seems that many Russians felt the money could be spent to much greater advantage on social and economic reforms.

Professor G. V. Petrovich feels that migration to other planets would not justify the expenditure, for resources on the Earth have not been expended. The establishment of expeditionary settlements or bases on artificial and natural satellites of the Earth and other planets are obviously necessary in the near future. (No reason was given as to why it was obviously necessary. Ed.)

I. Shevlyakov feels that the sole purpose of space flight is to discover new laws of nature and new mysteries of the Earth and sky to improve life on Earth. He feels that migration of man to other planets is nonsense, because Earth is the ideal planet for man.

S. N. Vernov writing in Pravda says that the most important reason for space flight is the great progress made in the discovery of new natural phenomena, the existence of which was impossible to foretell. He feels that a greater amount of knowledge is yet to be discovered.

B. Kozachenko feels that it will be possible to utilize the energy of the Sun by means of interplanetary communications on Earth. Raw materials from other planets will become more valuable as they run out on Earth. (Source: U.S. Dept. of Commerce, A.I.D. Report No. 61-72, May 22, 1961, pp. 137-138)

Satellites, Soviet manned X Vostok X

DESCRIPTION OF THE VOSTOK SPACESHIP. From all reports, the Soviet Vostok is a honey of a spaceship. It is roomy enough for two and able to sustain its crew in orbit for over a week. It represents a class of craft that the United States will not have until the two-man Project Gemini capsules fly a year or more from now.

Even then, the Vostoks will be the heavyweights. All models so far orbited weigh about five tons. Gemini vehicles are expected to weigh some two tons less.

With details held secret, it is impossible to judge what kind of space flight capacity Soviet designers have built into the Vostoks. It seems likely that they could easily carry men around the Moon and back again, even if they are not suitable for a lunar landing.

One thing, however, does seem certain. The Vostok design does not reflect the full lifting power of Soviet rockets.

Engineers of the United States Mercury and Gemini capsules are using every ounce of payload that their launching rockets will place in orbit.

Soviet rockets, on the other hand, have orbited seven-ton payloads, two tons more than the Vostoks. Soviet designers apparently can get all the performance they now need in a spaceship without stretching their launching capacity to the limit.

The shown artist's conception of a Vostok, based on information publicly available in the West, should be taken with a grain of salt as far as details are concerned. However, it quite likely represents the general features of Vostok design.

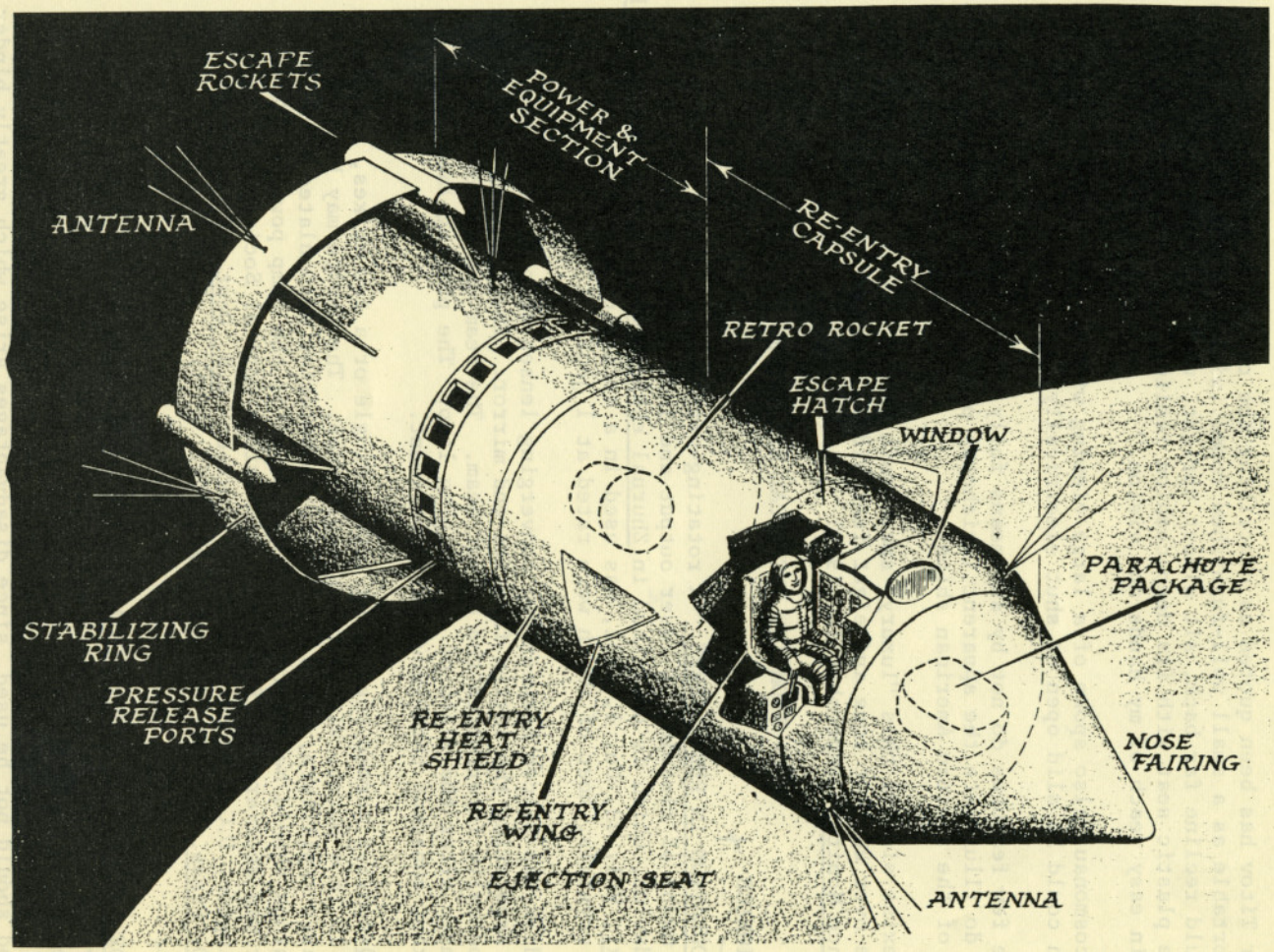
The ship appears to be in three parts. A nose covering is shown which probably would protect the parachute end during launching. This would be jettisoned for descent.

Next is shown the crew carrier, which would also be the reentry vehicle. Last there is shown an instrument and power-carrying module with escape rockets mounted on a stabilizer ring that might be needed to stabilize the vehicle during an escape.

For reentry, the crew carrier would presumably separate and swing around to come in backside foremost, as does the Mercury capsule. Expert Western observers believe that the reentry vehicle has small "wings," aerodynamic surfaces which would give limited flight control during reentry. The Mercury craft has no such control surfaces nor will the Gemini capsules have any.

Inside, the crew carrier provides many comforts. Where the Mercury capsule fits as snugly as a lady's glove, the Vostok cabin is big enough for a cosmonaut to leave his seat and float freely in space. Maj. Andrian G. Nikolayev and Lt. Col. Pavel R. Popovich did this during their sustained orbital flights.

The atmosphere within the cabin is maintained at sea level pressure (as opposed to one third that level in Mercury craft). Temperature can be set anywhere between 50 and 75 degrees F, while relative humidity may be about 75 percent.



THIS DRAWING ILLUSTRATES PROBABLE FEATURES OF A SOVIET VOSTOK

Soviet cosmonauts, reportedly, have not had the troubles with their climate control system that at times have cropped up on Mercury flights.

Major Titov has been quoted as describing the cabin "as spacious and as comfortable as a small well-furnished room...with soft luminescent lights. I could recline far back, sit almost upright, work, or even sleep in the white plastic seat with its deep-cushion feeling.... Everything lay within easy reach of my hands and vision."

The cosmonaut also spoke of a large viewing window with a metal cover which could be slid open or shut electrically.

These few features do not by any means fully characterize a Vostok, but they do illustrate the apparent lavishness of its design as opposed to that of the spartan American ships.

The exist size of this "luxury" spacecraft is not known. It is believed to be over 20 feet long and eight feet wide. (Source: The Christian Science Monitor, September 18, 1962)

FROM THE TECHNICAL LITERATURE

ASTRIONICS

lasers

Q-MODULATION IN RUBY LASERS. A rotating-disk Q-spoiler has been applied as a means of cleaning up laser output and increasing its peak power. The device, which is described in Zhurnal eksperimental'noy i teoreticheskoy fiziki, Vol. 43, No. 1, 1962, was used in a series of experiments with ruby crystals, most of which were rated at 1 joule.

The disk was placed between two converging lenses at one end of the ruby rod, separating the latter from its end mirror. The rotating disk thus periodically interrupted the output beam. The beam was restored 0.3 to 0.5 msec after the flash of the pumping lamp. The pumping-lamp power was kept constant throughout the experiment.

The Q-spoiler formed the output into a single or a few spikes, never more than 10 in a burst, with varying amplitudes. The device may be of use in laser amplifiers, since the excited population accumulated between emissions should be practically independent of the pump power. (This paper was delivered by Basov at the American Optical Society Meeting in Washington, D.C., in March, 1962.) (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 799, September 20, 1962, p. 1)

gyroscopes

USE OF A VACUUM ON GYRO ELEMENTS. The possibility of utilizing a vacuum in gyro elements to eliminate aerodynamic drag of the gyrowheel is discussed by A. G. Bessonov in Izvestiya. Priborostroyeniye, Vol. 5, No. 3, 1962. It is concluded that although a vacuum does eliminate drag, the method should not be used, since disadvantages arise which greatly hinder operation of the gyromotor and the accuracy of the gyro instrument.

The use of hydrogen or helium is proposed for filling gyro elements, with a pressure in the element equal to half the atmospheric pressure. Recommendations for proper gyrowheel design, optimum spacing between the wheel and the casing, and the finish required on the wheel surface to reduce aerodynamic drag are also made. (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 784, August 31, 1962, p. 2)

ASTRONOMY

SOLAR FLARES STUDIED. Announcement of a new method for forecasting solar flares was made at the Thirteenth Annual Congress of the International Astronomical Federation in Varna. An article appeared in Pravda Ukrainy stating that A. B. Severnyy, Corresponding Member of the Academy of Sciences USSR, and associates at the Crimean Astrophysical Observatory have invented a new method for forecasting solar flares. Analysis of data on 50 solar flares obtained by improved astrophysical instruments made it possible to determine the characteristic phenomena which usually precede the flares. Maps showing the concentration of magnetic fields in the active regions of the Sun have been compiled. In 75 to 80 percent of the cases, forecasts for the next two or three days were reported to be exact. (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 810, October 5, 1962)

ASTROPHYSICS

HYPOTHESIS ON LUNAR RING FORMATIONS. A method of modeling based on the cumulation principle has been employed to reproduce lunar ring formations. This method is discussed by A. M. Benevolenskiy writing in Vsesoyuznoye astronomo-geodezicheskoye obshchestvo. Byulleten', No. 30(37), 1962.

The action of a meteorite striking a still soft lunar surface is reconstructed by dropping a solid body into a viscous surface at precisely the moment of hardening or setting. Tests conducted under normal atmospheric pressure (760 mm Hg) and in a rarefied atmosphere (300 mm Hg) yielded excellent models of typical lunar ring formations, including surrounding walls, central peaks, clefts, etc.

By analogy, it is concluded that lunar craters and cirques were formed in an ancient selenological period in which the lunar surface was in the process of hardening. (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 795, September 14, 1962, p. 4)

SOME CONSIDERATIONS ON THE LUNAR GRAVITATIONAL FIELD. A paper appearing in a recent issue of Soviet Astronomy-AJ considers the gravitational field established by the Moon, on the basis of present-day data relative

to the mass and shape of the Moon. Authors N. P. Grushinskii and M. U. Sagitov state that study of the lunar gravitational field is essential to understanding physical conditions at the Moon's surface.

The gravitational field is the basic factor determining the presence of an atmosphere on planets since it plays the major part in preventing scattering of gas molecules. Maintenance of an atmosphere for a protracted time requires a parabolic velocity at the surface of the planet appreciably in excess of the root mean square velocity at which gas molecules are moving. For the Moon, the parabolic velocity attained is 2.38 km/sec. This low value of parabolic velocity has resulted in the complete dissipation of the lunar atmosphere.

The absence of atmosphere and moisture on the Moon could not help but exert a telling effect on erosion and denudation processes at the surface. Preservation of topographical relief must exist on the lunar surface to an extent far beyond anything on Earth. This indirect effect on the force of gravity on the formation of the Moon's exterior appearance is supplemented by the role which it plays, a role not to be underestimated, in opposing those forces responsible for various modes of raising lunar surface rocks in response to processes taking place beneath the crust, or in response to meteorite impacts.

The low value of the Moon's gravitational force provides an acceptable explanation for the transport of the materials composing the Moon over great distances on its surface. It can in addition partially account for the sharp angular features of the Moon's relief: the gravitational force is too weak to overcome molecular cohesion in rocks under conditions where larger values of gravitational force would have long since brought about avalanches.

The value of the gravitational force has a certain role to play in the meteoritic theory of the formation of lunar craters.

Because the gravitational field is of such significance, the authors proceed to discuss how the average gravitational force of the Moon may be determined from known mass ans size. At present, a large number of determinations of lunar mass are available, lunar mass being one of the fundamental constants used in astronomy. The following methods were used to determine these constants:

1. Determination of mass from inequalities in solar longitude.
2. Determination of mass from observations of the constant of nutation and precession.

Investigation is also made into intensity variation of the gravitational force field at different parts of the lunar surface. Such changes are discussed in regards to the following agencies:

1. Ellipticity of the Moon and varying effect at different latitudes of the centrifugal force generated by the Moon's rotation about its axis.

2. Perturbing effect of the Earth.
3. Different arrangement of observation points on the lunar surface, with respect to height.
4. Inhomogeneous mass distribution throughout the Moon.
5. Librations of the Moon.

The paper includes 15 equations, 3 tables, and 17 references. (Source: Soviet Astronomy-AJ, Vol. 6, No. 1, July-August, 1962)

ATMOSPHERICS

UPPER ATMOSPHERE INVESTIGATIONS WITH INFRARED RAYS. V. I. Krasovskiy says in an article appearing in Akademiya nauk SSSR, Vestnik, No. 6, June, 1962, that on the basis of investigations of twilight infrared helium emission at 10,830 A with image converters, it has been possible to obtain information on solar short wave and corpuscular radiation and the stage of the ionosphere. This method for investigating the physical properties of the ionosphere from ground stations is considered far more economical than the present method using rockets and satellites. (Source: U.S. Dept. of Commerce, A.ID. Press, No. 790, September 11, 1962, p. 1)

CHEMISTRY

RADIATION STABILITY OF FLUORINATED OIL. In the July issue of Atomnaya energiya, V. N. Cherednikov indicates that fluorinated oil has a low neutron-capture cross section and good moderating properties. In a study of the stability of this oil under nuclear radiation the amount of gas released from the oil and the variation in the oil's viscosity and fractional composition with the amount of radiation energy absorbed were determined.

Quartz ampules filled with the oil and placed into aluminum containers were subjected to a neutron flux from a nuclear reactor. Two experiments were conducted, one with neutron fluxes of $5 \cdot 10^{12}$ n/cm^2·sec (thermal) and $3 \cdot 10^{12}$ n/cm^2·sec (energy = 1.5 Mev), and the second with neutron fluxes of $2 \cdot 10^{12}$ n/cm^2·sec (thermal) and $1.2 \cdot 10^{12}$ n/cm^2·sec (energy > 1.5 Mev).

The results obtained indicate that under the action of radiation intensive polymerization takes place with the formation of a high-boiling fraction. The radiation effects depend only on the energy dose and are independent of the type of radiation (γ-rays or neutrons). (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 793, September 13, 1962, p. 2)

FLIGHT MECHANICS

LAUNCHING A MANNED LUNAR ROCKET. Yu. Marinin, a commentator for Novost' Press Agency, discusses two possible methods for effecting a manned lunar landing and return to Earth in Bakinskiy Rabochiy.

The first calls for the use of a giant rocket 100 m high and 15 m in diameter, which would be launched from the Earth, fly directly to the Moon, make a soft landing, and return to Earth. In Marinin's opinion, the difficulties inherent in transporting and assembling such a huge rocket preclude its use in the current decade, even though this method offers greater chances for a successful flight.

The second method discussed by Marinin is orbital rendezvous with launching from orbit, of which there are several variations. The most realistic of these is launching from a low-altitude Earth orbit, using several medium size rockets to place the components of the spaceship in orbit. These components might include a cabin, retroengine for deceleration during a lunar landing, and a booster engine unit for liftoff from the Moon. These units would be assembled in space and joined later by a fueled rocket to be used in breaking the spaceship from orbit and propelling it to the Moon.

Depending on the suitability of available rockets, the procedure could be somewhat as follows: an unmanned cabin would be put into orbit; then a second rocket carrying the crew in a capsule (weight, 2 tons) would rendezvous with the cabin, and the crew would transfer to it (manned cabin weight, 5 tons). The remaining two engine units could be orbited fueled or unfueled (fuel comprising 90 percent of each engine unit's weight. In the latter case, a fueler rocket must also be orbited to perform in-orbit fueling of the assembled spaceship.

Marinin further states that orbital rendezvous could be made near the Moon or on its surface.

For a lunar orbit rendezvous, a spaceship not equipped with a retroengine is put into orbit around the Moon. A second rocket carrying the retroengine joins the first rocket and a landing is made. For rendezvous on the Moon's surface a spaceship not equipped with a booster engine lands on the Moon. A second rocket carrying the needed booster and an empty cabin is landed nearby. The crew transfers and takes off.

According to Marinin, these last two methods are unsatisfactory because of the great difficulty to be encountered in aiding cosmonauts should a dangerous situation arise. Also, it is almost impossible for Earth-based stations to participate in effecting the rendezvous.

Marinin concludes by saying that the development of rendezvous techniques in orbits around the Earth is of prime importance. (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 782, August 29, 1962, p. 1)

INSTRUMENTATION

PRECISION MEASURING DEVICE. Krasnaya zvezda wrote of a remarkable device recently for making measurements with a precision of two one-hundred-thousandths of a millimeter. It has been developed by the Institute

Construction, East German Academy of Sciences. The design of the device is based on the principle of electro-induction. The air in the place where it is operating must be strictly maintained at a constant temperature, since the device will even record changes occurring as a result of variations in the temperature of the surrounding air. (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 810, October 5, 1962)

LIFE SCIENCES

RADIATION MEASUREMENTS IN VOSTOKS 3 AND 4. Izvestiya reported in an August issue that Lt. Gen. of the Medical Service Yu. Volynkin and Doctor of Medical Science S. Pavlov stated that the level and intensity of radiation in Vostok-3 and Vostok-4 during flight would be systematically transmitted to Earth from a dosimetric apparatus.

For purposes of scientific research, as well as for thorough control of radiation conditions, the cosmonauts are also equipped with several types of individual dosage meters.

In addition, lysozume, drosophilae, blooming tradescantia, chlorella, seeds of pea, wheat, pine, and beech, and a number of other biological specimens were placed in the cabins of the spaceships. These specimens were equipped with dosage meters.

It is asserted that these methods of measuring cosmic radiation will provide new data on the dangers of radiation in the lower regions of space and will facilitate development of all the necessary means of protection. (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 799, August 24, 1962, p. 1)

EVOLUTION IN WHITE RATS DUE TO DECREASED OXYGEN SUPPLY. N. A. Verzhvinskaya told, in an article appearing in Akademiya nauk SSSR, Seriya biologicheskaya, No. 3, 1962, of work done in studies with white rats. According to him the acclimatization of white rats to a decreased oxygen content has been observed through eleven generations which were born, grew to maturity, and reproduced in a hypoxic medium containing 10.5 to 11 percent oxygen. The speed of adenosinetriphosphate production of the brain in vivo and the permeability of the hematological barrier was studied with the introduction of small doses of radioactive phosphorous (P^{32}) into the body of the animals for 5, 10, and 15 min.

In the first period of acclimatization, which lasted two generations, the survival of the animals was secured by mobilization of various physiological reserves toward maintainance of a normal oxidation level in the brain. This was reached through an increased expenditure of oxidation energy of the whole organism. Nonbalanced conditions were manifested by increased permeability of the hematoencephalitic barrier and the absence of a reaction to hypoxemia in the brain cells.

The "true acclimatization" began with the eighth generation, when tissue reaction to hypoxemia appeared again, and the permeability of the hematoencephalitic barrier was restored to normal. The increase in the effectiveness of oxygen metabolism which was observed as attributed to an increased coupling of oxidation with phosphorylation.

Hereditary accumulation of an acclimatization effect, produced by a change in the environment was observed in these experiments. (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 785, September 4, 1962, p. 4)

PHYSICS

instruments

EXPERIMENTAL NEUTRON COUNTER. In an article appearing in Ukrayins'kyy fizychnyy zhurnal, Vol. 7, No. 6, 1962, P. M. V'yugov, V. S. Dementiy, and V. S. Poryatuy state that the Physiocotechnical Institute, Ukrainian Academy of Sciences, has designed a flat multiwire neutron counter with stable characteristics in the 10° to 60°C range.

The counter, a cylindrical box 112 mm in diameter and 32 mm high, is made of copper plate 0.5 mm thick. Three nichrome wires parallel to each other are placed inside the box in a plane parallel to the top and bottom of the box. Copper shields 0.1 mm thick are mounted between the nichrome wires for electrostatic field equalization.

Experimental studies show that optimum properties are obtained when the counter is filled with $B^{10}F_3$ gas at a pressure of 220 mm Hg. The counter, which has a plateau region of 150 v, operates stably at -4 to -12 v threshold voltage and is not sensitive to Co^{60} γ-radiation of 4 millicurie activity beyond a distance of 20 cm.

The above experimental counter has been operating since 1956 without gas refill. An Ra-Be neutron source with an activity of $4.8 \cdot 10^5$ neutrons/sec was used for testing the counter. (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 788, September 10, 1962, p. 2)

EFFECT OF SCREENING MEDIUM ON GRAVITATIONAL INTERACTION. An experiment has been conducted at Moscow State University to determine the screening effect of a two-blade rotor placed between two masses on their gravitational interaction. A report on this work was presented by V. B. Braginskiy and coauthors in the Zhurnal eksperimental'noy i teoreticheskoy fiziki, Vol. 43, No. 1, July 1962.

The measuring device used was theoretically considered to be sufficiently sensitive to detect possible changes in the weight of a 10-kg mass screened by a steel plate 10 cm thick. An electromechanical transducer and electronic equipment designed for optimal separation of signal from noise were used. No change in gravitational interaction was detected.

By using statistical methods, the probability that a screening effect went undetected was found to be ~0.004 for an effect of the order of $\geqslant 1.3 \cdot 10^{-10}$ of gravitational interaction and ~0.002 for one of the order of $\geqslant 2 \cdot 10^{-10}$. (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 797, September 18, 1962, p. 1)

Radiation

RADIATION SHIELDING STUDIED. It was reported in Krasnaya zvezda recently that a new reactor shielding material, "heavy concrete", developed by the Hungarian research scientist Kunst, makes it possible to reduce shielding thickness by one meter. The material is made from bauxite, cement, water, iron scrap, iron ore, and nonferrous metal slag, and withstands mechanical and thermal loads. (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 809, October 4, 1962)

POWER

Power sources

VOLCANOES TO BE USED AS POWER SOURCE. B. Glebov reports, in Vechernyaya Moskva, June 1962, that attempts are now being made to utilize the energy of thermal waters and volcanoes in the Soviet Union.

The first Soviet electric power plant to operate on the energy generated by thermal waters is under construction in Kamchatka. The laboratory of Volcanology, Academy of Sciences USSR, has conducted drilling operations in the Pauzhetskaya Valley in Kamchatka, where at a depth of 500 m a mixture of hot water and steam was found which could provide enough energy for a 5000-kw power station. Such a station is in the planning stage.

The construction of a "volcanic" station in the Kamchatka area with a capacity of 50,000 to 100,000 kw is also under consideration. It would supply power to the southern shore of the Sea of Okhotsk and the city of Petropavlovsk. (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 777, August 22, 1962, p. 6)

PRODUCTION ENGINEERING methods

ELECTROSPARK MACHINING OF COMPLEX PARTS. A. B. Sosenko, reporting in Stanki i instrument, No. 6, June 1962, discusses the possibility of electrospark machining of complex parts, particularly radial vaned impellers for small gas turbines and turbocompressors, from heat-resistant, stainless, and other steels as well as alloys.

It was determined that the laws governing the electrospark erosion process previously determined for carbon steels apply also to the heat resistant alloys ЭИ661 (composition unknown), ЭИ617 (by percentages: 0.08 C;

13-16 Cr; 2 Al; ~2 Ti; 0.5 V; 5-7 W; 3 Mo), and ЭИ437 (Nimonic 80). However, with the same current and machining area, the metal removal rates for heat resistant alloys are considerably higher than those for steel 45 (C-1045), while their surface finish is about 15 percent poorer. The improvement of surface finish to class 6 [roughness height, 1.6 to 3.2 μ (rms)] can be achieved by lowering power levels in finishing operations.

The experiments also determined that thin wall sections (0.3 to 0.5 mm) can be machined without increasing the allowance for finishing operations. Owing to the complex shape of impeller channels, electrode (tool) wear is an important factor in obtaining the required precision.

A universal formula is presented for determining either the number of electrodes needed to machine one channel or the number of channels which can be machined with one electrode. Equations for determining the optimum current and machining area are also derived. On the basis of these calculations a technology for electrospark machining of impellers is developed.

The form electrode is fed toward the blank, set on the mandrel of a dividing head at a rate of 0.8 to 2 mm/min until the channel, which is the inverse image of the tool, is formed in the workpiece. The most advantageous method was found to be rough machining of all channels of the impeller with an undersized (worn) electrode, followed by finish machining with a new electrode. Productivity in electrospark machining of an impeller 300 mm in diameter was tenfold that of milling. (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 790, September 11, 1962, p. 3)

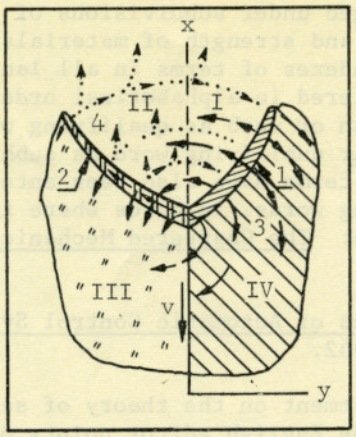
PROPULSION

Propellants

FLAME PROPAGATION ALONG A METAL-FUEL, SOLID-OXIDIZER INTERFACE. The Institute of Chemical Physics, Academy of Sciences USSR, has conducted experiments on flame propagation along cylindrical contact surfaces of powder-metal fuels and solid oxidizers in air under atmospheric pressure or in nitrogen under a pressure varying from 1 to 100 atm. These experiments are discussed in Inzhenerno-fizicheskiy zhurnal, Vol. 5, No. 7, July 1962.

Aluminum and tungsten powders with particle sizes of ~0.1, 10, 200, and 500 μ for the former and ~5 and 270 μ for the latter were used as fuels. $KClO_4$, $KMnO_4$, BaO_2, $Ba(NO_3)_2$, Ag_2O, PbO_2, MnO_2, CuO, Co_2O_3, PbO, Fe_2O_3, SnO, ZnO, and Cr_2O_3 served as oxidizers.

In some experiments both components were used with as-poured density, while in others the oxidizer was compacted to a relative density δ of ~0.95 and the metallic powder had various densities. The dependence of the velocity of flame propagation on the diameter D and structure of the metal powder core and on pressure was determined.



Combustion pattern for high-melting metals

I - metal oxide
II - condensed residue of oxidizer decomposition
III - solid oxidizer
IV - metal

1 - combustion zone
2 - oxidizer decompostion zone
3 - heat transport
4 - transport of gaseous products of oxidizer decomposition

The results showed the feasibility of the combustion of metal fuels with a large D and even with $D \rightarrow \infty$ if δ is not too high. The existing limitations appear to be associated with the metals' high heat conductivity. Generally, combustion of metals with low boiling points proceeds according to the same pattern as that of organic fuels. In the case of metals with a high boiling point the pattern is different. In both cases, however, the convective transport of the oxidizer plays an important role in combustion. In the presence of dense solid products of the decomposition of the oxidizer and of metal oxides, the convective transport is accomplished through the pores as a result of increased pressure in the combustion zone. (Source: U.S. Dept. of Commerce, A.I.D. Press, No. 800, September 21, 1962, p. 6)

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n.a., Vocabulary of Theoretical Mechanics in Five Languages, Group 05. Pergamon Press, Ltd., Oxford, England. 1962.

The five languages covered in this dictionary are English, German, French, Polish, and Russian.

This vocabulary is arranged under subdivisions of the main subjects such as theoretical mechanics and strength of materials with which this particular volume deals. Indexes of terms in all languages follow the main text, the terms being entered in alphabetical order and in addition all compound terms having noun or verb as qualifying word have been entered alphabetically under their qualifying word as subheadings. Some of the German compound one-word terms have also been entered additionally under their component qualifying words, in cases where these constitute independent terms. (Source: The Chartered Mechanical Engineer, July 1962)

Popov, E. P., The Dynamics of Automatic Control Systems. Pergamon Press, Ltd., Oxford, England, 1962.

This is an extensive treatment on the theory of servomechanisms and control systems which, as the English editor points out, will show English readers 'the meticulous detail into which Russian engineers and students are led when discussing these subjects'. The book presents those theoretical methods of analysis and synthesis of automatic control systems common to systems of various physical natures and designs, and the author has endeavoured to reduce to a minimum the use of operational calculus and the theory of functions of the complex variable, and, where possible, has confined himself to the use of the symbolic operational method as a means of simplifying the notation and manipulation of differential equations. The material is arranged in five sections covering respectively general information about automatic control systems, ordinary linear automatic regulation systems, special linear automatic regulation systems, non-linear systems, and methods of plotting the regulation-process curve. (Source: The Chartered Mechanical Engineer, July 1962)

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