

Space INTELLIGENCE NOTES

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

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FROM THE WORLD PRESS

UN SPACE GROUP ENDS FIRST SESSION. The United Nations Space Group ended its first attempt to prepare the legal basis for international cooperation in space on June 20th of this year.

Concluding its first session, the legal subcommittee of the 28-member UN Committee on the Peaceful Uses of Outer Space reported that "no agreement has been reached on any proposals" submitted to it. The subcommittee said, however, that a "most useful exchange of views" had been held.

The U.S. and the Soviet Union clashed from the outset of the session because of what Leonard C. Meeker, the U.S. delegate, described today as the "political" and "so obviously controversial" issues raised by the Soviet delegation.

Agreement was sought by the U.S. on draft resolutions covering assistance to astronauts and spaceships in difficulty and their return after accidental or forced landings and on liability for damage caused by them.

Although the legal subcommittee failed to achieve any agreements, a second subcommittee on technical questions approved during the week of 11-15 June a series of recommendations for international cooperation. Among them was one for the setting up of a sounding rocket range near the equator that would be open to all UN members. (Source: New York Times, June 21, 1962)

Interplanetary flight X

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SOVIET PREDICTS SOLAR FLARES MAY PROVE FATAL TO 1966-70 ASTRONAUTS.

Astronauts who try to visit the Moon from 1966 through 1970 may be bombarded by lethal nuclear particles being spewed into space by the Sun. This warning was made recently by Soviet scientist Professor G. I. Pokrovskiy of Moscow. The period 1966-70 is precisely the time in which the U.S. hopes to land an Apollo crew on the Moon and return it safely to Earth.

A spokesman said NASA scientists are well aware of this menace and are working on forecast methods whereby such flares can be avoided.

From time to time gigantic eruptions occur on the face of the Sun and are associated with sunspot activity. Some of the larger eruptions, known as cosmic ray flares, hurl myriads of high-energy particles into space. These particles are largely protons, the core of hydrogen atoms. Traveling at many thousands of miles a second, they constitute one of the most serious obstacles to manned space flight.

Material shields dense enough to protect astronauts will be prohibitively heavy until considerably more powerful rockets are developed than any now planned for 1966-70.

Pokrovskiy, writing on flights to the Moon, Mars, and Venus in a Moscow publication, said manned trips to the Moon should be made during periods of the quiet Sun. Parenthetically, he added that "this would appear to exclude the years of high solar activity 1966-70." (Source: Newport News, Va., Times Herald, June 13, 1962)

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CHINESE ESTABLISH ELECTRONICS SOCIETY. The Chinese newspaper Kuang Ming Jih Pao announced on April 22, 1962, that the first meeting of the newly established Electronics Society of China was held in Peking on April 10-17, 1962. Over 300 scientific and technical reports were submitted and over 140 reports read by radio and electronics engineers and scientists. Regional branches and discussion groups were organized. (Source: Dept. of Commerce, A.I.D. Press, No. 717, May 28, 1962, p. 3)

+ astromicrobiology

TRACES OF LIFE FOUND IN METEORITE. Microscopic remains of organic origin have been found in the "Migei" stone meteorite by B. Timofeyev, a senior scientific associate of the All-Union Scientific Research Petroleum Institute in Leningrad.

Carbonaceous powder from the meteorite was treated with acids and reagents in one of the Institute's laboratories. Spore-like formations and dispersed microscopic remains of organic origin have been identified. (Source: Pravda, May 11, 1962, p. 6)

Electronics X
SOVIETS MAKE INFRARED PHOTOS OF THE MOON. N. F. Kuprevich of Pulkovo Observatory has succeeded in obtaining what is claimed to be the first infrared photos ever made of the Moon. Twenty photos were obtained in the 0.9 to 2.3- μ wavelength range with a special semiconductor television tube.

Relief features stand out with particular clarity in the photos; the rays emanating from the crater Tycho in the direction of Mare Nectaris are now seen to be a rather high and long mountain chain. The details of other lunar landforms (Copernicus, Sinus Iridum, and isolated mountains in Mare Serenitatis) can be seen in new configurations and contrasts.

The heightened contrasts and new details revealed by infrared light may be due to the presence of a luminescent glow of the lunar surface in a wide spectral range, caused by the action of solar radiation. A. A. Mikhaylov, Director of the Pulkovo Observatory, reports further that a new dual television telescope is now being assembled which will make possible even more detailed studies of the structure of the lunar surface in the infrared region of the spectrum. (Source: Trud, June 20, 1962)

+
SPACE FOOD FOR COSMONAUTS. Space food for cosmonauts, according to Candidate of Medical Sciences, N. Gurovskiy and Candidate of Biological Sciences, M. Gerd, will consist of a paste of Chlorella, zooplankton, mollusks, and possibly fungi. Mollusks and zooplankton are required to supply animal proteins. Zooplankton will be cultivated together with Chlorella. (Source: Izvestiya, May 18, 1962)

+
SOVIETS BUILD COSMIC RAY CENTER. The Soviet Union is building a cosmic-ray research station in the mountains of Georgia to study the interaction between high-energy particles of cosmic rays and atomic nuclei.

Disclosing the construction project 65 miles west of Tiflis, the Georgian capital, the trade union newspaper Trud stated on June 10 that the station would be equipped with an electromagnet weighing almost 1,000 tons.

The magnet, consisting of a core 6.5 ft in diameter, is designed to guide cosmic rays into the desired part in the same way as electromagnets control the paths of particles in cyclotrons and other high-energy accelerators.

The cosmic ray station is situated at Tskhratskaro Pass, a few miles south of the ski resort of Bakuriani. A small-scale experimental model of the cosmic-ray magnet is scheduled to go into operation at Bakuriani this summer. No date is given for completion of the larger station. (Source: New York Times, June 11, 1962)

FROM THE SEMITECHNICAL LITERATURE

SOVIETS TO DRILL EARTH WITH UNDERGROUND ROCKET. Rude Pravo, a Czech newspaper, reports that Soviet scientists are preparing to "launch" an underground rocket which will penetrate far into the Earth's interior. Soviet Academician Nalivkin is cited as the source for this information.

Ordinary drilling equipment can only penetrate to depths of 20 to 30 km, but it is hoped that the rocket will penetrate to depths of 100 or 200 km. The rocket will be radio controlled, like space rockets.

According to Academician Navilkin, the launching of this underground rocket will be a far more complex undertaking than the launching of space rockets. Soviet scientists have great expectations for this experiment. [Unfortunately, no details of this revolutionary rocket were made available with the news release nor were specific missions of the rocket discussed. Ed.] (Source: U.S. Dept. of Commerce, Joint Publications Research Service, 14106, June 14, 1962, p. 23)

A SPECULATION ON VOSTOK 2 REENTRY DESIGN. As the Russians remain reluctant about releasing information on Vostok 2, some U.S. engineers recently decided to figure out on their own how the spacecraft worked. Their analysis of the reentry configuration was based on films and photos, and they apparently arrived at their conclusions with only limited use of readily available U.S. design information (see Figs. 1 and 2).

A film, based on the Titov orbital flight film, shown in October 1961 revealed clues to the puzzle of the Soviet reentry design. Significant observations made include:

- One set of canard control surfaces mounted in reverse position.
- A metallic cap on spherical nose, resembling ship-type hatch cover.
- Shutters mounted on aft end, which open and close.
- A ring of small rectangular ports near aft end.
- A stabilizing ring at the base of the vehicle.

The internal arrangement of the vehicle, judging by the external configuration, reveals considerably more room than afforded by the Mercury vehicle. In addition, a circular window was observed above and to the right of the reclining cosmonaut.

The Vostok reentry vehicle apparently used the Mercury technique for positioning the man so that he reenters in a reclining position, facing upward. This simplifies the crew-restraint problem; loads can be applied to the cosmonaut in the same direction for both launch and reentry.

As shown in Fig. 2, the single set of canards (1) are actually control fins for the reentry vehicle. The reversed mounting of these fins indicates that the vehicle reenters in an attitude opposite to that of ascent--

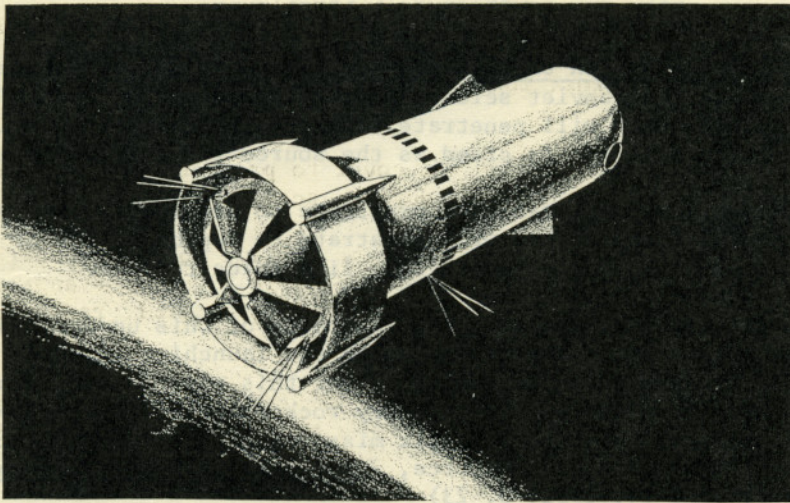
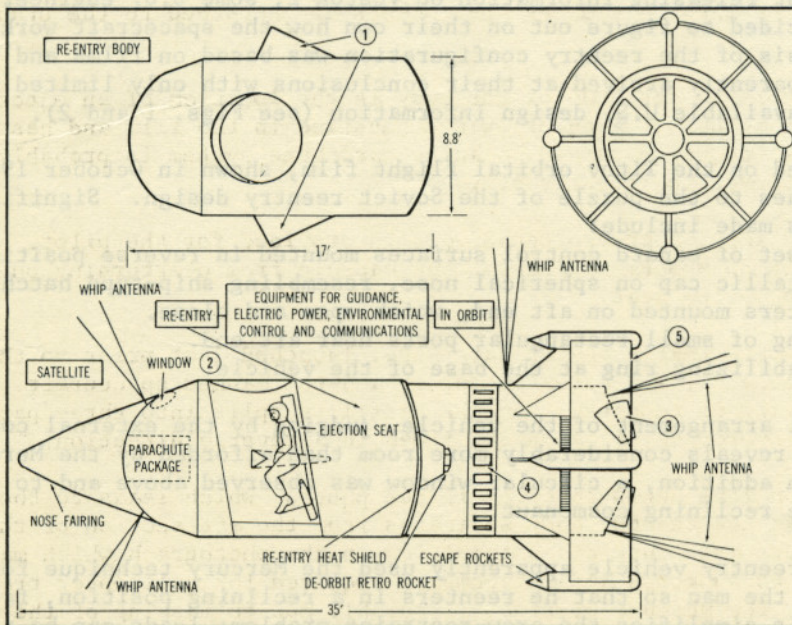


FIG. 1. Artist's Concept of Vostok 2



(1) Canard control fins for reentry vehicle. (2) Protective cap over window. (3) Shutters for temperature control. (4) Ports for pressure release. (5) Stabilizer ring.

FIG. 2. Diagram of Vostok 2, based on external configuration

as with Mercury. These surfaces trim the vehicle to an angle of attack permitting a limited degree of maneuverability. Roll jets, which could be mounted aft of the fins, would be used to maintain the desired roll attitude.

The metallic cap (2) is apparently a cover to protect a round window from aerodynamic loads and heating during ascent.

The shutters mounted on the aft end of the vehicle (3) indicate the location of power supplies, environmental control, guidance and communications equipments for in-orbit use. The shutters permit radiation cooling of the vehicle.

The small ports near the aft end of the vehicle (4) are probably blast ports for pressure relief. A retrorocket, which ignites before separation, would be located on the heat shield. Whip antennas are mounted on the nose, midsection and aft end.

An outstanding feature of Vostok is the stabilizing ring at the base of the vehicle (5). This provides stability with a minimum drag penalty. Drag is extremely important when escape is initiated under high dynamic pressure conditions. Four escape rockets are attached to the stabilizing rings.

The large hole in the side of the body is the location of an ejection seat. This method of recovery was emphasized in the film and has been mentioned in press releases. A large parachute system is probably provided to recover the reentry body.

An ejection seat, a proven technique, is provided for the pilot. There was probably no system to prevent the capsule from overturning on landing--hence the ejection seat.

It was reported that a Soviet satellite, launched just prior to the Paris Summit Conference, was a test model of a 5-ton manned spacecraft. Our tracking stations reported that the satellite split into three parts when the retrorocket, apparently, fired in a reverse direction.

A separation line seems to exist in the photos, which leads to the conclusion that the reentry body separates from the aft section of the vehicle. There are other discontinuities in the photograph which may correspond to supports and attachments required for helicopter transportation. The absence of fins is probably due to masking of the photograph. (Source: Missiles and Rockets, July 9, 1962, p. 18)

LUNIKS 2 AND 3 CREDITED WITH EXCELLENT TARGET CAPABILITY. The two 1959 Lunik spacecraft had velocity tolerances of about 0.1 percent, indicating excellent targeting and launch guidance capability, says a scientist of the Douglas Missile and Space Systems Division.

K. W. Kiser, chief of the Guidance and Control Section, Douglas Space Systems Engineering, presented the results of an analysis of the Lunik guidance systems at the 18th annual Institute of Navigation meeting in San Diego on June 20. The paper which was co-authored with A. H. Gallas, assessed the accuracy of the Luniks, within reasonable error limitations, despite the blackout of Soviet information on such matters. Since mid-course guidance was not used in either attempt, the navigation and guidance must have been completed during the pre-launch and powered portions of the flights.

In the evaluation, Douglas engineers computed two approximate trajectories for the flights and then instigated a study of the effect of rocket burn-out error on the desired end-points of these trajectories.

The mission of Lunik 2 apparently was to impact the lunar surface, while Lunik 3 was to televise the backside of the Moon. Both shots were probably successful, Kiser said. (Source: Douglas News, 62-107, June 20, 1962)

Mars +
MARTIAN CANALS OR RAVINES? According to the Soviet astronomer Alexander Souslov, the Martian canals are ravines or natural fissures that formed after long geological development. The dark color of the lines results from vegetation growing in them. (Source: Les Ailes, No. 1882, June 15, 1962, p. 5)

Thermochimistry +
RESEARCH ON TEMPERATURE OF LIGHTNING. Soviet scientists Y. Zhyvlyuk and S. Mandel'shtam are reported to have developed a method for determining the temperature of lightning and the energy of thunder. They have been able to establish that the temperature of lightning reaches 20,000°C. With this information, it is now believed possible to determine the pressure on the front of the shock wave resulting from atmospheric electrical discharges.

The scientists are now seeking practical applications of their discovery. (Source: U.S. Dept. of Commerce, Joint Publications Research Service, 14106, June 14, 1962, p. 2)

Russian Secret Space Program +
SOVIET IRON CURTAIN AROUND SPACE SCIENCES. The Soviets have put an iron curtain around space as far as information is concerned, Dr. Homer E. Newell, director of space sciences for NASA, said recently. "We are in continuing contact with the Soviets but we all have the feeling at NASA that their output of information is not as open as ours."

He noted that Soviet scientific papers often quote results and findings on a "take-it-or-leave-it" basis, without enough information to verify or substantiate what are offered as scientific truths.

The Soviets claim their limitation on information is dictated by military necessity. Dr. Newell pointed out, however, that it extends to data on the structure and fittings of space capsules, which can have no more military implications than an automobile chassis without an engine.

Space Sciences are the only area in which the Soviets maintain this secrecy, Dr. Newell said. In the biological sciences, oceanography, botany, and medicine, papers presented are complete.

While NASA scientists are much interested in Soviet space probes, NASA has abandoned attempts to track sputniks and cosmos craft. "Of necessity, our tracking systems are directed to our own vastly expanded space probes and those of other nations with whom we have joined in space explorations," he stated. These nations include Italy, Great Britain, Canada, Australia, Japan, and Sweden. (Source: Science News Letter, June 2, 1962, p. 344)

SATELLITE LAUNCHINGS AID STUDY OF GEOCOSMOLOGY AND SPACE HYDROLOGY. The study of geocosmology is being advanced by satellite exploration of space. This science is a broad field in present-day natural science which studies the Earth in interrelation to space and employs knowledge of the Earth for the study of space.

I. Zabelin points out in the March 23, 1962, issue of Sovetskaya Rossiya that the Earth's inhabitants are in fact all "cosmonauts" on a "planet-ship" in an immense "cabin" shielded by the atmosphere and magnetic field from the dangers of space. The study of the upper atmosphere and magnetic field is of cardinal importance for understanding the conditions under which life developed on our planet. Knowledge of the Earth is being used more and more for study of the other planets.

"Space hydrology" is described by the author as a new scientific discipline which studies the Earth's loss of moisture into space, receipt of moisture from space, and the role played by water in processes transpiring in the universe. (Source: Dept. of Commerce, Joint Publications Research Service, 14106, June 14, 1962, p. 26)

FROM THE TECHNICAL LITERATURE

AERODYNAMICS

LAWS OF AERODYNAMICS AT COSMIC VELOCITIES. Professor G. I. Pokrovskiy reviews the classical laws of aerodynamics in Priroda, No. 3, 1962, and points out how they proved inadequate where cosmic velocities were involved. He points out, for example, that when bodies attain velocities exceeding three times the speed of sound many substances undergo physical change and chemical reactions, whereas first cosmic velocity is 23.5 times greater than the speed of sound.

He first discusses phenomena which occur in the surface layer of a rapidly moving body when it collides with individual air particles--the formation of tiny pits and the loss of matter. This leads to a rapid increase in the resistance of the medium when the rate of motion is increased. Ordinary resistance, proportional to the square of the rate of motion, is enhanced by resistance appearing at the onset of deterioration of the moving body; the latter increases approximately proportional to the cube of the rate of motion and the classical concept of aerodynamic resistance is invalidated. If it is assumed that intense evaporation begins at a velocity of 2 km/sec, at a velocity of 8 km/sec the additional resistance exceeds by twice the ordinary aerodynamic resistance corresponding to this velocity and at a velocity of 24 km/sec the ratio is 5.5.

At the Earth's surface the free path of an air molecule is 1/100,000th of a centimeter, but at a height of 200 km it is 100 km. If the free path of the molecule is considerably less than the dimensions of a body moving at superhigh velocities, the latter will be enveloped by an exceedingly hot gas consisting of a mixture of air and vapors from the moving body and the dimensions of the moving body are in fact increased thereby. Resistance to motion will increase proportionally to the increase in the dimensions of this gaseous envelope. The classical laws of aerodynamics are therefore secondary to phenomena associated with the evaporation and combustion of such moving bodies.

The electrical properties of a moving body at great velocities will also modify aerodynamic resistance. If the body is an insulator and freely holds electrons on its surface, the electron bombardment of its surface will cause it to become negatively charged. This charge will protect it against further electron impacts. The energy transfer to the moving body is therefore sharply reduced and there will be a decrease in the destruction of the surface layer and a decrease in the rate of aerodynamic braking. If the surface has a high electric conductivity and easily emits electrons, the rate of loss of material from the moving body is considerably increased and there is a corresponding increase in the resistance of the medium. (Source: U.S. Dept. of Commerce, Joint Publications Release Service, 14106, June 14, 1962, p. 27-28)

ASTRONOMY AND ASTROPHYSICS *outer space*

RUSSIANS "SEE" HYDROGEN IN DISTANT GALAXY. In an article by M. M. Butslav and associates, they state that huge clouds of glowing hydrogen have been discovered by Russian astrophysicists in a distant galaxy similar to the Milky Way.

Stars and galactic systems are formed from hydrogen. Stellar hydrogen changes into atoms of helium and other higher elements as the star exhausts its hydrogen fuel.

According to one theory, the more hydrogen in cosmic matter, the younger it is. The finding of the hydrogen nebulae or gaseous clouds tends to prove that there will always be a process of stellar formation.

It is possible, the Russians pointed out, that these previously unknown nebulae have concentrations of matter from which stars are born.

Astrophysicists of the Crimean Observatory conclude that "hot" stars are not responsible for the luminescence of hydrogen after studying photographs of galaxies taken with a 2.6 m telescope by electron-optical photography.

On several photos it is possible to see jets coming directly from galactic nuclei, and in some cases, the clouds of luminous hydrogen seemingly occupy the galactic nucleus itself, they reported. (Source: Science News Letter, June 2, 1962, p. 338)

Russ Space Prog.†

SOVIET PLANS FOR PLANETARY STUDIES. A plenary session of the Astronomical Council of the Academy of Sciences held at Pulkovo early in 1961, emphasized the need for a heavier program of study of the planets using the largest telescopes in the USSR. A special working group was established for preparing a plan for such research, especially investigation of the Moon, Mars, and Venus. Its preliminary proposals were disseminated to all interested organizations for their comments.

The results of this work were discussed in Moscow during the period 7-8 December 1961. The working group proposed that the 2.6-m reflector of the Crimean Observatory be used for planetary research and that a special high-mountain planetary station be established. Plans call for an increased emphasis on the study of the atmosphere and surfaces of the planets, their structure, petrographic composition, and temperature regime. Polarization, photometric, and spectral studies will be made of small sectors of the surface of planets, supplemented by radioastronomical observations. Emphasis was placed on the importance of increasing the accuracy of maps of the Moon and Mars and the development of theoretical research on the internal structure and origin of celestial bodies.

It was decided to concentrate attention on making more precise determinations of the distance from the Earth to all the planets, their sizes and shapes, macro- and microrelief, and chemical and mineralogical composition. Plans also call for measurement of the temperatures of the surfaces of the planets at different latitudes; determination of the chemical and aerosol composition, density and optical thickness of their atmospheres; detection of planetary ionospheres and magnetic fields; and the development of a theory of the internal structure and origin of these planets. Radar methods are to be used not only to more precisely determine the distance from the Moon to the Earth, but also to study its microrelief.

The development of polarization research has also been included in the work plan. A number of infrared and ultraviolet studies of planets are to be made.

The above plans were reported on by A. V. Markov in Vestnik Akademii Nauk SSSR, No. 3, 1962. (Source: U.S. Dept. of Commerce, Joint Publications Research Service, 13931, May 31, 1961, p. 1)

ATMOSPHERIC PHYSICS

IONS OF EXTRATERRESTRIAL ORIGIN IN EARTH'S IONOSPHERE. Mass-spectrometric measurements recorded on June 15, 1960, have been reported on in Iskusstenny sputniki zemli, No. 11, 1961. The measurements were made at a solar altitude of 15 deg from the medium latitudes of European USSR. *A. I. Physics*

In addition to NO^+ and O_2^+ ions usual for altitudes of 100 to 200 km, particles not normally found at these heights were detected. These particles had atomic mass values of 24 and 26, identified as Mg^+ ions, and 40, 56, and 28, identified as Ca^+ , Fe^{56} , and Si^+ , respectively.

The facts that Mg^+ , Si^+ , and Fe^+ along with O^+ represent the predominant elements of stony meteorites and that these ions appear at altitudes where meteoric phenomena is typical support arguments that the ions are of extraterrestrial origin. (Source: Dept. of Commerce, A.I.D. Press, No. 740, June 29, 1962, p. 1)

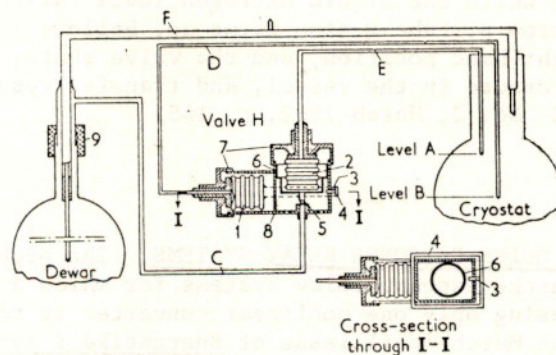
Atmos. + Physics
ENERGY SOURCES OF THE UPPER ATMOSPHERE. Yu. I. Gal'perin, writing in Izvestiya. Seriya geofizicheskaya, No. 2, February 1962, reports on experimental upper-atmospheric data. Analysis of thermal energy sources of the upper atmosphere on the basis of experimental data on the structure of the atmosphere and the extent of solar ultraviolet radiation flux indicates that the solar radiation flux ionizing the F layer amounts to ~ 1 to $3 \text{ erg cm}^{-2} \text{ sec}^{-1}$. Analysis of models of the atmosphere shows that at altitudes of 250 to 350 km the heat flux amounts to ~ 0.2 to $0.6 \text{ erg cm}^{-2} \text{ sec}^{-1}$ in the daytime, but does not exceed $0.05 \text{ erg cm}^{-2} \text{ sec}^{-1}$ at night. Shortwave solar radiation during the day is held to be insufficient to cause the daytime flux.

It is considered likely that at heights above 200 km, the atmosphere is heated by the dissipation of hydromagnetic waves. The fact that no auroral emission in the nightsky spectrum of low latitudes could be observed suggests that the upper limit of the mean flux of absorbed corpuscular radiation at night is $S_e < 3 \cdot 10^{-2} \text{ erg cm}^{-2} \text{ sec}^{-1}$. In high latitudes, a mean absorbed corpuscular radiation flux of $\sim 1 \text{ erg cm}^{-2} \text{ sec}^{-1}$ is possible. The presence of auroras in equatorial regions and the significant density variations in low latitudes during magnetic storms indicate that heat is liberated in the low as well as the high latitudes. (Source: Dept. of Commerce, A.I.D. Press, No. 687, April 16, 1962, p. 1)

CRYOGENICS

AN AUTOMATIC ARRANGEMENT FOR SUPPLYING A SPACE WITH LIQUID NITROGEN.

L. I. Roizen and V. K. Gannus have reported in *Pribory i Tekhnika Eksperimenta* on the problem of supplying a vacuum system and other apparatus with liquid nitrogen. To do this it is necessary to provide a periodic flow of liquid nitrogen up to a determined level after its evaporation. One arrangement for accomplishing periodic filling with liquid nitrogen between given levels is described below (see Fig. 3).



- | | |
|-----------------|---------------------------|
| 1, 2: Bellows | 8: Body |
| 3: Catch | 9: Rubber sleeve |
| 4: Rod | C: Tube |
| 5: Valve | D, E: Oxygen filled tubes |
| 6: Guide sleeve | |
| 7: Lid | F: Transfer tube |

FIG. 3

The arrangement consists of an automatic bellows valve H and the vacuum insulated transfer tube F. Tube F is sealed in the neck of the Dewar by the rubber sleeve 9.

The vessel is connected to atmosphere through the automatic valve by tube C. The bellows 1 and 2 are fixed into the body 8 of the valve and tubes D and E are connected to them, filled with oxygen under a pressure of several atmospheres. Bellows 2 is firmly connected to valve 5, covering the opening for the nitrogen vapour leaving the Dewar. The ends of tubes D and E are placed at two different levels in the volume being filled with liquid nitrogen.

The instrument works in the following way. When the level of liquid nitrogen is below level B, tubes D and E warm up and the oxygen in them is under pressure, stretching the bellows. The catch 3, firmly connected

to the bellows 1 by the rod 4, is in the extreme right-hand position and valve 5 is tightly closed, preventing the exit of nitrogen vapour from the vessel. The pressure in the Dewar rises until the transfer of liquid nitrogen starts in tube F to the cryostat. When the level B is reached, the oxygen in the tube condenses, bellows 1 contracts, and catch 3 is displaced to the stop in the guide sleeve 6 of bellows 2. On reaching level A, the oxygen condenses in tube E, bellows 2 contracts, opening valve 5 and connecting the Dewar with the atmosphere. The transfer of liquid nitrogen stops. When the valve lifts up, the catch moves to the extreme left-hand position; moving underneath the sleeve 6, and prevents the valve shutting while the liquid nitrogen level falls below A. When the level falls below B, tube D also warms up, bellows 1 moves the catch to the extreme right-hand position, and the valve shuts, again leading to an increased pressure in the vessel, and transfer resumes. (Source: Cryogenics, Vol. 2, No. 3, March 1962, p. 145)

ELECTRONICS

IMPROVING CERTAIN QUICK-RESPONSE RELAY SYSTEMS. The problem of constructing third-order quick-response relay systems for which a control law can be formulated by using only one nonlinear converter is reported on by A. A. Pavlov in the March-April issue of Energetika i avtomatik, No. 2. Only third-order relay control systems whose linear parts can be represented in the form of three first-order components connected in series are considered.

Four relay control systems are investigated, where the linear part is represented in these forms:

1. One aperiodic component and two integrators.
2. One integrator and two aperiodic components.
3. Three aperiodic components.
4. Three integrators.

A method is proposed for determining the control function on the basis of the study of optimum phase-trajectory projections in the phase plane. From the optimum trajectories in phase space, the switching lines are traced and either a linear or a nonlinear control law (depending on the structure of the linear part of the system) can be determined on the basis of their distribution. The phase representation presented can be directly applied to the selection of a control law for a class of relay systems whose structure coincides with that of the systems described and also for delay relay systems. (Source: Dept. of Commerce, A.I.D. Press, No. 733, June 20, 1962, p. 4)

ELECTRICAL ENGINEERING

THERMAL NOISE THERMOMETER. A. V. Savateyev, reporting in Izmeritel'naya tekhnika (Measurement Techniques), No. 2, February 1962, reports on the development of a method for measuring low temperatures by the intensity

of thermal noise in a resistor. It is based on the measurement of the number of noise-voltage pulses exceeding a certain threshold value V. It was found that V, the average number \bar{N} of noise pulses per unit of time, and temperature T have the following relationship:

$$\bar{N} = D \exp - \left| \frac{V}{2(g=cT)} \right|$$

where D, g, and c are meter constants.

The method has the following advantages: (1) a greater quantity of information is obtained than with other methods, and therefore reliability and accuracy are increased; (2) a digital frequency meter with high accuracy (± 1 pulse) can be used in the output circuit; (3) very low temperatures can be measured with a high degree of reliability, even when the thermal-noise level is below that of the amplifier.

In the first model built, it was found the instability of the equipment (e.g., in amplifier gain, discriminator threshold) had an adverse effect on the accuracy of measurements. This was minimized by means of a compensated circuit [description given]. The increase in sensitivity at low temperatures was verified experimentally. The formula for calculating the sensitivity threshold and means for further improving the accuracy of the device are also discussed. (Source: Dept. of Commerce, A.I.D. Press, No. 705, May 10, 1962, p. 4)

HIGH-VOLTAGE TERMINAL PULSE CIRCUIT. B. S. Muravskiy reports in the January issue of Pribory i tekhnika eksperimenta that a high-voltage terminal pulse circuit, to be used with a pulse oscillator, has been developed for the purpose of investigating strong field effects in semiconductors and semiconductor devices. The tubes of the circuit are connected in series and the coupling resistors are such that a high voltage can be applied to the tubes without exceeding the permissible power dissipated by the tube plates.

Depending on the required pulse output voltage, any type of high-power tube can be used. For example, $\Gamma\Pi$ -30 tetrodes connected in series together with a $\Gamma\Pi$ C-2 oscillator make possible, without noticeable distortion, pulses 50 μ sec to 2 msec in duration with a repetition frequency of 20 to 20,000 cps and a voltage of 3 kv. To exclude completely the shunting action of spurious capacitance, $\Gamma\Pi$ Y-50 triodes should be used instead of $\Gamma\Pi$ -30 tetrodes; the pulses thus obtained have a duration of 5 μ sec and are without noticeable distortion. (Source: Dept. of Commerce, A.I.D. Press, No. 709, May 16, 1962, p. 1)

GUIDANCE

EFFECT OF STATIC BALANCING ON GYROSCOPIC MOTION. The effect of the static balancing of a gyroscope on its motion is discussed in Priboro-stroyeniye, Vol. 5, No. 1, 1962, by A. M. Lestev. A statically balanced gyroscope with gimbals suspension, mounted on a vibrating base, is considered.

The inertia center of the rotor is displaced along the main axis from the point of intersection of the gimbal axes and the resultant moment relative to the inner-ring axis is balanced by the corresponding displacement of the center of the inner ring in the opposite direction. It was assumed:

1. The vibration amplitudes of the base are small.
2. The inertia center of the gyroscope system coincides with the point of intersection of the gimbal axes.
3. Friction and elastic deformation of the rotor, its axis, or the gimbal rings can be neglected.

The calculations show that the changes in the inertia moments (0.1 to 0.2 percent) in actual aviation gyroscopes are, for practical purposes, negligible. (Source: Dept. of Commerce, A.I.D. Press, No. 715, May 24, 1962, p. 1)

INTERPLANETARY FLIGHT

POKROVSKIY DISCUSSES LUNAR AND PLANETARY FLIGHTS. Future lunar exploration may call for additional flights to and around the Moon according to Professor G. Pokrovskiy. He writes in the December 1961 issue of Kryl'ya Rodiny that such flights may be necessary to gather essential data before landing men on the Moon. Data needed includes photographs of the surface, determining there are no dangerous radiation belts, and structure and composition of surface materials.

A television camera and transmitter landed on the Moon could send views of its landscape and take microphotographs of the surface. The latter may reveal that long exposure to high-energy particles and meteors has led to the development of surface materials not found on Earth. Subsequently, apparatus might be devised to collect these materials and return them to Earth.

Manned flights may overlap the period of exploration with automatic stations. Such flights would be made during the period of the "quiet" sun (this would appear to exclude the years of high solar activity 1966-1970). At the present time, it is not feasible to place a man on the lunar surface. Data are still too meager. A landing can only come after a manned flight has been made around the Moon. The same sequence

of events will later apply to exploration of Mars and Venus. However, the problem of sending television transmissions from these planets will require many advances in this field of communications.

Pokrovskiy discusses the selection of trajectories for manned interplanetary flights. The likelihood that Mars and Venus have radiation belts considerably complicates this problem because an approach to their surface must be made from the poles, and the axes of both planets are tilted from the orbital plane. He also discusses the problem of return to Earth.

The text is illustrated with well-conceived diagrams enabling the reader to visualize the problems involved. (Source: U.S. Dept. of Commerce, Joint Publications Research Service, 13931, May 31, 1962, p. 17)

POSSIBLE SEQUENCE FOR SOVIET LUNAR EXPLORATION. After interviewing Academician N. P. Barabashov, Yu. Khokryakov reports in Kommunist Tadzhikistana, March 28, 1962, that Barabashov discussed Soviet lunar research in essentially the following terms.

Many of the Moon's secrets have not yet been discovered and much remains to be done before a man treads on its surface. Artificial satellites and spaceships will therefore continue to be launched for the purpose of determining how long a man can remain in space. This will be followed by rockets flying around the Moon; they will carry automatic instruments to help detect various peculiarities of the Moon which we may not even yet suspect. The next stage is a manned flight around the Moon, observations being made from aboard the spacecraft. Even then no man will be landed on its surface.

Automatic instruments will be landed which will transmit information to Earth by radio and television via stationary artificial Earth satellites (by that time such satellites will already exist). Information is needed on day and night temperatures, humidity, the number of meteors striking its surface, etc. Only then will man be ready to land on the Moon, and his first visit will be brief.

It is not impossible that rocks will be found which are unlike any on the Earth, and Barabashov is convinced that no life will be found. Nevertheless, man is capable of transforming the natural conditions on the Moon, even creating an atmosphere. Lunar astronomical observations will be made and cosmodromes will be constructed to serve as way-stations for space flights to Mars, Venus, and other planets. (Source: U.S. Dept. of Commerce, Joint Publications Research Service, 13931, May 31, 1962, p. 22)

INSTRUMENTATION

SELF-ADJUSTING FLOATING LEVEL SENSOR. A simple floating level sensor, see Fig. 4, which requires no adjusting or regulating during continuous technological processes has been tested in the General Chemical Technology and Equipment Department Laboratory of the Tomsk Polytechnic Institute. N. V. Podbornov reports on this device in Khimicheskaya promyshlennost', No. 3, 1962.

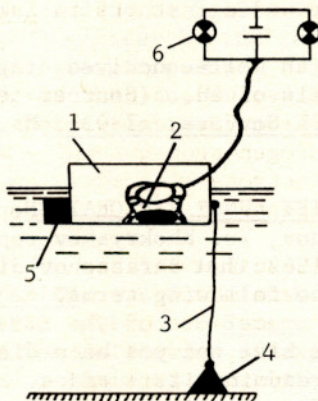


FIG. 4

The sensor consists of buoy 1 with built-in mercury contacts 2, whose leads are connected to signaling or control circuit 6. The buoy is connected by flexible line 3 to weight 4, which rests on the bottom of the vessel. Weight 5 is attached to the opposite end of the buoy. Normal level inside the device is determined by the length of line 3. At normal level the buoy is in horizontal position and the contacts are open. At a higher level, the buoy tries to float, tilts, and one of the built-in contacts closes to connect a control circuit or a signal bulb. At a low level, the buoy tries to assume a free stable position (with weight 5 downward), which closes the other contact, setting off the signal device. (Source: Dept. of Commerce, A.I.D. Press, No. 719, May 31, 1962, p. 3)

~~NEW METHOD OF MEASURING FLOW OF LIQUIDS.~~
NEW METHOD OF MEASURING FLOW OF LIQUIDS. A new liquid flowmeter based on nuclear magnetic resonance is proposed by A. I. Zhernovoy in the May 1962 issue of Inzhenerno-fizicheskiy zhurnal, Vol. 5, No. 5. Flow is determined according to resonance frequency on a radio-frequency coil wound around a pipeline. This frequency causes nutation of the magnetization vector of the nuclei by a given angle in the polarized liquid passing through the pipeline. The size of the angle is controlled by changes in

amplitude of the signal at the output of the nuclear magnetic resonance detector, whose coil is wound around the pipeline over the first coil. (Source: Dept. of Commerce, A.I.D. Press, No. 737, June 26, 1962, p. 3)

MEASURING EQUIPMENT OF THE SECOND AND THIRD SOVIET SPACESHIP-SATELLITES Hermann

Solar x-radiation at wavelengths shorter than 10 Å was measured by the second Soviet spaceship-satellite on August 19-20, 1960, and by the third one on December 1-2, 1960. The report on these measurements was made by S. L. Mandel'shtam and co-authors in Iskusstvennyye sputniki zemli, No. 11, 1961.

The main radiation receivers of the second spaceship-satellite were six photon counters with beryllium foil end-windows ($15 \text{ mg}\cdot\text{cm}^{-2}$, 7 mm in diameter) containing a hydrogen-neon quenching mixture and having protective magnets against electrons with energies of 15 to 20 kev. The field of vision of each counter was about 45 deg.

Equipment on the third spaceship-satellite utilized three types of transducers whose joint performance made possible continuous measurements for 24 hr. The main radiation receivers of the first transducer were two counters, connected in parallel, with a mica window ($1.6 \text{ mg}\cdot\text{cm}^{-2}$, 4 mm in diameter) covered with aluminum foil and a lead shield. The second transducer also consisted of two mica counters connected in parallel, which served as monitors. The third transducer contained two counters with beryllium windows; these counters were fixed on the outside of the satellite. A protective magnetic system against electrons with energies of 30 to 40 kev was used. A comparison of beryllium and mica counter readings made it possible to evaluate energy distribution within the spectrum, while scanning in various directions by the beryllium counters permitted the direction of oncoming radiation to be monitored. The electronic recording system differed from that of the second spaceship-satellite in that it utilized independent scalers for each of the three transducer types. Every 3 min the storage device read the state of the last eight cells of each scaler, and the information accumulated in a 24-hr period was transmitted to Earth by the telemetric system. (Source: Dept. of Commerce, A.I.D. Press, No. 740, June 29, 1962, p. 2)

MATERIALS

NEW REFRACTORY MATERIALS ⁴ (HUNGARY). The April 1962 issue of Ekonomicheskaya gazeta states that the Central Scientific Research Institute of the Building Materials Industry in Budapest has developed a new low-cost refractory material called "Riopirit". It is produced from perlite with the use of a ceramic binder. Two brands of "Riopirit" reportedly withstand temperatures of 900° to 1350°C. Their insulation properties surpass those of other similar refractory materials. (Source: Dept. of Commerce, A.I.D. Press, No. 710, May 17, 1962, p. 5)

materials X
HARDNESS OF PLASTICS AT HIGH TEMPERATURES. Reporting in Zavodskaya laboratoriya, No. 4, 1962, A. D. Kuritsyna and P. G. Meynster state that the Institute of the Science of Machines, Academy of Sciences USSR, has studied the hardness and relative elasticity of a series of plastics, including teflon, polyamide, plexiglass, and "stirakril," at 20° to 150°C. A Rockwell device equipped with special fittings to permit measurements at high temperatures was used. Dependence of the hardness H on temperature t° was plotted both in the coordinates H- t° and log H- t° . The H- t° curves are smooth, while critical points corresponding to the transition of polymers from the glassy to the high-elastic and from the high-elastic to the viscous-liquid state appear on the log H- t° curves. The angular coefficients of the individual curve sections can be used as criteria of the degree of change in the mechanical properties of the plastics with temperature. Their relative elasticity was determined by evaluating the percent ratio of depths of impressions made without load to those made under load. The relative elasticity of all the plastics tested was shown to drop with an increase in temperature. (Source: Dept. of Commerce, A.I.D. Press, No. 720, June 1, 1962, p. 3)

met. +
RHENIUM EXTRACTION. Appearing in the 1961 Transactions of the All-Union Conference on Problems of Rhenium is a report by G. I. Abashin concerning reclaiming rhenium from industrial dust. The extraction of rhenium from dust collected in gas conduits of a unit for processing molybdenum ore concentrates was studied by an industrial plant in cooperation with the State Scientific Research Institute of Rare Metals and the Institute of Nonferrous Metals imeni M. I. Kalinin. Some 0.4 to 1.5 percent rhenium was contained in the dust.

The procedure for extraction consists of double leaching, neutralization, filtration, condensation of the filtrate, and precipitation of potassium perrhenate with a solution of calcium chloride; 85.03 percent of the rhenium was recovered. The potassium perrhenate was then subjected to two-stage reduction with hydrogen. The first reduction was carried out in a three-zone furnace with zone temperatures of 480°, 500°, and 600°C, and the second at 1000°C. Re powder obtained had a density of 1.5 to 1.7 g/cm³ and contained 0.16 to 0.21 percent impurities. Bars sintered from this powder were brittle and could not be forged. To obtain ductile rhenium the bars were dissolved in nitric acid; Re was precipitated as potassium perrhenate, and the latter was reduced with hydrogen. The Re powder thus obtained had a density of 2.5 to 2.7 g/cm³ and contained 0.1 to 0.15 percent O₂, 0.004 to 0.005 percent Fe, 0.001 to 0.002 percent Ca + Mg, and 0.001 percent Cu. After sintering it had a density of 19 to 19.5 g/cm³ and could be worked by pressure with process annealing. (Source: Dept. of Commerce, A.I.D. Press, No. 721, June 4, 1962, p. 4)

MECHANICS

ON THE PROBLEM OF MAGNETIC NOISE IN DC MACHINES. E. R. Kucher, writing in Vestnik Elektroprom., No. 9, September 1961, made the following statements concerning his work on magnetic noise.

"The experimental investigations of noise and vibrations in machines which can be performed using modern equipment permit a quantitative estimate of the degree to which the noise and vibration intensity of a motor is reduced due to various structural measures.

"This paper studies the effectiveness of certain measures adopted to reduce the noise and vibrations which are of magnetic origin in dc machines. Experimental results are cited to verify the conclusions drawn in the article.

"We know that magnetic noise arises due to the operation of mutually attracting forces between the stator and armature fields; this noise is quite pronounced within the overall noise of the machine due to the frequency spectrum of 400 to 4000 cps which it occupies. The spectrum coincides with optimum auditory perception.

"The paper demonstrates that chamfering the slots, selecting the ratio between the width of the pole arc and a tooth division, closure of the slots, etc., are of great importance in reducing noise and vibrations. These factors should be considered in addition to such factors as ferrodynamic balancing, improving the rigidity and strength of the motor stand, etc.---" (Source: Power Express, Vol. 1, No. 2, 1962, p. 30)

METALLURGY

PREDICTION OF MELTING POINTS OF MULTICOMPONENT ALLOYS. An attempt has been made to predict the melting point of some Ni-Ti-Cr-Mo-W-Nb alloys. A report on this work appears in the April 1962 issue of the Zhurnal neorganicheskoy khimii, Vol. 7, No. 4.

From previously published data on the binary and ternary systems making up the above alloys, approximate phase diagrams for four six-component alloys, two of which were nickel-rich and two titanium-rich, were plotted. The melting point of one of these alloys, containing by percentage 65 Ni, 15 Cr, 25 Mo, 5 Ti, 7 W, and 3 Nb, was calculated as 1360°C, compared to the experimentally determined value of 1356°C. For another alloy, containing by percentage 70 Ni, 10 Cr, 5 Mo, 5 Ti, 7 W, and 3 Nb, the corresponding melting points were 1376°C and 1350°C. (Source: Dept. of Commerce, A.I.D. Press, No. 731, June 18, 1962, p. 4)

Metallurgy +

NIوبيUM SILICIDES. In the Zhurnal neorganicheskoy khimii, Vol. 7, No. 4, April 1962, a report by S. I. Alyamovskiy and others states that a study of 29 alloys of the Nb-Si system showed that at temperatures up to 1500°C only two stable silicides, α -Nb₅Si₃ and NbSi₂, are formed. No Nb₄Si is observed.

Both stable silicides form solid solutions of the substitution type. At 1250°C, the former compound has a homogeneity region from NbSi_{0.58} to NbSi_{0.66}, and the latter from NbSi_{1.85} to NbSi_{2.20}.

Lattice parameters of neither silicide depend on composition, apparently because the sizes of the component atoms do not differ greatly. (Source: Dept. of Commerce, A.I.D. Press, No. 731, June 18, 1962, p. 4)

METEOROLOGY +

SOVIETS NOW BELIEVE ANNIHILATION OF ARCTIC ICE MIGHT NOT BE PERMANENT. Irina Lunacharskaya tells of a change in the thinking of Soviet specialists in her article "The Arctic Without Ice" which appeared in the December 1961 issue of Dushanbe, Kommunist Tadzhikistana. Previously published articles by Budyko suggest that if the ice of the Arctic were to be annihilated it would not be restored. A recently published article, quoted in part below, would suggest that Soviet specialists are not altogether convinced that this would be true.

"The Laboratory of Marine Meteorology of the Institute of Oceanology is studying the problem as to whether the Arctic ice would be restored subsequent to its annihilation. This work is being done under the direction of the chief of the laboratory, Doctor of Geographical Sciences Vladimir Samoylenko.

"The transport of heat by air and ocean currents is dependent on the difference in temperature between the Arctic Basin and the surrounding area. After the annihilation of the Arctic ice, this difference would decrease; this should result in a lesser flow of heat from the low latitudes. Because of this, the increase in temperature will not be as great as might be expected. It is therefore extremely probable that the ice cover would be restored after some time." (Source: U.S. Dept. of Commerce, Joint Publications Research Service, 13931, May 31, 1962, p. 8)

NUCLEAR PHYSICS +

THERMIONIC ENERGY CONVERTERS. A report by B. A. Ushakov appearing in Atomnaya Energia, No. 4, April 1961, discusses the problem of direct conversion of nuclear energy to electrical energy using thermionic devices. A comparison is made between the properties of materials which

contain fissionable material and simultaneously have good thermionic emission properties. Results are cited for the tests of a thermionic converter in the active zone of a reactor.

Experiments completed demonstrated that during the process of operation, a converter filled with inert gas is converted into a plasma cesium diode. This makes it possible to avoid introducing cesium vapor into the converter. Moreover, it becomes possible to evacuate the gases during the process of operation; this prolongs the service life and improves the characteristic of the thermionic converter.

At the present time, an efficiency of approximately 15 percent has been achieved in experimental thermionic converters. The conversion efficiency can be increased to 20 to 25 percent by using optimal converter dimensions and working temperatures. The anode temperature may be made sufficiently high (approximately 1000°C), and this makes it possible to remove the heat from the anode using a heat carrier that can then be utilized in a conventional steam turbine cycle with an efficiency of approximately 30 percent.

Thus, in the combined reactor-converter system a portion of the heat energy is converted directly to electrical energy while the remaining portion is transferred to the heat carrier and is then finally converted to electrical energy in an ordinary steam turbine cycle. This makes it possible to improve the efficiency of such a system to 40-45 percent. (Source: Power Express, Vol. 1, No. 2, 1962, p. 33)

VVR-M REACTOR. Physical parameters of the VVR-M reactor have been experimentally investigated during start-ups at the Physics Institute of the Ukrainian Academy of Sciences. The VVR-M reactor is the modernized version of the VVR-S-type water-water reactor. As a result of the modernization the reactor power level was increased fivefold and the neutron flux tenfold. The reactor was provided with a new core design with tubular fuel elements and a beryllium neutron reflector. Modernizing was conducted jointly by the Leningrad Physicotechnical Institute and the Atomic Energy Institute imeni I. V. Kurchatov, both of the Academy of Sciences USSR. 38 Physics

Data on critical dimensions of the core, effectiveness of the control rods, and neutron-flux distribution are presented in the Ukrains'kyi fizichnyy zhurnal, Vol. 7, No. 1, 1962, pp. 3-14. (Source: Dept. of Commerce, A.I.D. Press, No. 700, May 3, 1962, p. 1)

OCEANOGRAPHY 31

EXTRACTION OF METALS FROM SEA WATER. Izvestiya VUZ, Tsvetnaya Metallurgiya, No. 2, 1962, discusses the experimental extraction of uranium and other metals made from Atlantic waters in the autumn of 1959 during the Sixth

Atlantic Expedition of the Marine Hydrophysical Institute of the Academy of Sciences. The tests were made aboard the expeditionary vessel "Mikhail Lomonosov" near the Azores, across the Atlantic to the Newfoundland Banks, in the Sargasso Sea, enroute to Cape Verde (Dakar), then to the Canary Islands and through the Bay of Biscay to the entrance of the English Channel. Water samples were collected during the entire voyage (11,000 miles) and filtered through an absorption column filled with 3.5 kg of an anion-exchange resin H-0 in chloride form.

The uranium content was found to be 5.12×10^{-6} g/liter by the radio-metric method, 6.99×10^{-6} g/liter by the luminescent method, and 7.04×10^{-6} g/liter by the polarographic method. The contents of other elements (Na, Mg, Ca, Ag, Fe, Si, Sr, Cu, Zn, Mn and Bi) are given. (Source: U.S. Dept. of Commerce, Joint Publications Research Service, 13931, May 31, 1962, p. 12)

PHYSICS

SILICON SOLAR PHOTOBATTERIES. G. S. Daletskiy and associates have reported in the January 1962 edition of Seriya fiziko-matematicheskikh nauk, Uzbekskoy SSR, on the collection of experimental data to find out how the intensification of luminous flux affects the output power of a silicon photoconverter.

To obtain an intensified luminous flux, a solar concentrator (parabolic-cylindrical mirror), which focused solar rays on the detector, was used. The detector was a silicon photobattery with an operating surface of 288 cm^2 . The concentration of luminous flux incident on the battery was increased by 7 times. It was found that owing to use of the concentrator, the output power of the battery increased by 3 to 4 times. However, by improving some features of the battery, such as the cooling system, and by securing uniform illumination of the whole battery surface, the output power could be increased up to 8 to 10 times. The concentration of the luminous flux reduces considerably the net cost of solar energy photoconverters. (Source: Dept. of Commerce, A.I.D. Press, No. 721, June 4, 1962, p. 1)

COSMIC RAY RESEARCH INSTALLATION AT TSKHRATSKARO PASS. The June 10 issue of Trud describes certain equipment which will be a part of the new cosmic ray research center. It states that the cosmic ray research installation now being erected at Tskhratskaro Pass will consist of three major components: an electromagnet, Wilson chambers, and an ionization chamber. Metal blocks with a 2 by 2-m section, 1.5 m apart, serve as the cores of the electromagnet. A 6-m^3 uniform magnetic field with an intensity of 10,000 oe is created between the poles of the magnet.

The installation will be able to determine the pulses of cosmic particles with energies 100,000 times greater than the limits of the most powerful accelerators now in operation. It includes two Wilson chambers (under construction in the Tbilisi Machine-Tool Plant imeni S. M. Kirov), located between the poles of the magnet, and an ionization calorimeter. Computers and automatic devices process all experimental data. A working model of the installation will be put into operation this summer. (Source: Dept. of Commerce, A.I.D. Press, No. 732, June 19, 1962, p. 2)

INVESTIGATION OF ANTIGRAVITY BY MEANS OF K^0 AND \bar{K}^0 MESONS. X Physics A method based on the effect of antigravitational forces acting on \bar{K}^0 mesons, which are assumed to have a negative gravitational mass, is suggested for the experimental study of antigravity by E. Okonov and others in their article published in the Zhurnal eksperimental'noy i teoreticheskoy fiziki, Vol. 42, No. 3.

In a vertical beam of K_2^0 particles, a difference of energy equal to $2 mgH$ should be observed between K^0 and \bar{K}^0 mesons due to a height difference H between the two types of particles induced by antigravity. This energy will result in a phase shift between the corresponding wave functions ψ and $\bar{\psi}$ and will eventually lead to transformation of K_2^0 particles into K_1^0 , with a subsequent decay into two π -mesons. This effect is evaluated by solving two equations which describe K_1^0 and K_2^0 behavior, including the damping forces.

It was found that for a K_2^0 meson velocity of $2c/3$ (c = speed of light), a reduction in the number of K_2^0 particles by a factor of e occurs for $H \approx 9$ m. With the highly improbable decay of K_1^0 mesons into three particles neglected, a general formula is deduced for $n(K_1^0)/n(K_2^0)$ as a function of H , where $n(K_1^0)$ and $n(K_2^0)$ are the numbers of K_1^0 and K_2^0 mesons decaying into two π -mesons and three particles, respectively. When the decay constants of K_1^0 and K_2^0 , λ_1 and λ_2 , are equal to 10^{10} sec^{-1} and $1.7 \cdot 10^7 \text{ sec}^{-1}$, then $n(K_1^0)/n(K_2^0) = 5 \cdot 10^{-6} H$.

It is then pointed out that at the present, no closed system is known in which antigravity and conservation of gravitational masses can exist with the interference properties of K^0 particles. This, however, does not disprove its existence. The difference in the inertial masses of K^0 and \bar{K}^0 [$M(K^0) - M(\bar{K}^0)$] should also lead to decay of K_1^0 particles in a beam of K_2^0 mesons. By using results obtained earlier by American scientists and assuming that $|m_1 - m_2| \sim \lambda_1$, it is proved that $|M(K^0) - M(\bar{K}^0)|/M \leq 10$ (m_1 and m_2 = masses of K_1^0 and K_2^0 mesons). (Source: Dept. of Commerce, A.I.D. Press, No. 734, June 21, 1962, p. 1)

PROCESS ENGINEERING +

VACUUM-SUCTION CASTING OF TUBE SHELLS. Vacuum-suction casting of tube shells from stainless and heat-resistant steels and alloys has been studied at the Central Scientific Research Institute of Ferrous Metallurgy. The method is a modification of slush casting.

According to V. Ye. Neymark's article in Liteynoye proizvodstvo, No. 3, March 1962, the liquid metal is drawn into a hollow cylindrical mold by a vacuum in the mold. After a certain time the vacuum is released and the liquid metal drops back, leaving a layer of solid metal on the walls of the mold. The technology of this process has been studied at the Southern Pipe Plant, where a casting machine with six molds, each 1600 mm long and 90 mm in diameter, was built.

Experiments conducted to determine the effect of metal composition, various modifiers (Ti, Zr, B), and other factors on the quality of the tube shells show that vacuum-suction casting is useful primarily for those modified alloys which do not deform strongly during crystallization. To obtain good surface quality in the hollow castings, the raw materials should be degassed and the molten metal protected from gas absorption. Arc melting should be used for alloys susceptible to excessive gas absorption.

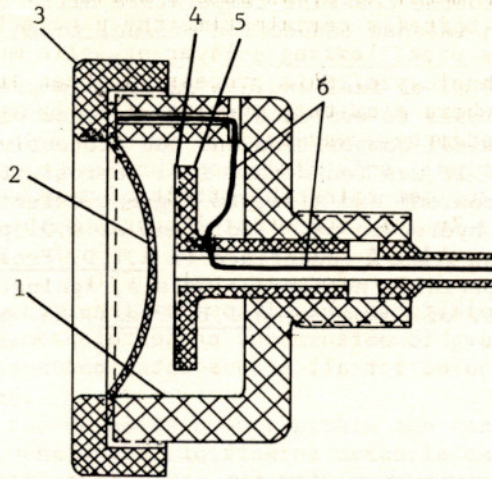
Transverse circumferential nonuniformity of wall thickness can be prevented by adding modifiers, lowering the rate of cooling, or rotating the mold during metal solidification. Longitudinal nonuniformity can be reduced by a controlled cooling rate along the mold length, so as to control the rate of solidification along the height of the casting. (Source: Dept. of Commerce, A.I.D. Press, No. 717, May 28, 1962, p. 5)

Proc *1962* *+*
EXPLOSIVE FORMING. Studies and experiments in the deep drawing of dome-shaped parts by means of underwater explosions are described in a report by Yu. S. Navagin entitled "Use of the Energy of an Underwater Explosion for Deep Drawing," Leningrad, LDNTP, 1961. The author, together with V. I. Yerebin, originally suggested the use of the energy of underwater explosions for metal forming in 1956 (Authors' Certificate No. 122731).

Equations are presented for determining parameters of the process, including the following:

1. Changes in shockwave pressure acting on the blank as a function of time.
2. The ratio of the shock pulse accepted by the blank to that acting on the blank as a function of the die-impression radius.
3. Sound velocity in the blank material and the exponential constant characterizing the rate of pressure drop behind the wave front.
4. The time required for the forming operation as a function of sound velocities in water and in the blank material, of die-impression radius, and of the distance from the charge to the surface of the blank.
5. The amount of charge required for explosive forming.
6. The ratio of the depth of an explosively formed dome to that of a statically formed dome at equal pressure.

Experiments showed that the elongation of explosively formed material was 15 to 30 percent, and depth of deep drawing more than 20 percent higher than for static deep drawing. A method was developed for recording



- | | |
|--------------------|--------------------------------------------------------------------------------------|
| 1. Die | 5. Plastic ring for setting
the initial gap between
capacitor plate and blank. |
| 2. Blank | 6. Wires |
| 3. Holding ring | |
| 4. Capacitor plate | |

FIG. 5

changes in the depth of an explosively formed dome as a function of time. It is based on changes in the capacitance of a capacitor in which the blank being deformed and a plate fastened to the die serve as capacitor plates (see Fig. 5). (Source: Dept. of Commerce, A.I.D. Press, No. 690, April 19, 1962, p. 5)

PROPULSION

x Fuels ↓

EVALUATING THE CORROSIVITY OF FUELS. An article in Khimiya i tekhnologiya topliv i masel, No. 2, February 1962, by I. V. Rozhkov and others pertains to fuel corrosiveness. The article states that an accelerated method and a special device have been developed for evaluating the corrosivity of fuels by the drop in the weight of a metal plate in contact with the fuel.

By creating very effective corrosion conditions, the test time is shortened to 4 hr from the 10 to 100 hr required by the usual "accelerated" methods. A metal plate is immersed in fuel heated to 90°C; the plate itself is cooled by tap water. Corrosion is accelerated by saturating the fuel with water supplied constantly by evaporation from a source

suspended in the device. The dissolved water condenses in droplet form on the plate. Owing to the constant temperature difference between the plate and the fuel, an intense convection of fuel takes place.

The method requires 70 ml of fuel and has an average precision of ± 8 percent. It has been used to evaluate the dependence of the corrosivity of fuels on their chemical composition and the protective effect of corrosion inhibitors. It was found that fuel corrosivity depends on the mercaptan sulfur content and also, to a great extent, on the presence of readily oxidizable hydrocarbons. Additions of 0.01 percent of such corrosion inhibitors as **AMBA** [undefined in A.I.D. Press] were found to protect metals, especially nonferrous metals, against highly corrosive fuels. (Source: Dept. of Commerce, A.I.D. Press, No. 684, April 11, 1962, p. 2)

SPACE MEDICINE + ↘

CONTROL MECHANISMS OF RADIATION SICKNESS. Author V. P. Efroiison, in a report on radiation sickness appearing in Problemy Kibernetiki, No. 6, September 1961, presents a general theory on causes, diagnosis, and treatment of the illness. Following is the author's introduction.

"An understanding of the effect of ionizing radiation on an organism requires synthesis of the data obtained from cytology, genetics, physiology, embryology, biochemistry, biophysics, and experimental therapy into a unified system of concepts. In developing a general theory, it is necessary to take into account the hierarchic significance and the specific weight of different phenomena and to resolve the contradictions. A considerable portion of the contradictions is caused by the difficulty in excluding numerous variables that affect the course and outcome of radiation sickness. We know in advance that only in rare cases does the investigated phenomenon arise in a clear and consistent form. Therefore, it is necessary to isolate the decisive factors from the mass of phenomenological data; for the time being we discard the less essential phenomena.

"Only a very extensive study of the facts permits us to develop a general theory for radiation sickness that encompass the most important groups of phenomena that are associated with radiation sickness and its therapy-- a theory that indicates new paths for diagnosis and cure.

"In presenting the genetic theory of radiation sickness, we shall only indicate those basic facts on which the theory shall rest, as well as certain practical consequences deriving therefrom; during our presentation we shall attempt to counter the most important objections which may be raised against our theoretical conclusions." (Source: Power Express, Vol. 1, No. 3, 1962, p. 21)

THERMODYNAMICS

HEAT AND MASS TRANSFER IN PIPES. An experimental study has been made, reports R. Z. Alimov in Izvestiya. Energetika i avtomatika, No. 1, January 1962, of the use of a vortex flow of air containing drops of water for increasing the rate of convective heat transfer from the inside surface of a heated pipe. Drops of water were injected into a swirling flow of air in a heated vertical porcelain pipe (inside diameter, 40 mm; length, 1200 mm). Chromel-copel thermocouples were used to measure water and air temperature at the inlet and outlet of the pipe and along the inside wall.

Analysis of the results led to the following conclusions:

1. By injecting liquid into a vortex flow of gas, it is possible to produce a continuous and quite stable fluid film on the inside surface of a cylindrical pipe.
2. By varying the Reynolds number within the range $2 \cdot 10^4$ to $8 \cdot 10^4$ for the vortex flow, the Nusselt diffusion criteria can be increased to approximately double that of a nonvortex flow; this indicates considerable intensification of heat- and mass-transfer processes.
3. A heat-transfer coefficient on the order of 2400 to 2900 kcal/m²/h/°C was obtained for a heat-flow rate of 75,000 kcal/m²/h in this range of Reynolds numbers; this is 40 to 70 times higher than that for nonvortex flow and 8 to 20 times greater than that for a single-phase vortex flow. The total resistance, however, increases by a factor of 7.
4. Despite the increase in resistance, under similar temperature conditions and equal energy input for inducing the vortex flow of a single-phase medium the heat-transfer rate increases by 2 to 2.5 times.
5. Improvement is needed in the design of systems for producing vortex flow.

This method may find wide use, particularly in cooling highly heated surfaces. (Source: Dept. of Commerce, A.I.D. Press, No. 704, May 9, 1962, p. 2)

BOOKS. The following book reviews have been selected from various publications as noted:

n.a., Welding Handbook, Vol. 1 (Spravochnik po svarke); E. V. Sokolov, ed. Mashgiz, 1960.

The Soviet Union is reported very advanced in the field of welding, but surprising enough, there has been as yet no truly comprehensive handbook on welding theory and equipment. In order to fill this gap, the welding section of the Scientific-Technical Society of the engineering industry has initiated the preparation of a multi-volume treatise on the subject. This would serve as a handbook representing the present status of welding

theory and describe the various welding methods and equipment used. The editorial committee, as well as the authors of the volume are prominent experts in welding technology and allied sciences--a fact which makes the book an authoritative work.

The book is intended for welding engineers as well as students and research workers in welding and related fields. Its usefulness to Western readers is in the insight it provides into the status of the development of welding theory and welding equipment in the USSR.

Volume 1 deals mainly with the welding of ferrous metals, both by electric and gas welding, and it consists of 14 chapters.

Chapter 1 contains a short classification of various welding processes, and Chapter 2 deals with the calculation of thermal processes in welding.

The third chapter is devoted to the metallurgy of fusion welding of steel. This extensive chapter deals in considerable detail with the various problems of interactions between the elements being used in the welding process.

Chapter 4 describes solidification of the molten metal and processes taking place in the parent metal near the weld. Hot and cold cracks are discussed, their formations explained, and ways of prevention indicated.

Chapter 5 deals with various energy sources for arc welding, both ac and dc, while Chapter 6 deals with the actual welding equipment other than power supply. This latter chapter contains detail descriptions of a large number of welding heads, tractors, automatic and semi-automatic welders, equipment for stud welding and electric riveting, and electroslag welding equipment.

The seventh chapter is brief and describes mainly electrode holders, welding shields, and fillet gages. The eighth chapter deals with the erection, maintenance, and fault elimination in electric welding equipment.

Chapters 9 and 12 deal with resistance welding equipment, Chapter 10 with electrodes for spot welders, and Chapter 11 with measurements of currents in resistance welding.

The thirteenth chapter deals in a concise manner with equipment used in gas welding and covers such topics as various acetylene generators, gas bottles, pressure regulators, torches, flame cutting machines, and equipment for gas heated butt welding. The final chapter covers the erection, correct usage, and maintenance of gas welding equipment. (Source: Soviet Technology Digest, January 1962, p. 95)

Ginzburg, V. L., Propogation of Electromagnetic Waves in Plasma. North Holland, Amsterdam, 1961.

Following is a partial extract of a review by Mr. J. Heading made for the British publication Planetary and Space Science.

"The record of the author's published work in Russian scientific journals is sufficient evidence to demonstrate the value of this book. He has succeeded in integrating two distinct lines of investigation into a harmonious exposition, namely the Russian and the non-Russian approaches. The most comprehensive account of electromagnetic wave propagation recently published in English, Radio Waves in the Ionosphere by Dr. K. G. Budden, contains only one passing reference to a Russian paper, but the book now under review reveals to the non-Russian reader the wealth of accumulated Russian research that the language barrier, apart from abstracts, has long concealed. The author moves freely amongst the ionospheric literature of the world, and although the major portion of the book is devoted to ionospheric propagation, yet plasma waves, cosmic considerations and non-linear effects are also treated in detail. The lack of an index, however, makes it very difficult to use as a reference book for factual information. Comparisons are invidious, but as far as ionospheric propagation is concerned, the reviewer feels that it is an excellent companion to, but not a substitute for, the English text mentioned above.

"The following criticism, however, deals with factors quite outside the control of the Russian author, and thus does not reflect upon his theoretical exposition.

"Without doubt, economic considerations dictated the particular method adopted by the publishers for the printing of this book, but the purchaser will feel that he has not obtained full value for his money. The method of reproducing all mathematical equations--including isolated symbols occurring in the text itself--by direct reproduction of the Russian original is not new, but it must be admitted that the Roman and Greek founts used by Russian printers are singularly unattractive when contrasted with those used by British printers. The whole text therefore looks artificial. Moreover, one judges that the preparations for printing were carried out very hastily, since errors of every kind abound.

"The actual translation, too, is very poor, and a sense of unreality pervades many paragraphs where the smooth flow of the English idiom is missing. The translation adheres very closely to the Russian grammar and idiom; for example, the omission of the definite article pervades the whole translation. One wonders why this was not detected by the two editors of the book." (Source: Planetary and Space Science, Vol. 9, May 1962, p. 292)

Orleans, Leo A., Professional Manpower and Education in Communist China. U.S. Government Printing Office, Washington, D. C.

This 260-page book was sponsored and published by the National Science Foundation. It examines the characteristics and training of Chinese professional manpower and their relationship to China's technological development. Dr. Waterman, Director of the National Science Foundation, points out in the foreword that the book represents 2 years of research and analysis applied to materials collected over a period of 4 years. It follows in the steps of a previously supported comparable study of Soviet professional manpower published in 1955.

The book has numerous tables and appendices, the latter including sample curricula, a list of institutions of higher education, institutions offering postgraduate courses and courses offered, and of specialization in higher technological institutions. (Source: Russian Technical Literature, No. 5, January 1962, p. 14)

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