

Space INTELLIGENCE NOTES

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

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RUSSIA MAY HAVE 'ASTEROID BOMB' THREAT BY 1970. Speaking before an American Astronautical Society Meeting in Washington D. C., General Electric's Dandridge M. Cole suggested the possibility that asteroids moving between Mars and Earth could be diverted to hit the Earth with power equal to millions of H-bombs.

He said a Nova-type vehicle, which the USSR should have developed by 1970, could push an asteroid, with a diameter of three miles and 500 billion ton weight, out of its normal orbit and make it hit a pre-selected target on Earth. (Source: MISSILES AND ROCKETS, January 22, 1962, p. 10)

METEORS STUDIED FOR SPACESHIP BRAKING CLUES. Prof. G. Pokrovskiy, of the Russian Academy of Sciences, writing in a brief article entitled "Meteor Rocket," suggests that a system be devised in which the kinetic energy of the moving body itself would be used for braking purposes. He points out that there is an urgent need to find a better way to brake the movement of large spaceships as they pass through the atmosphere on their return to Earth and that much may be learned by a study of the way in which meteors are braked during their entry into the dense layers of the atmosphere. (Source: TEKHNIKA-MOLODEZHI, No. 1, 1961, p. 37)

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FUTURE SPACE FLIGHT MISSIONS AND TECHNOLOGY DISCUSSED. A. Mikoyan, designer of the new 20-yr program of the 22nd Communist Party Congress, discussed the present trends in aircraft and spacecraft and gives clues to long range Soviet plans in a recent issue of RED STAR, the Soviet Army newspaper. According to Mikoyan, missions to planets in the solar system will probably consist of three phases: (1) from the Earth to an artificial Earth satellite in a vehicle resembling a hypersonic plane; (2) from the Earth satellite in a spaceship to an artificial satellite circling the planet; and (3) from this satellite to the planet in a vehicle resembling a spaceship and hypersonic airplane. Without actually saying it, Mikoyan intimates that the three types of spacecraft required to accomplish the three phases of interplanetary spaceflight listed above will be built during the next 20 yr.

He further clarifies the three types with the following data on Soviet aerospace vehicles: the record altitude of 34,714 m reached by the E-66, the speed of 2730 km/hr attained by the E-166, and a Tu-114 nonstop flight range of more than 8000 km. Existing Soviet aircraft engines make it possible to fly at speeds two to three times faster than the speed of sound. The problems of intercepting and destroying aerial targets are being solved successfully through the close cooperation of aviation and rocket technology. Future civil aircraft will be able to fly at speeds of 3000 to 3500 km/hr; nonstop flights between any two points on the globe will be possible with such aircraft. Short-range and VTOL aircraft will also be used.

The flight of aircraft at speeds higher than Mach 3 is limited by the high temperatures developed on the vehicle surfaces. This problem will be solved by the creation of new supersonic planes and supersonic spaceplanes. The new supersonic plane will be a multistage vehicle, the first stages of which will be launching boosters and droppable fuel tanks. The last stages will be guided missiles of different classes. The spaceplane is an intermediate link between aviation and rocket technologies, a combination of a ballistic rocket and airplane; viewed as a whole, the spaceplane will have the general outlines of a modern airplane with elements of a spaceship. The spaceplane will be launched as is a ballistic missile and will fly at altitudes of 100 to 200 km.

After acceleration to a speed of 7.9 km/sec, the spaceplane will follow a ballistic trajectory with deceleration. For the launching of a spaceplane, different launching systems will be used, including multistage rockets. Spaceships are vehicles which will travel within the solar system and also beyond it. New propulsion systems used in the spaceships will be characterized by a high discharge velocity of the working substance. The orbital spaceships Vostok-1 and Vostok-2, the forerunners of future spaceships, were created as a result of a fruitful fusion of rocket and aviation technology. (Source: KRASNAYA ZVEZDA, January 9, 1962, p. 2 & 3)

X WAS GHERMAN TITOV SPACE-SICK? A paper by two eminent Soviet space
X X medicine specialists, O. G. Gizenko and V. J. Yazdovski, of the Academy
of Sciences of the USSR, was read at the 12th IAF Congress in Washington.
As the report, entitled "Some Results of Physiological Reaction to
Space Flight Conditions," sheds further light on what is already known
of the Gagarin and Titov operations, a summary based upon it is given
below.

Overloads originating during the placing of a vehicle into an orbit and during the trajectory of descent can adversely effect the pilot's health and working capacities, especially in the case of the vehicle's deviation from the calculated trajectory. The resistance of the organism to overloads is much higher if they act perpendicular to the longitudinal axis of the body (transverse overloads), but even so there comes a point at which disorders in breathing, hemodynamics, and nervous regulation reach a critical value. Experiments with dogs on the centrifuge produced interesting results. These experiments were intended to investigate the hemodynamics of the pulmonary circulation and the degree of blood oxygenation during transverse overloads. Despite the decrease in the aeration of the lungs, the active rearrangement of the pulmonary circulation can, within certain limits, ensure preservation of the necessary blood oxygenation level.

There is reason to believe that there is an inequality between the volumes of the blood ejected by the right and left ventricles, with the stroke volume from the right ventricle predominant. If this supposition is true, then, taking into account the resultant progressive storage of the blood in the lungs, it is difficult to imagine the possibility of man's remaining under conditions of increased gravitation for a lengthy period of time.

It is necessary, and in our opinion feasible, to select tests - foretokens of functional disorders - which can serve as objective diagnostic criteria in the estimation of the astronaut's health condition. It can always be objected that the results obtained in laboratory experiments on the centrifuge cannot be fully applied to the solution of problems connected with actual flight. The difference in conditions is obvious. In actual flight, overloads are combined with a complex of other factors, among which the pilot's emotional stress is of primary importance:

Comparison between the data obtained from the tests on the centrifuge and from the active evaluation of the actual space flight results is instructive. From their subjective impressions, Yuri Gagarin and Gherman Titov unanimously estimated that laboratory and flight experiences corresponded closely. They believe that accompanying factors did not complicate the tolerance of overloads. On the other hand, it is noteworthy that the frequency of pulse and breathing, as well as other objective indications of some physiological functions during flight, differed considerably from those recorded on the centrifuge. It is difficult to doubt that this was a result of emotional stress.

The apprehension has often arisen that sensory, somatic, and vegetative disorders will limit the possibility of man's stay in conditions of weightlessness. The experiments with animals did not supply any explanation. Observation of the seven dogs sent into orbit revealed that, during the first period of the animals' stay under conditions of zero-gravity, there was a definite tendency for the main physiological indices to regain initial levels after the marked changes originating during the portion of flight when the engines were working.

During the first two hours, some changes in the functional condition of the heart could be observed. These changes disappeared quickly, but eight to ten hours later some changes in the heart's functional condition reappeared.

During the flight of Belka and Strelka, considerable increases in the bitches' frequency of pulse and respiration rates as well as in increase of arterial pressure were recorded.

The Laika experiment has already shown that the time of recovery of the heart contraction to normal under conditions of weightlessness was approximately three times longer than if subjected to the same accelerations on the Earth. During the first four to six hours of orbital flight of Laika and the other dogs, the fluctuations of the frequency of the heart beat varied considerably. Relative instability of the rhythm of the heart beat, though expressed in a lesser degree, remained to the end of the stay under conditions of weightlessness. A similar, though less expressed, picture of the rhythm fluctuations was observed in Yuri Gagarin's ECG.

The results of the astronauts' flights were naturally anticipated with great interest. Shepard spent five minutes under conditions of weightlessness, Gagarin endured zero-gravity for more than an hour. Neither Shepard nor Gagarin displayed any disturbance in the sensory and motor spheres. Data recorded during Gherman Titov's flight are being processed. However, it is known that during the whole flight the astronaut retained a sufficient level of working capacity. No pathological indications were observed in his main physiological functions.

At the same time, Titov noted some important symptoms. During the condition of weightlessness, unpleasant sensations of giddiness were felt increasingly, especially when the astronaut sharply turned his head or was observing swiftly moving objects. After a period of sleep these phenomena decreased, but did not disappear until the onset of acceleration during the reentry phase of the ship's return to earth. Thus, the sensation of discomfort existed during a considerable portion of the flight and resembled seasickness. (Source: INTERAVIA, December 1961, p. 1652)

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SOVIETS PLAN TO LAND ON MOON IN 1967. The first Russian will land on the Moon in '67, according to a Polish source. The preparations for the flight will get underway this year, says Ryszard Piekarowicz, writing in MAN AND THE COSMOS.

The Reds will start by flying a man around the Moon in '62 or '63 along a course similar to that of Lunik 3 which took pictures of the Moon's far side in 1959, according to Piekarowicz. Lunik 4 will have a small telescope to search the Moon's surface for a suitable landing spot. (Source: SPACE/AERONAUTICS, January 1962, p. 37)

GERMAN PARTICIPATION IN INTERNATIONAL SPACE EFFORT. Last year, the Max Planck Society celebrated the fiftieth anniversary of the founding of its predecessor, the Kaiser Wilhelm Society. At a Berlin meeting of the Society, Dr. Reiman Luest of the Max Planck Institute for Physics and Astrophysics, Munich, discussed international cooperation in space research and the role of the Max Planck Society in European efforts.

Plans were discussed for the development of a European scientific organization which could effectively engage in astronautical and space research. Nations which will probably participate in the program include Belgium, Denmark, England, France, the German Federal Republic, Italy, the Netherlands, Norway, Spain, Sweden, and Switzerland. About 20 per cent of the total costs of such an organization would be financed by the German Federal Republic.

European plans envisage initially a short-term program devoted to the launching of vertical rockets. Within 3 to 4 years this will be followed by a more extensive program over a longer period, during which small satellites and space probes are to be launched. Finally, the long-range program calls for the launching of heavier satellites and space probes.

During the first years, about 50 vertical rockets are to be launched which will carry useful loads of several hundred kilometers. These rockets will be used for investigations of the upper atmosphere, geophysical research (particularly in the polar-light zone), and astrophysical observations. Beginning with the fourth year, two to three smaller satellites or space probes will be launched annually which will carry useful loads of up to 100 kg. A number of geophysical and astrophysical research projects have already been proposed to be conducted with the aid of these rockets. During the sixth year, and at two-year intervals thereafter, a heavy satellite with a useful load of several tons or large space probes are to be launched. At first, it is planned to bring an astronomic satellite equipped with a 50-cm mirror telescope into orbit around the earth. The second large satellite will probably be a lunar satellite, i.e. one orbiting the moon. This could be used for investigations outside the geomagnetic field.

To participate in this general research effort, the Max Planck Society has formed a Working Group for Extraterrestrial Research to prepare a coordinated program. This group consists of each of the institutes having special competence in some areas of space research. It includes the Max Planck Institute of Aeronomy under Prof. Dr. Walter Dieminger at Lindau (Harz) with its constituent Institutes for the Physics of the Stratosphere (Prof. Dr. Julius Bartels) and for the Physics of the Ionosphere (Prof. Dr. W. Dieminger); the Max Planck Institute for Nuclear Physics at Heidelberg (Prof. Dr. Wolfgang Gentner); and the Max Planck Institute for Physics and Astrophysics at Munich (Prof. Dr. Werner Heisenberg) with its respective Institutes for Physics (Prof. Dr. Heisenberg) and for Astrophysics (Prof. Dr. Ludwig Biermann).

Future plans include the development of a satellite instrument which will make possible the measurement of the ionosphere from above. This instrument will be developed by the Institute for the Physics of the Ionosphere. Observations of satellites are in progress to determine the density of electrons in the atmosphere. At the Institute for the Physics of the Stratosphere this work will be extended by using balloons, vertical rockets, and eventually, satellites. For test purposes, small vertical rockets have already been launched. At present, balloon ascents are also made in cooperation with the geophysical observatory at Kiruna, Sweden, to measure eruptions of solar protons and to observe X-ray radiation in the polar-light zone.

A new division for the development of satellite instrumentation will be added to the Max Planck Institute of Astrophysics, Munich. The Institute of Astrophysics will concentrate primarily on research of the interplanetary medium, an area in which the Institute has been engaged for a number of years. The first objective of the experimental program is the development of a space probe with an artificial ionized tail (like a comet tail) perhaps with the aid of alkaline-earth metals. By using artificial comets of this kind, it should be possible to gather important information on the nature of the interplanetary medium.

These plans of the Max Planck Society could be put into practice either through cooperation with the National Aeronautics and Space Administration (NASA) or with the proposed European organization. Dr. Luest believes cooperation with NASA would be desirable at the beginning. According to him, it is conceivable that the Max Planck Society might conclude an agreement with NASA, if authorized to do so by the German Federal Government. In the meantime, the European organization could reach its anticipated size and budgetary strength. (Source: GERMAN SCIENCE BULLETIN, No. 68, November 1961, p. 29-31)

RADIO ASTRONOMY IN POLAND. Wilhelmina Iwanowska, a Corresponding Member of the PAS, has reported in NAUKA POLSKA on the developmental outlooks of radio astronomy in Poland. Her article presents a general account of

radio astronomy and its problems and mentions briefly radio astronomical research in Poland. The two Polish radio astronomical centers are located in Kraków and Toruń. A 5 m parabolic antenna built in 1954 and a 37 cm wavelength receiver built at a later date became operative at the Kraków center in 1957. The equipment is used for solar observation. The Toruń group of radio astronomers was originally headed by Master Engineer Grzesiak and since 1958 by Master S. Gorgolewski. The group received support from Professor S. Manczarski and from Professor J. Groszkowski's and Professor S. Ryżka's departments of the Politechnika Warszawska (Warsaw Polytechnic Institute) in the form of scientific advice, equipment, and funds. The Toruń center built a cylindrico-parabolic antenna measuring 26 x 12 m, a rotary parabolic antenna 12 m in diameter, and several receivers for the 2.37 m wavelength (127 mc). Systematic observation of the sun started in November 1958. Master Gorgolewski spent 18 months at the radio astronomical observatory of Cambridge University in England under Professor Ryle, and wrote a doctor's thesis. He was the first in Poland to acquire a doctor's degree in radio astronomy. (Source: Dept. of Commerce, ENGLISH ABSTRACTS, No. 11, December 1961, p. 8)

PROPAGATION OF L-F WAVES IN A PINCHED VISCOUS PLASMA ALONG A MAGNETIC FIELD. In a study of the fading and interaction of various types of oscillations related to the heating of the solar corona, the theory of magnetohydrodynamic corona heating, "in spite of some difficulties," is considered the only acceptable theory, because it provides a satisfactory explanation of a number of phenomena. It can, in many cases, be brought into agreement with observational results by systematically taking into account the effect of viscosity. This possibility is illustrated by the consideration of a plane wave propagating in the direction of a magnetic field in a pinched viscous plasma and having an amplitude lower than the magnetic-field intensity. The fluctuation of the plasma density is considered lower than the density fluctuation of unperturbed plasma and the effects of radiation and heat conductivity are ignored. Relationships generalizing the known magnetohydrodynamic equations are derived and the following conclusions reached: (1) in a pinched viscous plasma the following waves may propagate along the magnetic field, depending on $V_0^2/\omega\eta$ where V_0 and ω are the wave velocity and wave frequency, respectively, and

$$\eta = \frac{c^2}{4\pi\sigma} + \nu$$

(σ being the plasma conductivity and ν viscosity): magnetohydrodynamic and sound waves if $V_0^2/\omega\eta > 1$; viscous, sound, and radio waves if

$V_0^2/\omega^2 < 1$; (2) in relation to a magnetohydrodynamic wave, viscous plasma is a dispersing medium; (3) at $V_0^2/\omega^2 > 1$ the attenuation is

$$S = \frac{\omega^2 \nu}{2V_0} \left(1 - \frac{c^2 \nu \omega^2}{2\pi \sigma V_0^4} \right) ;$$

(4) the attenuation of magnetohydrodynamic waves in plasma cannot be of unlimited low value, and the concept of undamped waves cannot be regarded as correct when applied to solar conditions; (5) magnetohydrodynamic waves cause the appearance of strongly damped longitudinal waves which, under certain conditions, dissipate considerable energy; and (6) in high-conductivity plasma, the depth of penetration of viscous waves may exceed considerably the depth of penetration of electromagnetic waves, although the former carry only an insignificant amount of the energy. (Source: A.I.D. PRESS, No. 619, January 9, 1962, p. 2; translation of article in ASTRONOMICHSKIY ZHURNAL, Vol. 38, No. 5, September/October 1961)

ON THE POSSIBILITY OF THE EXISTENCE OF A RING OF COMETS AND METEORITES AROUND JUPITER. Astronomer S. K. Vsekhsvyatskiy, writing in IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR, propounds an interesting possibility concerning the planet Jupiter.

The author enumerates arguments of the theory of eruption for the existence of masses of comets and meteorites moving around the planets (existence of asteroids and meteor showers in central regions of the solar system; the impossibility to explain by pulling in the small age and the peculiarities of the motions of short-periodic comets; existence of the families of comets of Saturn, Uranus, and Neptune; the agreement of the chemical composition of the comet gases and the atmospheres of the planets; the peculiarities of the system of parabolic comets; the presence of ice in the comets; the results of structural and chemical investigations of the meteorites; volcanic phenomena of the bodies of planets).

The author points to the essential alternations considered in the Saturn ring. With the aid of the measurements of Huyghens, O. Struwe, Ranyard, Henry, Rudaux, and others, the velocity of the extension of the rings of Saturn and their approximation to the planet are calculated. For the full mechanic energy of the Saturn ring it is calculated: for the epoch of Huyghens

$$E = 4.75 \cdot 10^{12} \cdot 2.3 \cdot 10^{25} \text{ erg, for today;}$$

$E = 4.60 \cdot 10^{12} \cdot 2.3 \cdot 10^{25}$ erg. The loss of energy of $\Delta E = 3 \cdot 10^{36}$ erg within 300 years must be caused by collisions and by resistances against motions. It is stated that the evolution of the ring is quicker than it was assumed till now. It can be assumed that also in the present time there happens a filling of the matter of the ring at the expenses of strong planetary eruptions.

The existence of active eruption processes in the system of Jupiter causes the author to assume that also around Jupiter there move masses of comets and meteorites in the form of a ring. The assumption of the existence of the ring is also supported by the often observed equatorial strip of Jupiter which is interpreted as a shadow of the ring. For a fortification of this interpretation, the author investigates the mutual situations of the observer, Jupiter and the Sun for different observers (Lohse, Nijland): the times of the best possibility for the observation of the strip agree with the periods of the maximal cenographical latitude of the Earth and the Sun. (Source: Dept. of Commerce, ENGLISH ABSTRACTS, No. 11, December 1961, p. 56)

MAGNETIC STORM EFFECTS IN COSMIC RAYS DURING MINIMUM SOLAR ACTIVITY.

The Forbush decrease has been analyzed on the basis of data on 92 magnetic storms recorded with a shielded ionization chamber at Tbilisi in 1953-1955. It was observed that the Forbush decrease occurred only during large storms with sudden commencement; also, an increase in cosmic-ray intensity was registered prior to the commencement of such storms. The change in the cutoff point of the hard component was determined to be about the same during minimum and maximum solar activity, indicating that the nature of interaction between corpuscular streams and the geomagnetic field does not change greatly during minimum solar activity. The results of the analysis show that the corpuscular streams which cause large magnetic storms with sudden commencement are magnetized, that they contain a magnetic cushion in their forward part, and that they carry extensive high-intensity frozen-in magnetic fields. (Source: A.I.D. PRESS, No. 621, January 11, 1962, p. 4; translation of article in GEOMAGNETIZM I AERONOMIYA, Vol. 1, No. 5, September/October 1961)

PRODUCTION OF CONCENTRATED H₂O₂ AT LOW TEMPERATURES. A new laboratory method of preparing concentrated H₂O₂ at low temperatures using a silent discharge has been devised at the Department of Physical Chemistry at the University of Moscow. To obtain comparatively high yields, dissociated steam is condensed as rapidly as possible on a surface cooled to -196°C by liquid nitrogen. Twenty-five per cent mole yields of 60 per cent H₂O₂ can be obtained under the above conditions. It was found that H₂O₂ did not form at -70°C. (Source: ENGLISH ABSTRACTS, 61-11, 141, No. 12, January 1962, p. 14)

PROGRESS OF ANALYTICAL CHEMISTRY IN 1960 (USSR). This report, by A. K. Babko, originally appeared in the Soviet journal ZAVODSKAYA LABORATORIYA in July of last year.

Mr. Babko's review deals only with part of "the most interesting literature data" on new chemical reagents and reactions for the detection of various ions. Some problems of the development of the theory of organic reagents, methods of photometric analysis, precipitation, and titration are also examined. Also included is a table which illustrates principally the progress of the analytical chemistry of the individual elements. Over 50 examples are listed along with literature references.

The major part of the report deals with color reactions and photometric methods. Particular emphasis has been received by boron and metals of the fourth and fifth groups of the periodic system: titanium, zirconium, thorium, tantalum, and niobium. For the analysis of the nonmetals, there are no generally accepted methods and procedures for the investigation of new reactions. However, the theoretical and practical importance of these problems is fairly high. Therefore, in the field of nonmetal analysis, the methods proposed are frequently more original in character, requiring considerable inventiveness on the part of the author.

Specific subject headings of the report include organic reagents, luminescence reactions, complexometric titration and indications, masking substances, process of precipitation and coprecipitation, extraction, photometric analysis, redox and catalytic reactions, and automatic methods of analysis. (Source: INDUSTRIAL LABORATORY, Vol. 27, No. 7, July 1961; translation published December 1961, p. 781)

CERTAIN QUESTIONS ON THE THEORY OF ORAL INFORMATION. This article, by Yu. F. Pelegov, originally appeared in the Russian publication ELEKTROSVYAZ', No. 4, 1960.

The following Abstract and Discussion of Results appeared in the ARS Journal:

"Abstract: On the basis of the proposed equivalent circuit for speech communication, individual elements of the theory of speech have been developed. The question of redundancy and its filtration has been rendered more exact. It has been shown that the problem of the objective recognition of a phoneme can be analyzed by the methods of the theory of the "ideal receiver."

"Discussion of Results: The elements of the theory of speech communication set out here allow us to explain a number of experimental facts which, in their turn, confirm the proof of the fundamental assumptions.

1. The clipping of speech. It is well known that in clipping there is an inconsiderable distortion of the correlation function determining, as we have shown, the orientation of the vector of the controlling signals. Consequently the amount of meaningful information changes very little, and in the final analysis this leads to a high degree of distinctness. Note that a possible objective method of estimating the distortion consists of the measurement of the rms errors of the instantaneous correlation function.

2. Preservation of distinctness on Gabor transformation. The Gabor transformation of speech provides for the preservation of portions of a duration in one or several periods of the fundamental note. On the other hand the duration of the short-time correlation function is either considerably less (unvoiced consonants, whispered speech), or this function is periodic with a period equal to that of the frequency of the fundamental tone. In both cases the Gabor transformation does not distort the correlation function which ensures the conservation of distinctness.

3. Compression of the spectrum by the "forming vocoder." We have seen that although the complete spectrum of the controlling signals can be fairly wide, information as to the "form" of the phonemes is transmitted by only part of the neurons. Their number includes a group which characterizes the fundamental resonance frequency and the goodness of the resonator of the mouth cavity, and also the degree of tension of the vocal chords. The construction of the "forming vocoder" is based on the transmission of exactly this group of signals, which also causes the compression of the spectrum.

4. High distinguishability of the oscillograms of "visible" speech. Visible speech is the description of the short-term energy spectrum, but the latter is analogous to the transmission function of the linear circuit for unvoiced consonants, or contains supplementary information as to the frequency of the fundamental tone. In both cases we have a complete characteristic of the vector of the controlling signals which carries all the information." (Source: ARS JOURNAL, Vol. 31, No. 9, September 1961, p. 1359)

COMBINATION NOISE IN DRIFT KLYSTRONS. In a study of the influence of combination effects on the noise level of a drift klystron used as a frequency multiplier or an amplifier, the noise power at the output of a klystron under nonlinear operating conditions, i.e., at high bunching parameter, was determined by spectral analysis. The system was assumed to be one-dimensional and the space charge in the drift space was ignored. The convection-current spectrum at the klystron output and the respective signal-to-noise ratio, as well as the spectral density of the effective convection current, were calculated for various klystrons,

and the following conclusions were drawn. (1) In multiplier klystrons, the effect of narrow-band noise decreases rapidly with increase of the multiplication factor. The largest signal-to-noise ratio occurs with an optimal bunching parameter. If the exciter is the only source of noise the signal-to-noise ratio of the exciter does not change within the multiplier circuit. However, this is not the case when noise frequency is remote from the carrier frequency; in such a case an improvement of the signal-to-noise ratio may be achieved by filtration in resonators. (2) Two-cavity klystron amplifiers, owing to their higher power, have a more favorable signal-to-noise ratio than multipliers. As in the case of multipliers, the transfer coefficient of exciter noise under optimal excitation conditions is close to 1 regardless of the parameters of the instrument. (3) In multistage klystrons under synchronous tuning the ratio of the signal to the spectral noise density is inversely proportional to K_1^2 (K_1 being the gain of all stages preceding the output stage). (4) The use of high-power klystrons with low-temperature cathodes is recommended for improving the signal-to-noise ratio. (Source: A.I.D. PRESS, No. 620, January 10, 1962, p. 1; translation of article in RADIOTEKHNIKA I ELEKTRONIKA, Vol. 6, No. 12, December 1961)

METHOD OF PULSE NOISE SUPPRESSION IN RADIOTELEGRAPH RECEPTION. On the basis of theoretical research carried out under the direction of A. A. Fersman, Candidate of Technical Sciences, a noise suppression system has been developed which is said to be free of the various deficiencies of other systems. In this system, the mean level of pulse noise is reduced by heterodyning the interference voltages, which have been prelimited to the level of the useful signal by introducing a bilateral semiconductor diode clipping circuit with a limiting threshold equal to the amplitude of the signal envelope. However, this action alone is not sufficient to eliminate noise overshoots. Conditions are therefore created under which a change can be obtained in the statistical structure of random noise which results in the reduction of the mathematical expectation of the mean value of overshoots at the output of the noise-suppressing system to 40 per cent of the value of the useful signal. This reduction is obtained by a simultaneous action of noise and of the voltage of the third heterodyne of the detector. Results obtained in experimental operation are said to be satisfactory. (Source: A.I.D. PRESS, No. 623, January 15, 1962, p. 3; translation of article in ELEKTROSVYAZ', No. 11, November 1961)

THE FOCUSING OF AN ELECTRON BEAM IN A TRAVELING WAVE TUBE. A method has been proposed by A. L. Igritskii in RADIOTEKHNIKA I ELEKTRONIKA for computing the electron trajectories in solid and hollow electron beams in a traveling wave tube with a periodic electrostatic field produced by means of bifilar helices. A derivation of the differential

equation for the electron trajectories is cited, and this equation is integrated for the more complicated case of a hollow beam. The derived equations are also applicable to solid beams with certain changes. The author derives the condition for optimal focusing. When this condition is satisfied, the boundary trajectories for a hollow beam are approximately parallel to the axis of the tube, or in the case of a solid beam, a low degree of ripple for the electron trajectories at the specified radius is assured. It is demonstrated that a periodic electrostatic field may act as a "transformer" that alters the cross section of a hollow beam. It is proven that periodic electrostatic focusing of a solid beam is also possible when a conventional electron gun with a single-velocity electron beam is used. (Source: ELECTRONICS EXPRESS, Vol. 4, No. 2, 1961, p. 10)

TWO CRITICAL CAVITATION STAGES. The following article on cavitation was written by Soviet author S. B. Stopskii.

"One of the most dangerous and adverse phenomena in hydraulic machinery, both turbines and pumps, is cavitation, and it is of extreme importance to establish the conditions of work in which cavitation occurs. Model analysis is often applied to hydraulic machinery design but as recent investigations have shown, the conditions cannot be established on the model with a sufficient degree of reliability. The standard method of discovering cavitation in an axial hydraulic machine is by measuring its mechanical efficiency. The efficiency is plotted against the values of the cavitation coefficient (which is a nondimensional parameter representing the ratio of the difference between barometric pressure and saturated vapor pressure to the head acting on the machine), and in most cases, the critical value is the one below which the efficiency drops very sharply. This corresponds to the development of cavitation in the stream with subsequent separation of the stream. Careful measurements, however, have shown that before the critical value of the coefficient is achieved, the efficiency in many cases suffers a minor change. Sometimes, it is slightly reduced and then goes up again, or is slightly increased and then reduces, and then goes up again to the value corresponding to the usual critical coefficient. This phenomenon was observed also on models and on machines with transparent walls, and it was found that before cavitation develops in the main stream, there is a definite stage at which cavitation begins to develop on the blades of the hydraulic machine. This first cavitation is represented by the development and collapse of small bubbles and is very detrimental, since it causes erosion of the turbine blades. Through some rather peculiar and not fully understood phenomenon, the efficiency of the machine can slightly increase at the moment in which the cavitation on the blades begins. Therefore, the beginning of cavitation which is detrimental to the mechanical state of the machine cannot be discovered with any degree of reliability by the usual method of measuring the efficiency.

"In 1957 the author of the present article developed an acoustic method of discovering cavitation. This method is based on the fact that the initial state of cavitation, i.e. the bubbles breaking down on the blade, produces a considerable noise which does not exist before this stage is reached. There is, however, a certain complication because the air and vapor bubbles which produce the noise by their breakdown also act, before they collapse, as a damping medium for this noise. In particular, they are highly effective damping media when they are of the size which is resonant to the noise frequency. In fact, the noise covers a wide frequency spectrum which can be analyzed, and even so, the damping still occurs because the bubbles develop in various sizes. After considerable experimentation, the following procedure was developed. The noise produced by cavitation is analyzed and only one frequency studied, preferably an ultrasonic frequency. The intensity of noise in this frequency is plotted against the variation of the cavitation parameter, and as cavitation conditions are approached, the intensity of the noise goes up. At a certain instant when the cavitation has reached very intensive proportions, the number of bubbles corresponding to the resonant size is also very large and the damping of the noise becomes very effective. This is shown by a reduction in the noise intensity. As the cavitation parameter is further reduced, a second peak occurs in the noise intensity which then reduces again.

"The application of the described acoustic method enables both stages of cavitation development in axial hydraulic machines to be established, which is not possible with the usual efficiency method." (Source: SOVIET TECHNOLOGY DIGEST, July 1961, p. 6)

ION FILTER (CZECHOSLOVAKIA). A filter for preventing the incidence of ions on the emitter during electron emission experiments with a Geiger-Mueller counter is based on reversal of the direction of the electric field between the counter and the emitter in a way which prevents the ions from penetrating the space above the emitter. This is achieved by utilizing the difference in the mobility of electrons and ions in a gaseous medium. A grid whose polarities vary with respect to the cathode is placed between the cathode and the emitter. The grid frequency selected must be high enough to permit passage only of the electrons, not of the ions, from the emitter into the space of the counter during the conducting half-period. The filter was tested with satisfactory results. (Source: A.I.D. PRESS, No. 619, January 9, 1962, p. 3; translation of an article in CESKOSLOVENSKY CASOPIS PRO FYSIKU, Vol. 11, No. 6, Section A, 1961)

SUPER-LIGHT ALLOYS. Soviet metallurgist E. M. Savitskii and several collaborators have investigated the possibility of producing super-light alloys, containing magnesium and aluminum as alloy elements, of sufficiently good corrosion resistance and mechanical properties to be used in machine construction and as structural materials.

Magnesium-lithium alloys were melted under Li + KCl flux, the lithium being melted first and magnesium being added to the melt at a temperature not exceeding 700°C. Aluminum-lithium alloys containing somewhat more lithium were prepared by the same method; alloys of low-lithium content were prepared by adding the lithium wrapped in aluminum foil to the molten aluminum, flux being added prior to teeming. Ternary alloys containing lithium were cast, using various combinations of the above methods. The alloys were melted in a resistance furnace in armco iron crucibles, and held in a molten state under a layer of flux for 10 to 15 minutes. After removing the flux, they were teemed into copper molds. The ingots were extruded at 200 to 240°C into rods of 10 mm diameter. The outflow pressure was between 70 and 30 kg/cm², depending on the composition of the alloys, the pressure decreasing with increase in lithium content. The specific gravity of the alloys was found to be between 0.8 and 2.2 g/cm³. Alloys having a specific gravity of between 0.8 and 1.1 g/cm³ exhibited no corrosion resistance at all and disintegrated in storage. In order to prevent rapid oxidation of the alloys, they were coated with a thin film of Canada balsam solution.

From the whole series of cast alloys, the authors chose five compositions of alloys, having specific gravities of from 1.05 to 1.30 g/cm³. The binary magnesium-lithium alloys chosen were all solid solutions. Ternary alloys with aluminum exhibited inclusions of MgLi₂Al intermetallic compound. It was found that the coefficient of thermal expansion of binary and ternary lithium-base cast alloys in the temperature range of -85° to 0°C decreases with increase in magnesium and aluminum. An increase in aluminum content of the alloys increases the hardness, a maximum of 63 kg/mm² being exhibited by an alloy containing 9 per cent Al and 25 per cent Li.

Compression tests were carried out on cylindrical specimens cut out from rods of deformed alloys. Specimens of magnesium-base alloys of low-aluminum content were very plastic and did not fail in compression. An increase in magnesium and aluminum content decrease the plasticity of lithium-base alloys and increase their compressive strength. The alloy exhibiting maximum plasticity was found to contain 50 per cent Li, remainder magnesium, while the strongest alloy was one containing 9 per cent Al. All specimens used for tensile testing were machined from deformed metal rods. Again the strongest alloy was the one containing 9 per cent Al and the least strong alloy, the one containing 50 per cent Li. For all alloys, an increase in aluminum content increases the strength and decreases the plasticity in tension. The strongest alloy was found to be one containing the following percentages: 65.8 Mg, 25.2 Li, and 9 Al. The specific strength, i.e. the ratio between U.T.S. and specific gravity, is an important indication of mechanical properties. The strongest alloy (9 per cent Al and 25 per cent Li) was found to have the greatest specific strength.

One of the important properties of casting alloys is their corrosion resistance. Whereas the binary 50 per cent Mg + 50 per cent Li alloy was rapidly attacked by a 3 per cent NaCl solution, additions of aluminum were found to increase the corrosion resistance of the alloys both in salt solutions and in moist air atmospheres. An alloy containing 22.5 per cent Li and 9 per cent Al was found to possess the best corrosion resistance properties. These can be further improved by protective coatings.

The authors suggest the use of ternary alloys containing 7 to 15 per cent Al, 15 to 25 per cent Li, and 60 to 80 per cent Mg as structural alloys. Alloys with a specific gravity of less than unity may be used as stiffeners for pipes, giving them rigidity while decreasing their specific gravity, as vibrating plates working in oily media, etc. (Source: SOVIET TECHNOLOGY DIGEST, August/September 1961, p. 46)

COBALT BEHAVIOR IN PROTECTIVE COATINGS ON MOLYBDENUM. The high-temperature behavior of cobalt in protective coatings on molybdenum has been studied by the method of radioactive isotopes. Four coatings containing 48.08 to 76.92 per cent refractory fillers, 9.61 to 48.07 per cent frit (glassy binder), and Co^{60} in the frit were applied as a slip on

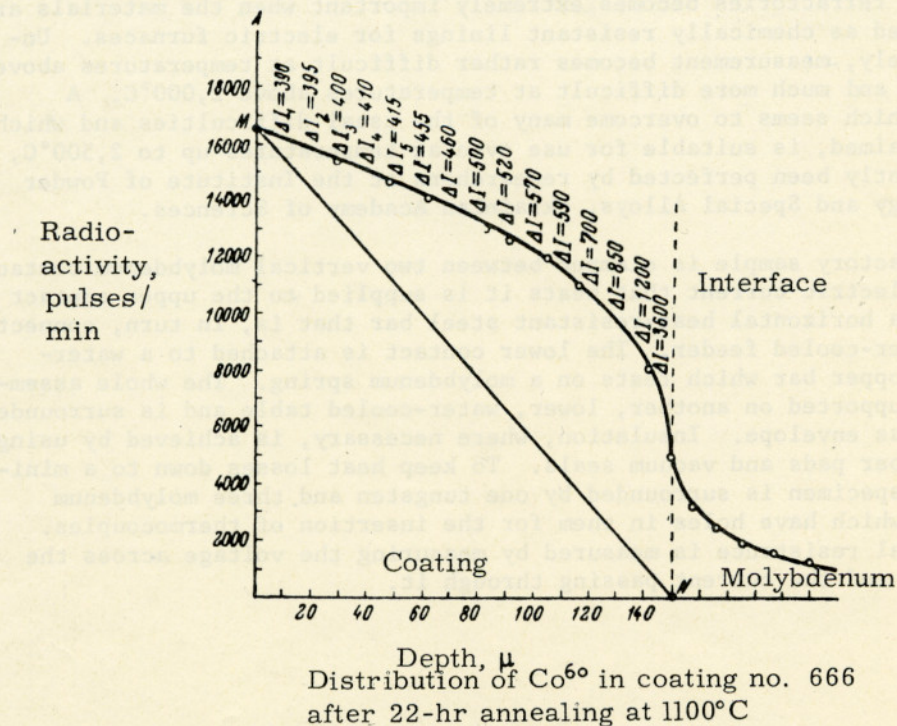


FIG. 1

flat specimens of sintered molybdenum. The specimens were baked at 1450° to 1660°C for 1.5 to 2 minutes in an argon atmosphere, producing coatings 130 to 160 μ thick. Some specimens were then annealed at 1000°, 1100°, 1200°, 1300°, or 1400°C for 22 hours. Several layers 0.008 to 0.029 mm thick were removed from the specimens by grinding to a total depth of 0.210 mm, the radioactivity being determined after the removal of each layer. It was found that in all coatings tested, diffusion of cobalt toward the coating-molybdenum interface occurred during baking. This resulted in a cobalt concentration at the interface. During annealing, the diffusion continued and the cobalt also diffused into the molybdenum; the higher the annealing temperature, the greater the amount of Co in the metal (see illustration). The mobility of Co also varied with the composition of the coating and was found to be considerably higher in coatings with a high than in those with a low content of high-melting frit. Some part is also played by the viscosity of the glassy component of the coating and by the diffusion of metallic components toward the molybdenum. (Source: A.I.D. PRESS, No. 617, January 5, 1962, p. 3; translation of an article in ZHURNAL PRIKLADNOY KHIMII, Vol. 34, No. 10, October 1961)

REFRACTORY RESISTANCE MEASUREMENT. Knowledge of the electrical resistance of refractories becomes extremely important when the materials are to be used as chemically resistant linings for electric furnaces. Unfortunately, measurement becomes rather difficult at temperatures above 1,000°C, and much more difficult at temperatures above 2,000°C. A method which seems to overcome many of the usual difficulties and which, it is claimed, is suitable for use even at temperatures up to 2,500°C, has recently been perfected by researchers at the Institute of Powder Metallurgy and Special Alloys, Ukrainian Academy of Sciences.

The refractory sample is clamped between two vertical molybdenum contacts, and an electric current that heats it is supplied to the upper contact through a horizontal heat-resistant steel bar that is, in turn, connected to a water-cooled feeder. The lower contact is attached to a water-cooled copper bar which rests on a molybdenum spring. The whole assembly is supported on another, lower, water-cooled table and is surrounded by a glass envelope. Insulation, where necessary, is achieved by using hard rubber pads and vacuum seals. To keep heat losses down to a minimum, the specimen is surrounded by one tungsten and three molybdenum shields which have holes in them for the insertion of thermocouples. Electrical resistance is measured by measuring the voltage across the specimen and the current passing through it.

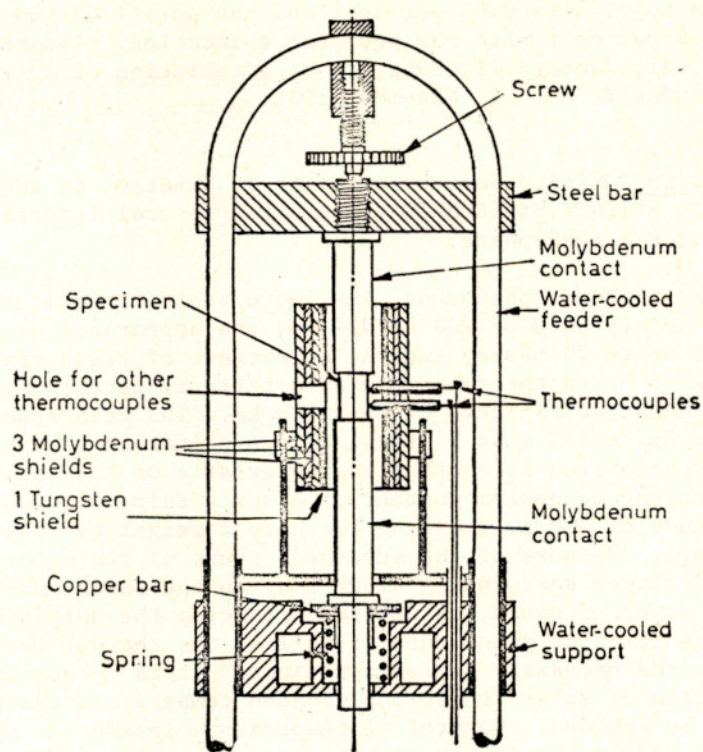


FIG. 2

(Source: NEW SCIENTIST, Vol 12, No 264, December 7, 1961, p. 626)

HIGH-PURITY TELLURIUM. A laboratory study has shown that tellurium containing 0.01 to 0.05 per cent impurities can be obtained from raw tellurium (in percentages: 69.23 Te, 5.01 Se, 1.01 Si, and 0.64 other impurities) or commercial-grade TeO_2 (in percentages: 40.56 Te, 0.79 Se, 2.80 Si, and 0.25 other impurities). With raw tellurium the best results were obtained by sulfatizing roasting, which eliminated most of the Se. Subsequent leaching in a solution of caustic soda dissolved up to 98 per cent of the Te contained in the initial product. Neutralization of the filtrate with sulfuric acid yielded TeO_2 containing 73.6 per cent Te and 0.31 per cent impurities. Leaching of commercial-grade TeO_2 in a solution of caustic soda produced refined TeO_2 containing 68.93 per cent Te, 3.27 per cent Si, and 0.51 per cent other impurities. The SiO_2 was eliminated by fusing refined TeO_2 with borax or caustic soda

and flour. The latter as a deoxidizer. In both cases the Si content was lowered to 0.01 to 0.03 per cent and the purity of the Te reached 99.8 to 99.9 per cent with ~80 per cent extraction. (Source: A.I.D. PRESS, No. 621, January 11, 1962, p. 3; translation of an article in TSVETNYYE METALLY, No. 11, November 1961)

IONOSPHERIC PHENOMENA. Soviet scientist I. Sabetay, in an article appearing in ȘTIINȚA ȘI TECHNICA, describes several interesting characteristics of the ionosphere.

Among the ionospheric phenomena, the increase in temperature to 1,500° to 2,000°C at an altitude of 200 to 300 km, the appearance of winds with a velocity of up to 70 m/sec, and the appearance of tides are mentioned. Instruments on board the third Soviet artificial satellite, have detected nitrous oxide at an altitude of over 200 km. The mean free path of a molecule is up to 1.5 m at a height of approximately 200 to 300 km. Increased sublimation is another characteristic of the ionosphere. Due to this fact, the magnesium content of a space ship hull would sublime at an altitude of 300 km reducing the ship's weight by 80 kg during a 3-month orbit. Because of the advanced vacuum of the upper atmosphere, the thin air layer surrounding every body on the Earth, due to the absorption power of gases, is detached reducing the ship's weight and changing the friction phenomenon as well as the thermal characteristic. To maintain the necessary "caloric balance," it is necessary to control the absorption of solar radiation. Sudden temperature changes must, therefore, be avoided. Control of temperature inside the space ship can be accomplished by a suitable combination of metal and paint. Plastics evaporate too fast in the ionosphere. The acoustic characteristics of the ionosphere differ from those on the surface of the Earth: there is no propagation of sound waves above an altitude of 100 km. Due to the fact that the high-altitude layers of the atmosphere are closer to the solar atmosphere than to the lower layers of the Earth atmosphere, the region between 250 and 300 km is called outer space. (Source: Dept. of Commerce, ENGLISH ABSTRACTS, No. 11, December 1961, p. 9)

CONFERENCE OF SOVIET METEOROLOGISTS. At the All-Union Meteorological Conference, July 21 to 29, 1961, which marked the 40th anniversary of the Hydrometeorological Service, Academician Ye. K. Fedorov spoke on the active influences on changes in weather and climate, especially in regard to the regulation of clouds, fog, and precipitation. I. M. Dolgin, D. L. Laykhtman, N. P. Rusin, and A. D. Treshnikov reported on meteorological investigations in the Arctic and Antarctic. V. A. Bugayev and M. I. Yudin, discussing the importance of the automatic processing of observational data for short-range weather forecasting, pointed out the need for more intensive studies of frontal sections and the formation of cyclones. B. A. Mirtov and P. G. Khvostikov reported on atmospheric

investigations to heights of hundreds of kilometers. The heat balance on the surface of the ground and in the lower layers of the atmosphere were discussed in the report of M. I. Budyko, who pointed out that with more precise and accurate information now available, the heat-balance atlas is now obsolete. F. F. Davitaya discussed agroclimatic studies and their connection with progressive agricultural techniques. The entire contents of the 450 reports will be published. (Source: A.I.D. PRESS, No. 614, January 2, 1962, p. 4; translation of an article in METEOROLOVIYA I GIDROLOGIYA, No. 11, 1961)

THE MEASUREMENT OF PRESSURE IN A COMPRESSED ATMOSPHERE. Series in powers of the Mach number are proposed by A. S. Monin for use in the equations for the dynamics of the atmosphere. He states, "Here we should retain the wave operator which enters into these equations, since when it is replaced with an elliptical operator (as is the practice in the so-called quasi-approximation) it is necessary to specify the initial data over the entire space even though for exact equations these conditions must be specified only in a limited region (within the characteristic cone). For equations containing the wave operator, a method is proposed for the approximate filtering of meteorological noise." (Source: PHYSICS EXPRESS, Vol. 4, No. 2, 1961, p. 17)

A NEW GALVANOMAGNETIC EFFECT IN SEMICONDUCTORS. Dr. Stanislaw Sikorski, of the Institute of Fundamental Technical Problems, Polish Academy of Sciences, Warsaw, has carried out a theoretical analysis of the electrical conditions in an inhomogeneous semiconducting specimen, which has one face uniformly illuminated and has a magnetic field applied perpendicular to the face. A general formula for the current density in such a specimen has been deduced and from this a new galvanomagnetic effect has been predicted. Experimental investigations have been carried out to confirm these theoretical predictions.

The effect is best observed in a thin rectangular semiconducting plate with electrodes making ohmic contacts at the ends, as shown in Fig. 3.

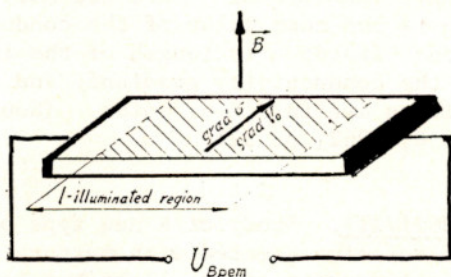


FIG. 3

A conductivity gradient exists in this sample perpendicular to its length. The upper face is uniformly illuminated and the magnetic field B is applied perpendicular to this face. The theory shows that under these conditions a voltage is developed between the end electrodes. Dr. Sikorski proposes that this effect be called the bulk photo-electromagnetic effect (B_{pem}).

The effect is different from the Kikoin-Noskov photo-electromagnetic effect. This is because the density of nonequilibrium current carriers δp in a sufficiently thin and uniformly illuminated plate is constant over the whole volume. It has been shown that the bulk photo-electromagnetic effect may be considered as a Hall effect in which the movement of nonequilibrium current carriers in an internal field must be taken into account. The nature of the internal field, $\text{grad } V_o$, is directly related to the conductivity gradient in the sample. The effect is, however, related to the Kikoin-Noskov effect as well as to the Taue-Trousil bulk photo-voltaic effect, and this is why the term bulk photo-electromagnetic effect has been chosen.

For the case as shown in Fig. 3, the general formula provides the following expression for the voltage U (bulk photo-electromagnetic effect) under open-circuit conditions:

$$U_{B_{pem}} = - \frac{e\mu^* \delta p \theta}{\sigma} \frac{dV_o}{dy} l$$

In the special case of an n -type semiconductor, this formula takes the more legible form:

$$U_{B_{pem}} = - \frac{kT}{e} \frac{e\mu_p \delta p \theta}{\sigma^2} \frac{d\sigma}{dy} l$$

where e is the charge of an electron; μ^* is the group mobility of nonequilibrium current carrier; δp is the density of nonequilibrium hole-electron pairs; $\theta = (\mu_{pH} + \mu_{nH})B$; μ_{pH} , μ_{nH} are the Hall mobilities of holes and electrons; σ is the mean value of the conductivity; dV_o/dy is the value of the internal field; l is length of the illuminated region; $d\sigma/dy$ is the value of the conductivity gradient; and μ_p is mobility of holes. All the quantities are in M.K.S. units. (Source: NATURE, Vol. 193, No. 4810, January 6, 1962, p. 32)

NEW TYPE OF PHOTOCONDUCTIVITY. Study of a new type of photoconductivity observed in samples of selenium treated with mercury indicates that it is not dependent on the intensity of the light but is a function only of

the wavelength of the light. It is assumed that this photoconductivity appears when all the usual mechanisms of recombination of current carriers seized by electron traps are so highly improbable that recombinations induced by the action of light begins to play the fundamental role. Two observations confirm this assumption. (1) A sample illuminated by monochromatic light does not return to the state of initial conductivity after the light has been dimmed, but retains for a period of hours the conductivity produced by the light. This indicates that recombination of trapped carriers does not occur in darkness. (2) Substitution of monochromatic light of one wavelength for that of another wavelength results in a new photoresponse within fractions of a second. Both the excitation of free carriers and their recombination, therefore, are accomplished by light. It is noted that the hypothesis of resonant saturation of traps does not satisfactorily explain the characteristics of this type of photoconductivity. (Source: A.I.D. PRESS, No. 618, January 8, 1962, p. 1; translation of article in FIZIKA TVERDOGO TELA, Vol 3, No. 10, October 1961)

STATIONARY MAGNETIC FIELDS IN COILS COOLED BY LIQUID HYDROGEN. One of the methods for thermal insulation of heated plasma is its retention in magnetic traps. Obtaining stationary magnetic fields of high intensity is associated with large expenditures of energy. A reduction in the energy expenditure required to produce the magnetic field can simplify the realization of a controlled thermonuclear reaction with a useful energy yield.

With a lowering of the temperature, the electrical resistivity of pure metals is reduced. Correspondingly, the Joule losses in the coils producing the magnetic field are also reduced.

However, in order to remove heat at low temperature by means of some cooling agent, it is necessary to expend an amount of work A which substantially exceeds the amount of Joule heat Q dissipated in the coil. But the ratio A/Q is less than the ratio between the resistance of the metal at room temperature R_{300} and the resistance of the metal at low temperature R_T (i.e., if $A/Q < R_{300}/R_T$); the use of low temperatures results in gain in terms of the energy expended in producing the magnetic field. Author E. S. Borvik and his associates have demonstrated in their analysis appearing in the ZHURNAL TEKHNICHESKOI FIZIKI 31, No. 4, April 1961, that this gain may be appreciable. (The translation of this analysis is available.) (Source: ENGLISH ABSTRACTS, 61-11, 141, No. 12, January 1962)

POLISH MACHINE TOOL INDUSTRY. The May 1961 issue of the Polish journal MECHANIK is devoted to the 30th International Fair in Poznan and contains a number of interesting articles reflecting the status and development trends of the Polish machine tool industry. This industry has

attracted the attention of Western experts for some time now - it is developing quickly both at the technical level as well as in output. Of the 68 exhibits shown in the Fair, 25 are new designs introduced as a part of the development plan for 1961 to 1965. The general trend of machine tool development in Poland is mechanization and automation just as in all other industrially developed countries. The fairly detailed plan includes 23 lathes, both program controlled and automatic, ranging from a single spindle automatic lathe running at 6,000 rev/min and weighing under a ton to a vertical boring mill weighing 170 tons and capable of turning workpieces up to 7 meters diameter. The plan envisages 8 new designs of milling machines, including 2 with a semi-automatic cycle, 2 with electronic copying devices, and 1 plano-mill; 12 grinding machines, some with live gauging; several drilling machines; a few special purpose machines; and ultrasonic and electro-erosive sinking machines complete the list of the metal cutting machine tools. Metal forming machines include 20 presses of diverse designs, 6 shears, 1 bulldozer, and 3 mechanical hammers. The largest item among these is a 1,600-ton pressure forging press, weighing 100 tons. The woodworking industry will be provided with 10 new designs of various woodworking machines.

Research and development work in the field of machine tools is organized in Poland on similar lines to those in the Soviet Union. There are several large factories of machine tools which have attached to them extensive design bureaus, but in addition, there are centralized national design bureaus for machine tools, for cutting tools, for forging equipment, etc. In the majority of cases, Polish designers draw freely on the experience of the more developed countries but at the same time, original designs exist and their proportion tends to increase. The young tool industry is particularly successful and already enjoys a high reputation in foreign countries, even in the United States. There are about 2 dozen large toolmaking plants, each specializing in a fairly narrow range. The overall range of the Polish tool industry nearly covers the entire spectrum from simple hand grinders to high precision dial gauges and from drills, taps, and drill chucks to electronic multi-dimensional live gauging equipment. Tool steels, as well as sintered carbide tools, are produced in Poland and are claimed to be of an excellent quality. (Source: SOVIET TECHNOLOGY DIGEST, August/September 1961, p. 110)

ELECTROSLAG MELTING. Academician B. Paton (Chief, Electric Welding Institute imeni Ye. O. Paton, Ukrainian Academy of Sciences) strongly favors electroslag melting, developed at his institute, as the final refining process in the production of the highest grade steels and alloys for aircraft, missile, and nuclear applications. According to Paton, the only advantage of consumable-electrode vacuum arc melting over electroslag melting is that the former produces a somewhat greater reduction of hydrogen content. Electroslag melting, on the other hand, produces

ingots with a better surface. The impurities are absorbed by slag, which can effectively eliminate such impurities as sulfur, and do not concentrate in the top of the ingot as they do in vacuum arc melting. Further, no vacuum is required and the process utilizes alternating current. The first production-scale electroslag melting unit was built at the "Dnepropetsstal" Plant. Similar units are now in operation at metallurgical plants in Elektrostal', Zlatoust, and Izhevsk. Electroslag melting units were scheduled for the Volgograd, "Uralsmash," and Chelyabinsk Plants but have not been received. The process has also been tested successfully in the USSR and Czechoslovakia in the melting of high-grade alloys on copper and copper-nickel bases. (Source: A.I.D. PRESS, No. 620, January 10, 1962, p. 4; translation of article in IZVESTIYA, December 22, 1961, 3, Cols. 4-7)

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

Auger, Pierre, Current Trends in Scientific Research. United Nations: New York; UNESCO: Paris; 245 p.

A recent issue of DISCOVERY carried a book review by Professor J. Rotblat on the above publication. Following is a partial reproduction of this book review.

"About 3 years ago, the General Assembly of the United Nations adopted a resolution, calling for a survey to be made on the main trends of scientific research, the dissemination and application for peaceful ends of scientific knowledge, and on the steps which might be taken by the United Nations, the Specialized Agencies and the International Atomic Energy Agency, towards encouraging the concentration of such efforts upon the most urgent problems, having regard to the needs of the various countries.

"After consultations with UNESCO, Professor Pierre Auger was given the task of preparing the survey. This was an excellent choice, since as former Director of the Department of Natural Sciences of UNESCO, Auger had been in close contact with scientists and scientific unions, and familiar with the important events in research. Even for a man with such wide knowledge and interest, the task would have been impossible without the assistance of many people. The book lists over 200 national and international organizations, as well as nearly 300 individuals who were consulted during the preparation of the report.

"Most of the book is taken up by a survey of current topics of scientific research in the fundamental sciences (mathematics, physics, chemistry, biology), the earth and space sciences, the medical sciences, food and agricultural sciences, fuel and power research, and finally industrial

research. This is really a monumental piece of work; it is probably the first time that such a comprehensive review, covering all fields of scientific endeavour, has been attempted.

"It is clearly impossible for any one person to judge whether all fields of research have received adequate treatment in the survey, but if the two areas with which the reviewer is familiar can be considered as random samples, then the conclusion must be that the task has been accomplished most successfully.

"Apart from its intrinsic value, the survey is of great importance in bringing to the fore the interdependence of various branches of science and the continuous emergence of new fields by the fusion of borderline subjects. It will also serve as a salutary lesson to the arrogant scientist who thinks of his piece of research as the most important thing in the world, to realize that it constitutes a very tiny fraction of the total research effort. For these reasons, the book should be studied by every scientific worker.

"Apart from the survey, the book contains an introductory chapter and a section dealing with recommendations. Both of these make very interesting reading.

"The introduction contains general remarks about the rate of development of science. As already noted, the growth of scientific activities follows an exponential law. According to Auger the doubling time of these activities is 10 years; every 10 years the volume of scientific work increases two-fold. This figure was deduced from a variety of statistical facts, such as the number of original publications in scientific journals, the number of abstracts in a single branch of science, the number of scientific personnel working in laboratories, or the number of significant scientific discoveries made each year.

"Another striking expression of the doubling of scientific activities every decade is quoted by Auger: the number of scientists alive today is equal to 90 per cent of all the scientists who have existed since the beginning of history!

"Other forms of human activities are, of course, also increasing, but at a far, far slower rate. The doubling time of activities not directly related to science is 40 years. Such a tremendous difference can hardly be maintained indefinitely; in fact, there are already indications of a slowing down in the rate of growth of science. Auger gives several reasons for this slowing down which can probably be best expressed as the result of self-suffocation. It is becoming increasingly difficult for the research worker to keep abreast of events, even in his own, very limited, research subject. The problem of training research workers at the necessary rate is becoming more and more formidable. Above all,

the output of the individual scientist, from the point of view of the value of the results of his research work, is bound to decrease, mainly because of the duplication, and the ever increasing likelihood that the same work is being carried out simultaneously in another part of the world. The policy of secrecy, whether imposed by governments for security reasons, or by industry for profit reasons, in contributing towards the multiplication of parallel efforts and towards the reduction of the effectiveness of research work. There is thus a great deal of waste which could be avoided by planning scientific research on an international scale.

"A certain amount of duplication is perhaps not entirely undesirable. Even if the same work is being carried out in two different places, the obtaining of identical results is a useful and often necessary check on their validity. Should the results differ, the discrepancy may bring to light some new phenomenon which would otherwise have been overlooked. Moreover, the element of competition, the rivalry between two teams working on similar projects, and vying with each other to be the first at the goal, is often a very stimulating factor. Nonetheless, one must agree with Auger that the amount of duplication is at present far too great, and that we would all benefit by a greater measure of coordination.

"This brings us to the recommendations which Auger makes about the organization of scientific research and dissemination of scientific knowledge. They are directly based on the survey of current research work and fall into two categories, general and special recommendations. The first class is concerned with projects which would affect a number of organizations, or would help the general development of science. The very important problems of scientific documentation, of international scientific conferences, of the organization of international cooperation in scientific research, are considered under this heading. The special recommendations deal with limited subjects and range over all branches of science discussed in the survey.

"One may not perhaps agree with all of Auger's recommendations. For example, some people will doubt whether very large conferences, of the type of the two United Nations Conferences on the Peaceful Uses of Atomic Energy, are really more useful than small symposia. One would have also liked to see more imaginative proposals in some areas, as for example the exchange of students and scientists. But these are very minor criticisms which do not detract from the great importance of the recommendations. It is to be earnestly hoped that they will be accepted by the appropriate national and international organizations.

"The implementation of these recommendations will certainly help to achieve the purpose outlined by Auger: better utilization of science with resulting material benefits to man. But it may achieve much more

than this, it may make for a safer world. Constructive international cooperation in science is one of the best ways of creating trust between nations. The greatest source of danger at the present time is the mistrust between the nations belonging to different political systems. This mistrust is aggravated by the tremendous discrepancy between the rates of growth of scientific activities and other human activities. International cooperation in science would diminish this discrepancy. Nothing helps more towards the development of trust than common interest and experience in working together for constructive ends. With the important role played nowadays by science, collaboration in scientific research would have a great significance in improving the general tone of the political situation.

"Scientists themselves have both the competence and the duty to initiate and stimulate such collaboration. One lesson which the scientist must learn from reading Auger's report is that he should not leave the task to others, but himself take on the responsibility for the implementation of the recommendations." (Source: DISCOVERY, December 1961, p. 556)

n.a., Physical Gas Dynamics (USSR). Edited by A. S. Predvoditelev. Translated by Dr. R. C. Murry and D. R. H. Phillips. London and New York: Pergamon Press. 1961.

The following comments on this book were made by Mr. I. S. Donaldson.

"This book is a translation from the Russian of a symposium of 12 papers covering a wide range of topics under the general heading of the title.

"Five of the papers cover the field of gas kinetics, the longest being concerned with calculating the properties of air in the temperature-range 1,000°K to 12,000°K, and the pressure-range 0.001 to 1,000 atmospheres. Two of the other papers calculate the changes across normal shock-waves in air considered as a real gas.

"The next two papers consider experimentally the supersonic flow at an oblique-cut nozzle and an oblique-cut base. These are related to the flow in turbine nozzles and blades.

"The next three papers again present a sharp contrast, the subject under discussion being the pressure field resulting from electrical discharges under water, while the last two papers in the book discuss shock waves associated with flames. Four of these five papers discuss experimental work.

"One of the difficulties encountered by publishers of a book of this nature is that of making the information available sufficiently quickly after completion of the work on which it is based. The references to

the various papers indicate that most of the work presented at the symposium was done prior to about 1956, so in this sense the book is not up to date; but, despite this, there is no doubt that it gives some of the most up-to-date information in English on the work being carried out in the USSR in the field of gas dynamics.

"It is fair to say that the translation into technical English is in general excellent, though it is noted that in some references which were originally in English, but have been translated into Russian, the authors' names are not correctly translated back into English. The printing is in nonletterpress type setting, but this in no way detracts from the book, perhaps the only thing which does being the quality of schlieren photographs on which several of the papers depend. The photographs are in general poor, but there is no indication whether this is due to the printing process used or to the poor quality of the originals." (Source: NATURE, Vol. 192, No. 4805, December 2, 1961, p. 837)

n.a., Atlas of the Other Side of the Moon. Edited by N. P. Barabashov, A. A. Mikhailov, and Yu. N. Lipskiy. Translated by Leon Ter-Oganian. London and New York: Pergamon Press. 1961.

In a recent review of this atlas, Zdeněk Kopal stated:

"Everyone is familiar with the fact that the tidal friction operative in the Earth-Moon system has gradually slowed down the axial rotation of our satellite to the rate with which it revolves around Earth (the periods of these two motions being now synchronized within at least 0.1 sec) - which makes the Moon show us always the same face. Lunar librations (both physical and optical) permit us, to be sure, to see from Earth somewhat more than one-half of the entire surface of the lunar globe - in fact, about 59 per cent of it - but the rest remained completely hidden to us, until the memorable flight of the third Russian space rocket in October 1959, which circumnavigated our satellite and by means of its photographic equipment carried aboard took at last the veil off its invisible face.

"The details of this feat are still sufficiently well remembered to require little repetition. A preliminary report on the photographic data obtained in the course of this flight and televised afterwards to Earth was released by the USSR Academy of Sciences in December 1959 (FIRST PHOTOGRAPHS OF THE FAR SIDE OF THE MOON, the English translation of which was published by the Pergamon Press, London, in 1960); while a definitive discussion of the entire material followed a year later in a volume the English edition of which is under review.

"This volume summarizes the results of an exhaustive study of the topographic as well as photometric features of all available negatives, carried out independently at the Pulkovo Observatory, Sternberg State

Astronomical Institute, Moscow, and the Kharkov Observatory, under the respective guidance of Profs. A. A. Mikhailov, Yu. N. Lipskiy and N. P. Barabashov - all well-known students of the Moon. The outcome of their impressive study (the methods of which are described in the first part of their book) resulted in the identification of 498 details on the lunar far side, the catalogue of which (classified according to their degree of reliability) constitutes the major part of the whole volume. The formations discovered on the far side of the Moon do not, in general, differ from those we know on the visible face in their photometric or topographic characteristics - though even a cursory glance at the first photographs of the far side revealed a much greater preponderance there of mountainous areas (and a corresponding scarcity of the maria) than is the case on the side that is familiar to us.

"The last, and most valuable, part of the present volume consists of the reproductions of 30 frames of the individual photographs secured by the Russian space station. Needless to stress, no one frame reveals all the details ascertained for that particular region from the ensemble of the material; but the best single frames appear to attain a ground resolution of some 10 miles.

"A map of the far side of the Moon, showing the distribution of topographic details listed in the catalogue, concludes the whole volume. It is the first map of its kind, and comparable in amount of detail with maps of the visible face of the Moon available by the first half of the eighteenth century.

"All considered, the scientific outcome of the flight of the Russian third space station must be regarded as a splendid success, and a wonderful achievement in which the Russian nation and all their fellow inhabitants of this Earth can justly rejoice. It does not mean that the days of discovery on the Moon are completely over; for a small part of its surface (approximately 40° in longitude) was not visible from the Russian space station at the time of photography and remains, therefore, still uncharted. It will, however, certainly not be long before even this remaining terra incognita of the Earth-Moon system will reveal its secrets to the inquisitive eye of the next lunar circumnavigating device, and the pioneer days of lunar mapping will irretrievably belong to the past.

"The volume under review constitutes without doubt an important landmark in selenographic literature, and Pergamon Press is to be commended for the speed with which it introduced it to the English reader. This speed entailed, however, also some obvious drawbacks; for by its external appearance the English edition (printed in Poland) does not come up to the quality of the Russian original; and the translation is decidedly weak - in marked contrast with the professional fluency and manner in which the preliminary report was translated, the year before, by Sykes." (Source: NATURE, Vol. 192, No. 4805, December 2, 1961, p. 839)

Turovtseva, Z. M. and L. L. Kunin, Analysis of Gases in Metals. Consultants Bureau Enterprises: New York, approx. 390 p.

A new book, published in complete English translation by Consultants Bureau last December, treats in detail the theoretical principles, equipment, and methods for determining hydrogen, oxygen, and nitrogen in metals of all groups of the Periodic Table. This book provides a complete survey from which the analyst may choose the best method for the problem at hand.

Using proved thermodynamic data, a rational basis for the design of analytical techniques is formulated. Of particular interest is the vacuum-fusion system developed by Soviet scientists, which utilizes a resistance-heated furnace. The general method of vacuum-fusion for analysis of gases in metals is exhaustively treated, with emphasis given to difficulties encountered in this method with regard to adsorption of metals on layers of volatilized metals. An extensive bibliography (545 references) listing the international literature on methods of gas analysis is appended. (Source: Consultant Bureau Enterprises, BOOK NEWS RELEASE, November 1961)

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(EDITORS' NOTE: Attention is called to an apparent error in the January 1962 edition of SIN concerning the article entitled "The Uses of Rare Elements in Russian Industry." Several elements included in the article are not rare elements according to the Periodic Table. Although the original Russian article called all of the mentioned elements rare, the meaning of rare in all probability referred to the scarcity of these elements. The editors wish to thank those readers commenting on this aspect.)