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No. 432

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1 November 1978

USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

GEOPHYSICS, ASTRONOMY AND SPACE

No. 432

This serial publication contains abstracts of articles and news items from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

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I. OCEANOGRAPHY

News

"CHERNOMOR-3" UNDERWATER LABORATORY TESTED

[Article by Ye. Solomenko: "Man Goes Into the Ocean"]

[Excerpt] Man is striving to penetrate deeper into the ocean. It is necessary to learn thoroughly about the world ocean as being our powerful ally -- a supplier of minerals and food resources, cheap energy and rare chemical elements. Much of this is not a prospect for tomorrow or even the day after tomorrow, because for the time being we still know too little about the "ocean planet." There are too many white spots here. But even today man is penetrating into the ocean, is studying and mastering it.

...This will be simultaneously a house and a laboratory in which it is necessary for researchers to live and work. This includes physicians, geologists and physicists. But the basement of this house will be the sea floor and over its roof instead of the sky will be a layer of water with a thickness of several tens of meters. That's what we have in the "Chernomor-3" -- an underwater biological laboratory for carrying out scientific research and underwater technical work on the shelf. The use of such a structure is approximately 16 times more economical than the work of divers for whom the time required for very slow, gradual floating up and descent frequently exceeds the period of the work itself.

The creators of the floating laboratory are scientists of the Institute of Oceanology USSR Academy of Sciences and the Leningrad Shipbuilding Institute. As follows from the very name, this sealab is the third in the Chernomor family. This third-generation representative in many respects is qualitatively more complex than its predecessors. The depth of its submergence is several times greater (and hence there is a fundamental difference in its entire design). The very dimensions of the "Chernomor" have become much greater. Its crew can now work for an entire month without going to the surface -- not four or five days, as before.

This is the third year that this work has been done by the instructors, engineers and students of the Leningrad Shipbuilding Institute under the scientific direction of a docent in the Department of Ship Theory, Aleksandr Aleksandrovich Bezprozvanniya.

The first important results have already been obtained. Scientists are now investigating the forces acting on the model in the course of its operation. But these forces are distributed and operate in a very unusual way because the configuration of the "Chernomor" is nonstandard.

Next summer plans call for the testing of a large operating model which is outfitted with registry and recording instruments; this model will be 10 times less than the "Chernomor-3" under the real conditions of operation in the Black Sea. The designer of this model was a student (and now a graduate) of the Leningrad Shipbuilding Institute and a USSR champion in ship modeling sport, Anatoliy Lezhnin. If the tests go successfully, the construction of the "Chernomor" itself will begin in 1980.

[35]

Abstracts of Scientific Articles

EFFECT OF LIGHT REFRACTION AND OTHER FACTORS IN STUDY OF UNDERWATER PHOTOS

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 8, 1978 pp 64-69

[Article by I. F. Kushtin, "Allowance for the Multiplicity of Media and Light Refraction in the Processing of Underwater Photographs"]

[Abstract] The article presents formulas for introducing corrections into the coordinates of points on a plane photograph in order to make allowance for the influence of a multiplicity of media when there is an arbitrary spatial arrangement of discontinuities of media with different refractive indices, formulas for the refraction of light rays in a water medium and expressions making it possible to take into account the influence of light refraction in the processing of underwater photographs. It is shown that as a result of refraction the displacements of points on underwater photographs can attain 0.2 mm. The problem of allowance for the refraction of light rays in a water medium must be solved in each specific case in dependence on the state of the water and the accuracy required in photogrammetric work.

[3]

MODELS OF NONSTATIONARILY COUPLED OCEANOGRAPHIC PROCESSES

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA, No 12, GEOLOGIYA-GEOGRAFIYA, Vyp 2, 1978 pp 114-127

[Article by R. G. Grigorkina and Yu. A. Chistyakov, Leningrad State University, "Some A Priori Models of Nonstationarily Coupled Oceanological Processes"]

[Abstract] In this paper the authors formulate the problem of investigations, in the time region, of the peculiarities of nonstationary coupling of oceanological processes and the factors generating them, in several simple models of nonstationary processes which can be assigned to the subclass of determined-nonstationary and random-nonstationary. The determined-nonstationary

category also includes those processes for which the dependence of the statistical characteristics on time is completely known. In random-non-stationary processes the dependence of the statistical characteristics on time is unknown. The results of the investigation revealed that the properties of a whole series of real processes in the ocean (intradiurnal components, currents on the shelf of southwest Africa, intramonthly variations of water temperature in the Kuroshio zone with a tide-generating force, etc.) are described well by the proposed models.

[21]

II. TERRESTRIAL GEOPHYSICS

Abstracts of Scientific Articles

DETERMINATION OF VERTICAL MOVEMENTS OF EARTH'S SURFACE

Budapest ACTA GEODAETICA, GEOPHYSICA ET MONTANISTICA ACADEMIAE SCIENTIARUM HUNGARICAE in English Vol 13, No 3-4, 1978 pp 463-474

[Article by I. Hazay, Hungarian Academy of Sciences, "Adjustment of Levelings for Determining Vertical Movements of the Earth's Surface"]

[Abstract] Consecutive levelings (within a long period of several decades) of the same points provide information on vertical movements of the earth's surface, and if more than two measurements are available the rate of the vertical movement can also be determined. The movements must be known to allow adjustments to be made of leveling networks. However, even more refinement can be obtained by taking the actual accelerations of the movement into account, rather than by assuming a constant rate of movement. The various methods used, in order of historical development and sophistication, are these: 1) simple comparison of the elevation of individual levelings at different periods, 2) use of a leveling network of connected closed polygons, 3) iteration or direct method using two levelings, both being reduced to certain epochs (different from one another) by means of preliminary values determined from the measurements, and 4) a method proposed by the author, which also takes the accelerations into account. The latter method involves a determination of the acceleration, which is mathematically calculated from periodic measurements. Adjustments are proposed to make the results more accurate. Consideration of the accelerations makes the results of measurements of vertical movements more accurate and also reduces the effects of systematic errors in the measurements, so that the differences in the adjusted values from the corresponding measurement results are caused solely by the adjustment conditions employed. The greater is the number of repeated levelings, the more accurate will be the values established for the acceleration. It is proposed to remeasure the accelerations from the third leveling onward prior to the adjustment of a new leveling, using the latest methods in the calculations. Electronic computers may make this practicable. Examples are presented to illustrate the improvements which may be obtained.

[1852/3]

GEODETIC APPLICATION OF DOPPLER SATELLITE OBSERVATIONS

Budapest ACTA GEODAETICA, GEOPHYSICA ET MONTANISTICA ACADEMIAE SCIENTIARUM HUNGARICAE in German Vol 13, No 3-4, 1978 pp 305-324

[Article by F. Halmos, Geophysics and Geodesy Research Institute, Hungarian Academy of Sciences, "Methodological Aspects of the Geodetic Application of Doppler Satellite Observations"]

[Abstract] The author discusses the accuracy of Doppler satellite observations (compensation without orbit determination, by means of simple point determination or translocation; compensation with orbit determination, by means of geodetic position determination using a short orbital arc or translocation using a short orbital arc), the mathematical model of the evaluation (for the geometric method, for the semidynamic method, and the problem of the standard-equation solutions in both methods), and model studies as well as practical results in the processing of data obtained in various observation methods. By optimum procedure under favorable conditions, the mean error may be as little as 0.5-3 meters. The mechanical compensation method using a short orbital arc can be made more accurate by considering the available information about the gravitational field. In geometric compensation the corrections are used for the raw measurement data; in mechanical compensation the correction members are incorporated as unknowns in the compensation model.

[1851/1]

STRUCTURE OF UPPER RИPHEAN IN SOUTHERN URALS

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA GEOLOGICHESKAYA in Russian No 8, 1978 pp 50-60

[Article by Vл. A. Komar, Geological Institute USSR Academy of Sciences, "On the Structure and Stromatolithic Standard Sections of the Upper Riphean (Southern Urals)"]

[Abstract] On the western wing of the Bashkirskiy anticlinorium there are three types of cross sections of the Karatauskaya series (Inzerskiy, Lemezinskiy, Ashinskiy) which differ with respect to the thickness of the individual subdivisions, presence or absence of the Podinzerskaya suite, its structure, and also the composition and nature of distribution of stromatoliths. The spatial distribution of these types of cross sections supports the opinion of the existence here of a system of allochthonous plates. The author demonstrates the presence of lateral facies intertransitions between the lower part of the Inzerskaya and Podinzerskaya (Kislyarskaya) suites, this making it possible to combine them into a single Inzerskiy horizon. The stromatoliths in these standard sections of the Upper Riphean are

concentrated at six stratigraphic levels. Each of these levels is characterized by a certain specific nature of the systematic composition of the stromatoliths, which makes it possible to discriminate the corresponding stromatolithic horizons: Lower Katavskiy, Upper Katavskiy, Lower Kislyarskiy, Upper Kislyarskiy, Minskiy and B'yanskiy. The collected data put in doubt the generally accepted two-level division of the Upper Riphean employed now in paleontology and historical geology.

[577]

DEEP FAULTS OF CENTRAL PART OF SIBERIAN PLATFORM

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA GEOLOGICHESKAYA in Russian No 8, 1978 pp 138-144

[Article by V. A. Vakhrushev, Geochemistry Institute imeni A. P. Vinogradov, Siberian Division USSR Academy of Sciences, "Deep Faults in the Central Part of the Siberian Platform, Their Activation and Mineral Formation"]

[Abstract] A study was made of data on the composition and sequence of deposition of mineral parageneses participating in the forming of skarn-ore bodies for understanding the history of development of deep faults in the Siberian Platform. It was established that there was a repeated manifestation of tectonic activation of deep faults in the Angaro-Vilyuy-skiy ore zone during the period of prolonged formation of iron ore deposits. The conclusion is drawn that the time frames of the Late Paleozoic-Early Mesozoic activation of deep faults of the central part of the Siberian Platform should be expanded at least to the Jurassic inclusive.

[577]

GEODYNAMICS OF GROUND WATER AS TOOL IN EARTHQUAKE PREDICTION

Tashkent UZBEKSKIY GEOLOGICHESKIY ZHURNAL in Russian No 4, 1978 pp 3-7

[Article by A. N. Sultankhodzhayev and I. G. Chernov, Seismology Institute Uzbek Academy of Sciences, "Hydrogeoseismological Precursors of Earthquakes. Variations of Hydrogeodynamic Parameters of Ground Water"]

[Abstract] The article examines the hydrogeodynamic changes in ground water during periods preceding and accompanying earthquakes. Specifically, this paper presents the results of study of excess stratum pressure in borehole No 9 at Ulugbek village, drilled within the limits of the Tashkent artesian basin. The water-bearing horizon is fed from the surrounding mountains and foothills. No water has been drawn from this source since late in 1975, whereas between 1962 and 1975 it was exploited. Excess

stratum pressure was measured using a manometer installed at the mouth of the borehole. The authors give an analysis of the variation in change in stratum pressure, in particular, by examining the pressure gradient. It was found that against a background of a general decrease in excess stratum pressure there were two deviations which coincided with major earthquakes in the region. In both cases from the onset of appearance of an anomaly in the pressure change to the time of the tremor the time lapse was 4.5 months. Thus, against the background of the general dropoff of pressure caused by exploitation of the reserves in the water-bearing horizon there are other pressure variations. These pressure variations are particularly graphic in the temporal variation of the pressure gradient. The gradient changes not only in value, but also in sign. These variations in excess stratum pressure are a result of changes in stresses in the water-bearing horizon as a result of impending earthquakes.

[550]

CONTRADICTION BETWEEN "FIXISM" AND "MOBILISM" CONCEPTS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEOLOGIYA I RAZVEDKA in Russian No 8, 1978 pp 24-32

[Article by V. I. Shevchenko, Institute of Physics of the Earth, "Basic Contradiction Between 'Fixism' and 'Mobilism' in the Example of the Caucasus"]

[Abstract] In present-day geotectonics there are two fundamental alternative theories concerning the structure and development of the earth's tectonosphere -- fixism and mobilism. In this paper an attempt is made to demonstrate that this contradiction between fixism and mobilism is manifested not only on a global scale, but also when one examines such a thoroughly studied region as the Caucasus. It is shown that despite their apparently contradiction, both the fixist and mobilistic concepts (with reference to the Caucasus) are based on definite, entirely reliable, but essentially different factual material. However, none of the testing of these hypotheses against the detailed material presented on the Caucasus region in this article is intended as an objection against the "new global tectonics," but only against application of these ideas to intracontinental geosynclinal-folded regions, such as the Caucasus.

[564]

STRUCTURE OF PRISAKMARSKAYA ZONE OF SOUTHERN URALS

Moscow GEOTEKTONIKA in Russian No 4, 1978 pp 91-98

[Article by M. A. Kamaletdinov and T. T. Kazantseva, Geology Institute, Bashkir Affiliate USSR Academy of Sciences, "Characteristics of Structure of Prisakmarskaya Zone of the Eastern Slope of the Southern Urals"]

[Abstract] The Prisakmarskaya structural-facies zone extends along the eastern slope of the Uraltau Range for a distance of about 400 km and has a width as great as 20 km. The so-called Main Ural Deep Fault can be traced along the western boundary of this zone. A detailed stratigraphic study of this zone has been presented. This study of the cross section of Lower Carboniferous deposits in the zone has demonstrated that the structure of this region is characterized by a monoclinial, rather than synclinal (as is usually assumed) structure. A major overthrust in the basin of the Ziren'-Agach River has been established.

[553]

METHOD FOR DETERMINING CROSS SECTION IN VELOCITY ISOLINES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 8, 1978 pp 65-72

[Article by V. B. Piyp, Geology Faculty, Moscow State University, "Method for Determining the Cross Section in Velocity Isolines from the Travel-Time Curves of Refracted Seismic Waves"]

[Abstract] A study was made of the two-dimensional inverse kinetic problem of seismic prospecting, involving a determination of velocity as a function of two variables (cross section coordinates) on the basis of the known travel-time curves of refracted waves. The solution of this problem is of importance for an interpretation of materials from deep seismic sounding, ore seismic prospecting and in investigations of media with a complex geological structure by the refracted waves method. The method proposed in this article for solution of this problem is as follows: on the basis of two given counter travel-time curves of refracted waves, and employing numerical methods, it is possible to find a homogeneous function of two variables which approximates the unknown velocity field. It is shown that the considered two-dimensional problem can be reduced to a one-dimensional problem and its solution can be obtained employing quite simple algorithms. Quite elementary nomograms are given. The presented method is more resistant to interference than those proposed earlier because it does not require differentiation of the travel-time curves and in addition, provides for the use of some "mean" travel-time curve computed using the direct and counter observed travel-time curves.

[572]

EXAMINATION OF AUTOCORRELATION FUNCTIONS OF POTENTIAL FIELDS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 8, 1978
pp 85-90

[Article by V. N. Glaznev, V. I. Pavlovskiy and A. B. Rayevskiy, Geology Institute, Kola Affiliate, USSR Academy of Sciences, "Autocorrelation Functions of Potential Fields Caused by a Horizontal Layer with a Random Distribution of Sources"]

[Abstract] Statistical methods for the interpretation of potential field anomalies, determined along profiles of a great length, are attracting the attention of a broad range of researchers. But the number of models with a random distribution of field sources for which theoretical and model autocorrelation functions of potential fields are known is extremely limited. This paper is a generalization and further development of work which has been done along these lines. The authors have determined the theoretical autocorrelation functions of anomalous potential fields caused by a random distribution of polar (gravitational) and dipolar (magnetic) sources in a horizontal layer which can be regarded as the most general model of an anomaly-forming object. The paper presents the derivation of expressions of autocorrelation functions of potential fields. It is demonstrated that the autocorrelation function, and therefore the magnetic field itself observed along a profile of great length, is determined primarily by the horizontal dimensions of blocks in the earth's crust, not by its deep structure. For this reason, the most correct approach to interpretation of the magnetic field is a method for determining the dimensions of crustal blocks. The method described here makes it possible to determine the depths to the upper and lower boundaries of a horizontal inhomogeneous layer on the basis of autocorrelation functions.

[572]

MEASUREMENT OF QUASISTATIC MOVEMENTS IN GRAVIMETRIC EXPERIMENTS

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 5, 1978 pp 119-124

[Article by M. G. Smirnov and Yu. A. Shchepetkin, Institute of Automation and Electrometry, Siberian Department USSR Academy of Sciences, "Measurement of Quasistatic Movements of About 10^{-9} m in Gravimetric Experiments"]

[Abstract] This article gives a circuit diagram for a frequency differential sensor of movements with a response threshold $2 \cdot 10^{-9}$ m with a measurement time of 3.33 sec for use in gravimetric experiments. The authors examine the peculiarities of use of this sensor in highly sensitive mechanical systems -- a long-period seismograph, intended for the introduction of corrections into readings of a ballistic gravimeter, and a three-component

accelerometer with a contactless suspension of the inertial element. Figure 1 in the text is a full-page block diagram-circuit diagram which serves as a basis for the detailed discussion of the design and functioning of this device.

[557]

NEW MANIFESTATIONS OF SEISMICITY IN AMUR REGION

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 6, 1978 pp 69-76

[Article by S. I. Golenetskiy, V. V. Nikolayev and A. D. Sarapulov, Institute of the Earth's Crust Siberian Department USSR Academy of Sciences, "New Manifestations of Seismicity in the Upper Amur Region"]

[Abstract] Information on earthquakes in the Upper Amur region, even for the last 15 years, contains gaps. Between 1963 and 1967 the annual publication "Earthquakes in the USSR" contained no reviews of the seismicity of Yakutia, adjoining this region. This article gives a list of earthquakes which was used in the preparation of the full-page map of distribution of epicenters (Fig. 1). On the basis of this map and all other observational data the authors present the best possible review of seismicity for this region. This is followed by a description of the tectonics of the region. It was found that the earthquake epicenters are associated with the zone of the Mongolian-Okhotsk lineament. The characteristics of this lineament and its branches are examined. The conclusion is drawn that there is a quite high seismic activity in the investigated territory.

[561]

EVALUATION OF PARAMETERS OF VELOCITY MODEL OF MEDIUM

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 6, 1978 pp 103-114

[Article by S. V. Gol'din, V. S. Chernyak and D. I. Sudvarg, Siberian Geophysical Expedition, Institute of Geology and Geophysics, Siberian Department USSR Academy of Sciences, "Evaluation of Parameters of a Velocity Model of a Medium Using Data from Multiple Tracing of Reflected Waves"]

[Abstract] The article describes a complex of programs (KING-76) for the kinematic interpretation of data obtained using a system for the multiple tracing of reflected waves in layered-inhomogeneous two-dimensional media. The initial data were systems of travel-time curves or systems of effective parameters obtained for extensive reflecting boundaries of the investigated seismic section. In principle, the initial data can be the results of any algorithms for the discrimination of reflected waves from

seismograms (or a set of seismograms) of any type with an arbitrary parameterization of time fields. The main idea in the proposed solution is optimization, that is, selection of such parameters of the medium which ensure a minimum value of the function characterizing the discrepancy between the theoretical and experimental time fields of all the reflected waves. The search for an initial approximation is accomplished using an iteration process. The complex of programs was developed by the Siberian Geophysical Expedition in collaboration with the Institute of Geology and Geophysics. By the use of the fictitious sources method it is possible to achieve a substantial acceleration of the direct problem. Examples of testing of the complex of programs are cited.

[561]

STUDY OF RESISTIVITY AND DIELECTRIC CONSTANT FOR GEOLOGICAL MAPPING

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEOLOGIYA I RAZVEDKA in Russian No 7, 1978 pp 105-110

[Article by V. A. Sikorskiy, Moscow Geological Prospecting Institute, "Study of Resistivity and the Dielectric Constant for Geological Mapping Purposes"]

[Abstract] One of the most economical electric prospecting methods is that based on a study of the fields of radio broadcasting stations operating in the long- and superlong wavelength ranges. In working by this method it is customary to register the various magnetic components of the radio field, slope of the magnetic vector to the horizon and surface impedance. The possibilities of the method are considerably broadened by making amplitude-phase measurements of surface impedance. When carrying out complex measurements there is still another advantage over other electric prospecting methods -- the possibility of determining both resistivity ρ and also its dielectric constant ϵ . In this paper it is shown that determination of ρ and ϵ makes possible a considerable broadening of the possibilities of the method in geological mapping. A good reproducibility of the measurements is achieved by use of the "Volna" instrument for determining ρ and ϵ . It was found that impedance parameters can be registered even in sectors with poor grounding conditions. The registry of the ϵ parameter made possible not only a more reliable discrimination of lithological rock varieties, but also a high effectiveness of detection of the inundated zone of faults.

[576]

TECTONIC-MAGMATIC ACTIVATION OF TERRITORY OF MONGOLIA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 241, No 6, 1978 pp 1303-1306

[Article by M. Ye. Artem'yev, Yu. S. Genshaft and A. Ya. Saltykovskiy, Institute of Physics of the Earth, "Correlation Between the Most Recent Tectonic-Magmatic Activation of the Territory of the Mongolian People's Republic and the Magnetic Component of the Gravitational Field"]

[Abstract] During recent years much new material has been obtained for the Mongolian People's Republic with respect to the gravitational field, seismicity and volcanism. The territory of Mongolia is characterized by a high degree of seismicity which is nonuniformly distributed over the area of the republic. Figure 1 in the text is a map of the distribution of epicenters, faults, basalts and the mantle regional component of the field of isostatic anomalies. The earthquakes of Mongolia are virtually absent in regions where the mantle anomaly is most intensive, that is, where it is possible to postulate the greatest decrease in viscosity of both the asthenosphere and the lithosphere. Earthquakes gravitate toward zones of well-expressed horizontal gradients of the magnetic anomaly. The presence of an enormous mass of heated material of low density beneath Central Mongolia, extending in the direction of the Baykal rift, explains both the nature of the volcanism superposed on the ancient Caledonian and Hercynian structures, but also some peculiarities of the present-day structure of the earth's crust and the distribution of earthquake foci. The neotectonic activation of Mongolia in the Cenozoic was determined by the dynamics of the anomalous mantle beneath this region. Interaction of movements in the crust and movements in the asthenosphere can explain well the formation of the present-day structure of Mongolia.

[580]

DISTRIBUTION OF EPICENTERS IN LATITUDE AND IN TIME

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 241, No 6, 1978 pp 1307-1310

[Article by Sh. A. Guberman, Institute of Applied Mathematics, "Discrete Distribution of Earthquake Epicenters in Latitude and in Time"]

[Abstract] In earlier studies by the author (DAN, Vol 224, No 4, 1975; Vol 230, No 6, 1976; Vol 230, No 4, 1976) it was demonstrated that: the strongest earthquakes lead to a change in the velocity of the earth's rotation ω ; a change in ω causes perturbations at both poles; these perturbations are propagated along meridians with the velocity $v_D = 0.15^\circ$ per year (D wave); D waves serve as the triggering mechanism for very strong earthquakes and such an earthquake can occur only when two D waves, traveling

toward one another, meet at the epicenter. It is shown that as a result of such a process earthquakes will arise only at latitudes determined by the expression $\varphi_i = (90^\circ/2^n)i$, $i = 0, 1, 2, 3, \dots, 2^n$. The hypothesis was checked using a catalogue of earthquakes in the 20th century. Specifically, the author has checked the hypothesis that earthquakes occur at latitudes 0° , 5.6° , 11.25° , 16.85° , 22.5° , 28.1° , etc. It was found that nine out of ten earthquakes occur in the predicted latitude intervals. If the latitudes of the epicenters were distributed randomly, the probability of such an event would be less than 0.001. For the entire picture as a whole there is a characteristic grouping of the epicenters of earthquakes at some latitudes and a symmetry of the epicenters relative to the equator. Demonstration was obtained that the distribution of epicenters of strong earthquakes in latitude has a discrete character and is determined by a system of D waves. There is also a discreteness of the distribution of strong earthquakes with time. The data analyzed here confirm the existence of a period of 18.6 years for strong earthquakes in Kamchatka and Japan, which conforms to the predicted periods (18.75 and 37.5 years).

[580]

III. UPPER ATMOSPHERE AND SPACE RESEARCH

News

TASS ANNOUNCES LAUNCHING OF "COSMOS-1033"

Moscow PRAVDA in Russian 4 Oct 78 p 2

[TASS Report: "'Cosmos-1033'"]

[Abstract] The artificial earth satellite "Cosmos-1033" was launched in the Soviet Union on 3 October 1978. The satellite was inserted into an orbit with the following parameters:

- initial period, 89.1 minutes;
- apogee, 268 kilometers;
- perigee, 223 kilometers;
- orbital inclination, 81.4 degrees.

Incoming information is being transmitted to the "Priroda" center for processing and exploitation. [5]

[20]

TASS ANNOUNCES LAUNCHING OF EIGHT "COSMOS" SATELLITES

Moscow PRAVDA in Russian 5 Oct 78 p 3

[TASS Report: "Eight Satellites in Orbit"]

[Abstract] On 4 October 1978 the following eight artificial earth satellites were launched by a single booster rocket in the Soviet Union: "Cosmos-1034," "Cosmos-1035," "Cosmos-1036," "Cosmos-1037," "Cosmos-1038," "Cosmos-1039," "Cosmos-1040" and "Cosmos-1041." All of them were inserted into an initial orbit with the following parameters:

- period of revolution, 115.8 minutes;
- apogee, 1,536 kilometers;
- perigee, 1,458 kilometers;
- orbital inclination, 74 degrees. [5]

[24]

TASS REPORTS ON PHOTOGRAPHY OF LUNAR ECLIPSE

Moscow TASS in English 0640 GMT 7 Oct 78

[TASS Report: "Scientific Observations from Orbit"]

[Text] Moscow, October 7, TASS. A total solar eclipse was observed from orbit for the first time ever in the history of cosmonautics. Soviet cosmonauts Vladimir Kovalenok and Aleksandr Ivanchenkov succeeded for the first time in photographing the far side of the moon, which was not illuminated by the sun this time, the newspaper SOVETSKAYA ROSSIYA reported today.

All information has already been transmitted through telemetric channels from on board the scientific orbital complex "Salyut-6"- "Soyuz" to the earth. The preliminary results are of undoubted interest. Thus, in particular, they are to shed light on the nature of the moon's own glow.

And again observations from outer space are made with the use of a unique telescope with a mirror diameter of 1.5 meters. The new telescope is meant for the exploration of many objects, including the coldest ones which simply do not glow in the visible range of the electromagnetic spectrum. Such a "supervision" is ensured through the deep cooling (of down to -269 degrees C) of a sensitive crystal submerged into a bath of liquid helium there. The "eye" of the telescope will be really sharp if it is cooler, for example, than a distant cloud in the Galaxy.

Liquid helium is obtained in orbit by means of a unique small plant, which is actually a whole miniature factory running the on-board power system.

[19]

CHRONOLOGY OF "SALYUT-6" MISSION 8 SEPTEMBER - 2 OCTOBER 1978

[Editorial Report] Moscow PRAVDA in Russian, dated 10 Sep 78 through 3 Oct 78, TASS provides the following information concerning activities on board the manned "Salyut-6" space station:

8 SEPTEMBER

8 September was devoted to medical examinations during which cosmonauts Vladimir Kovalenok and Aleksandr Ivanchenkov wore their "Chibis" vacuum suits in order to study cardiovascular reaction to simulated hydrostatic pressure. Also conducted was a study of vascular tonicity.

According to the results of medical examination, the pulse rate of commander Kovalenok was 77/minute, of engineer Ivanchenkov -- 68/minute; their blood pressures were 130/65 and 135/60 respectively. (PRAVDA 10 Sep 78 p 1)

9 SEPTEMBER

A day of "active rest" for the cosmonauts, 9 September was spent in systematizing experimental results, exercising and resting. (PRAVDA 10 Sep 78 p 1)

10 SEPTEMBER

11 SEPTEMBER

On their 87th day on board the space station, cosmonauts Kovalenok and Ivanchenkov conducted observations of and photographed the earth's surface and its oceans. They also monitored the operation of equipment processing biological specimens and recorded the growth and development of plants being studied on the station.

The orbital parameters of the space complex were as follows:

- period of revolution, 91.3 minutes;
- apogee, 358 kilometers;
- perigee, 333 kilometers;
- inclination, 51.6 degrees. (PRAVDA 12 Sep 78 p 1)

12 SEPTEMBER

13 SEPTEMBER

Having completed their 13th week in orbit, cosmonauts Kovalenok and Ivanchenkov continued to photograph the earth's surface (in particular, areas of Kazakhstan, Central Asia, Siberia, the Baykal, the Far East, European USSR and the Caspian Sea) in accordance with the earth resources program. Throughout the day they also exercised on the bicycle ergometer and comprehensive trainer and conducted the standard operations involved with the biological experimentation program.

Parameters of the microclimate maintained within the station were:

- temperature, 22 degrees C;
- pressure, 790 mm Hg. (PRAVDA 14 Sep 78 p 1)

14 SEPTEMBER

Using the BST-1M submillimeter telescope, the crew conducted measurements of submillimeter radiation in the earth's atmosphere in an effort to refine methods for predicting atmospheric processes. (PRAVDA 16 Sep 78 p 1)

15 SEPTEMBER

Overnight the next in the series of material processing experiments in "Kristall" was conducted.

Throughout the day, cosmonauts Kovalenok and Ivanchenkov made observations of the earth's surface and transmitted information on meteorological conditions to the Flight Control Center.

They also showered, worked with flight documentation and prepared various equipment for upcoming experiments. (PRAVDA 16 Sep 78 p 1)

16-18 SEPTEMBER

For several days cosmonauts Kovalenok and Ivanchenkov were engaged in scientific and technical experimentation. They completed the next series of materials processing experiments in "Kristall," including the Soviet-Czech "Morava" experiment. During the lunar eclipse, they used the BST-1M telescope to study the moon's luminescence in the ultraviolet range and photographed various stages in the eclipse.

18 September was a day of "active rest" during which the crew continued to conduct visual observations of the earth's surface and to monitor their biological research projects.

19 SEPTEMBER

20 SEPTEMBER

Cosmonauts Kovalenok and Ivanchenkov spent their 97th day in orbit engaging in medical self-examinations to determine and predict the condition of their cardiovascular systems. They also checked for vascular tonicity and for the elasticity of muscles not significantly stressed during spaceflight. They used the "Polinom-2M," "Beta," and "Reograf" instruments in the examination.

During the second half of the day, the crew conducted another materials processing experiment in the "Kristall" furnace. (PRAVDA 21 Sep 78 p 1)

21-22 SEPTEMBER

In accordance with the earth resources program, the cosmonauts photographed the earth's surface, including, in particular, the Aral Sea, Central Asia and the Caucasus. Having completed the photography, they put the complex into a gravity gradient stabilized mode to reduce vibration in preparation for the next technological experiment to grow a semiconductor crystal in "Kristall."

Comprehensive medical examinations indicated that the pulse rate of commander Kovalenok was 66/minute, of engineer Ivanchenkov -- 70/minute, their blood pressures were 110/65 and 115/68 respectively. (PRAVDA 23 Sep 78 p 2)

23-25 SEPTEMBER

For several days the "Kristall" furnace was in operation to produce semiconductor materials, including, for example, one composed of germanium, antimony and sulfur.

The cosmonauts monitored the course of the biological experiments conducted on board the space station, carrying out standard operations to ensure the optimum conditions for plant growth and development. Special attention was focused on the arabidopsis being processed in the special "Fiton" ("phyton") chamber. (PRAVDA 26 Sep 78 p 1)

26-27 SEPTEMBER

Using the BST-1M submillimeter telescope on 26 and 27 September, cosmonauts Kovalenok and Ivanchenkov conducted a series of measurements of the atmosphere's submillimeter radiation.

On 27 September they continued their study of the earth's surface, observing the snow cover and glaciers of the Pamirs at the request of Soviet glaciologists. It was their 104th day in orbit. Parameters of the microclimate within the complex were:

- temperature, 19 degrees C;
- pressure, 780 mm Hg.

28 SEPTEMBER

29 SEPTEMBER

29 September marked the end of the first year of the "Salyut-6" mission.

After completing a medical examination, cosmonauts Kovalenok and Ivanchenkov began work with the BST-1M telescope to measure the ultraviolet radiation of a number of stars, including Beta-Centaurus. These studies provide information on the ozone layer of the earth's atmosphere. (PRAVDA 30 Sep 78 p 1)

1 OCTOBER

The crew's day of "active rest" was devoted to housekeeping duties, consultations with specialists on earth resources and rest. (PRAVDA 3 Oct 78 p 1)

2 OCTOBER

Visual observations of the earth's surface continued as did the physical exercise and materials processing. In addition to this work, the crew conducted a check of the station's control systems in both manual and automatic orientation and stabilization modes. (PRAVDA 3 Oct 78 p 1)

All of the TASS statements indicated that the cosmonauts were in good health and that all on-board systems were functioning normally. [5]
[28]

"PROGRESS-4" REPLENISHES "SALYUT-6" STATION

Moscow PRAVDA in Russian 7 Oct 78 p 6

[Article by V. Gubarev: "Meeting Over the Planet"]

[Excerpt] Passenger and freight ships regularly move along the space bridge Baykonur-"Salyut-6" strictly on schedule. Today the "Progress-4" arrived at its destination: the next stage has begun in the flight expedition of Vladimir Kovalenok and Aleksandr Ivanchenkov.

The docking process has been completed, but since the main events -- approach, mooring and checking of tightness of joining -- occurred deep at night and the crew of the "Salyut-6" had to depart from the established daily schedule and be awake, the opening of the hatch into the "Progress" had to be postponed. Therefore, the surprises prepared for the long-dwellers in space by relatives, friends and comrades from the Control Center and specialists at Baykonur, for the time being have not been publicized. But now the nature of the cargo delivered to the "Salyut-6" is known to the crew. There is replenishment of the supplies of film for the motion picture and still cameras, since there has been an intensive expenditure of film during the past month of flight. Finally, the "Progress-4" has brought fuel for the station engines because much fuel has been expended during orbital correction and for orientation of the complex: indeed, the geophysical and astronomical experiments carried out by Kovalenok and Ivanchenkov required that the "Salyut-6"- "Soyuz" flew in a strictly definite position in space.

"This freighter," says K. P. Feoktistov, "carries the most different apparatus and instruments. When the space cargo was made up, I carried out an unusual experiment. I approved all requests from specialists who felt that this or that instrument had to be sent into orbit. The requests were submitted and I did not disapprove them. And now the loading of the 'Progress' began and I thought, 'where will it all go?' But it all did fit, as they say, down to the last item. Our freighter has a very great capacity!"

The course of the flight introduces its corrections into the plans for ensuring reliable operation of the complex. It was proposed that it is necessary to replace the atmosphere within the station; during a year its chemical composition changes greatly, despite the fact that special filters absorb carbon dioxide and different harmful substances. Now it was planned that the "Progress-4" should deliver to the station a supply of fresh air and if the atmosphere is not fully replaced, it might be somewhat renewed. However,

this was not required. V. Bykovskiy and S. Jaehn, returning from orbit at the beginning of September, returned air samples. There was a careful investigation of the chemistry and biology and the "examination" was very rigorous: an analysis was made of all the components in the station's atmosphere -- including the relationship of the elements and presence of bacteria. It was found that the life support system is operating excellently -- the air in the station is normal. And a new set of filters which is to replace the ones now in use is in the freight compartment of the "Progress-4."

[26]

COMMENTARY ON "PROGRESS-4" CARGO

Moscow IZVESTIYA in Russian 7 Oct 78 p 3

[Article by B. Konovalov: "Space Mooring"]

[Excerpt] On the night of 5-6 October the ordinary daily schedule of the "Fotony" was disrupted. Vladimir Kovalenok and Aleksandr Ivanchenkov did not go to sleep: they were making preparations for meeting the automatic emissary from the earth -- the "Progress-4" ship with a cargo of fuel, food and equipment.

When Valeriy Bykovskiy and Sigmund Jaehn returned to earth we asked them what the "Fotony" were expecting, what they asked be sent.

"Mail, onions, garlic and a little more meat," said the "Yastreby."

All this and much more is being delivered to them by the "Progress-4." It carries letters from relatives and friends, newspapers, including a special issue of IZVESTIYA, for the crew of the "Salyut-6," surprise packages from Zvezdnyy Gorodok, Baykonur, from the Flight Control Center, and about 50 kg of food products specially requested by the cosmonauts. In the concluding stage of the flight the "Fotony" manifested a particular craving for meat and they ate an above-normal amount of baby sausages, beef tongue, a favorite kind of sausage and sublimated beef. The long-dwellers in space find it extraordinarily useful to have foods containing much potassium: they have been sent sublimated curds with strawberries, walnuts and fresh milk. There are also special treats -- strawberries with sugar, their beloved fruit sticks, two large boxes of candy.

The "Progress-4" is loaded with many things whose need is dictated by the unusual duration of the flight. The cosmonauts have somewhat worn out their clothing and shoes. Some rubber strands on the "Pingvin" suits have broken due to intensive use. These suits bend the cosmonaut's body and thereby force the muscles to work in order for the cosmonaut to remain in a normal position. Aboard the "Progress-4" there is a set of new "Pingvin" suits

for creating a physical load for the crew.

The "Fotony" note that their feet are freezing. Under weightlessness conditions the blood flows from the legs and flows toward the head. Therefore, the crew is taking advantage of the popularity of the short fur "untyata" [boots]. These boots have now been sent along together with socks, linen and inserts for sleeping bags.

The "Agidel'" electric shavers have worn out somewhat and the earth is sending new ones. The crew has a new magnetic recorder with a large supply of new tapes. So the assortment of concert programs aboard the ship is being renewed.

A special order from the crew was for photographic and motion picture films. A favorite occupation of the "Fotony" is the photographing of interesting phenomena on the earth's surface and in the atmosphere. They have an entire arsenal of cameras, there are nine of them, and during their free time they photograph the most different phenomena: unusual cloud formations, auroras, glaciers and annular structures on the continents. All this requires different films, with different sensitivities, and the "Progress" affords an excellent possibility for replenishing the supplies.

But, to be sure, a large part of the freight compartment was occupied by fresh components of the life support system, different kinds of instrumentation, tools for repair and preventive maintenance work, new "food" for the "Splav-01" and "Kristall" technological furnaces. The creators of the "Salyut-6" used the "Progress-4" to send special screens so that the sections of the station could be isolated from one another for creating calm, quiet "corners."

In general, the crew has to move a lot of cargo, but they have experience. Although the "Fotony" have already received two freighters, the station is not "loaded with furniture." It has been possible to distribute all the articles successfully. They are also coping with the new flow of cargo.
[27]

COMMENTARY ON PLANT GROWTH UNDER WEIGHTLESSNESS CONDITIONS

Moscow PRAVDA in Russian 5 Oct 78 p 6

[Article by R. Fedorov: "It is not Easy to Grow Without Life"]

[Text] "Aboard the complex biological experiments are continuing for the purpose of studying the development of plants under conditions of prolonged space flight."

What stands behind this sentence in a TASS communication from the Flight Control Center? Why does gravitational biology, arising in the era when man began to inhabit a world without gravity, space, include plants among its subjects.

Why is it that in an era when man has begun to inhabit a world without gravity, space, plants are included among the experimental objects? After all, they are capable of growing even in infertile clay and in freshly dumped soil, or like birches, they can take root in slits between the bricks of old structures, so why is gravity necessary? Without it, it will probably be even easier...

In space answers are being sought to terrestrial questions.

Leaves of grass grow upward. The branches of trees extend toward the sun. This is true even of birches if you look at their crowns. But from the lower levels of the crown thin twigs with leaves hang down almost to the ground.

Bionics, calculating the loads, arrived at the conclusion that "weeping" forms are more rational: a tree, in order to spread its crown, expends less strength in such cases. After all, with dilatation any material supports a considerably greater load than during compression. But it is interesting that the branches do not hang due to the influence of their own weight. These weeping forms have been "programmed" in advance: look at the ends of growing sprouts -- the linden strives to thrust them upward, whereas from the very beginning the ones for the birch droop downward. The two examples show that trees are not indifferent to the direction of gravity. This is understood even more graphically if one observes a group of sprouting pea plants. Whatever might have been the initial orientation of the seeds, the roots extend downward and the stems extend upward.

But is it possible that gravity is not involved at all? Is it simply that the roots head down into the soil, into the nutrient medium, whereas the sprouts with the leaves head in the opposite direction? Already in the last century botanists sowed seeds in pots placed on a centrifuge. The plants extended out precisely along the vector summing the effect of the forces of terrestrial gravitation and the centrifugal force. Further investigations led to the discovery in rootcaps and the growing tips of stems of special cells similar in structure to the organs of equilibrium of invertebrates -- statocysts.

On this basis a theory has been advanced of the perception of gravity by a plant: under its influence the relatively heavier starch grains floating in the "sensing" cells move. Their pressure irritates the cell cytoplasm along some wall and the plant determines whether it is orienting its growth properly.

And how is this "feeling" transformed into specific action? How is the curvature of a stem directed upward or the curvature of a root directed downward? The search for an answer led first to the discovery of chemical regulators, growth hormones, auxins, produced by the tips of the sprouts, and then to the formulation in the 1920's of a hormonal theory of directed growth: it transpires primarily in those parts of the organism to which the auxins are transported.

It is interesting to examine two equal groups of germinating seeds, one of which was obtained in a world of gravity, whereas the other is from a world of weightlessness. In the first case, sprouted green stems stand, like at attention, in a line parallel to one another; in the second case they extend out randomly in different directions and neither the ends of the stems nor the roots know in what direction they should go. Every sprout seems to be frozen in a posture of perplexity. Experiments with the clinostat were continued for many days in a row. And these experiments invariably indicated that after two weeks most of the plants had died...

From the beginning of space flights it became possible to carry out biological experiments under weightlessness conditions. The "Salyut-4" carried the "Oazis" apparatus which was used for the cultivation of peas under conditions of already "prevailing" weightlessness. The "Salyut-6" carried containers with onions which were cultivated with artificial illumination. Each onion plant produced up to 14 pinnate leaves. In other instruments there was a greening of arabis, a plant which is known in many laboratories throughout the world. It was grown by means of a special apparatus.

For the cosmonauts the botanical experiments are of more than scientific interest.

"It pleased us to fuss around with the plants," recalls a flight participant, Hero of the Soviet Union, USSR Flier-Cosmonaut Petr Klimuk in his notes. "With one glance at them our hearts grew lighter..."

It is easy to visualize the disappointment of the cosmonauts when their green charges began to wilt...

"Death after two or three weeks of presence in space or in a clinostat shows that gravity is evidently necessary for plants," notes Al'fonas Ionovich. For the time being, unfortunately, it is not clear to us what abnormalities in the course of their development are caused by weightlessness. This will have to be clarified."

In addition to the theoretical side, there is also a practical side: in the opinion of specialists in the field of space biology, green plants are a necessary link in a closed life support system, which will invariably be necessary in the future on long-lived stations, or, shall we say, on interplanetary space flights.

In order to create the necessary conditions on such stations it is important to know the gravitational sensitivity of plants. As follows from the experiments in the clinostat, it is not entirely mandatory that the gravity be the same as on the earth. The threshold value of the gravitational stimulus is thousandths of terrestrial gravity. It is only necessary to rise a little above the threshold and this will be adequate for the plants to develop normally. But this assertion must still be checked in space.

These two theories supplement one another and both have been widely accepted by scientists. But the problem still is by no means completely exhausted. Much remains unclear.

Al'fonsas Ionovich Merkis, now Academician of the Lithuanian Academy of Sciences and Head of the Plant Physiology Laboratory of this academy, developed an interest in this theory long ago. His candidate's dissertation was devoted to chemical methods for contending with the falling down of cereals. At first glance is this not a geotropic reaction? A striving of the stem to grow in a direction opposite the force of gravity? In all probability the responsible factor is the low strength of the straw, which at times cannot withstand the weight of the forming ears. However, grains also fall down in early stages of development, especially when there is a great moistening of the soil after rains. In this case the plant freely recovers its vertical position. The stem node begins to grow intensively in its lower part and thereby raises the straw.

It is interesting that the greater or lesser strength of the geotropic reaction is an inherited characteristic. At the same time, an important role is also played by external circumstances. We can note that an excess of nitrogen fertilizers favors the laying down of grains, but a combination of high doses of these fertilizers with a definite quantity of phosphorus and potassium fertilizers corrects the situation.

These and other dependences discovered by scientists are of considerable interest for practical work. They put into the hands of agriculturalists the keys to plant control. It becomes possible to slow down or speed up the growth process.

However, while having the keys in their hands, scientists do not know the design of the lock, the internal picture of the processes transpiring in a green plant. On the contrary, the collected facts make it necessary for researchers to answer new questions.

"We long thought: why does a plant grow upward? And we understood that we still do not know why it grows at all." In such a paradoxical form A. I. Merkis summarized the status of research in this field.

These two questions are inseparable. It is all the more interesting to learn whether a green organism can develop in the absence of terrestrial gravitation.

Botanists attempted to create a world without gravity for their charges even when space flights were still a fantasy. Test tubes with plants were placed in a clinostat. Although this apparatus does not create weightlessness, its effect is produced. The plant continuously turns relative to the direction of gravity and gravitational irritation does not succeed in attaining a threshold value which is capable of inducing a response reaction of the organism.

It is also of great theoretical interest to continue experiments for the cultivation of different crops under weightlessness conditions. After two or three weeks they possibly will also perish, but in the course of these days they live! This means that the seeds carry the capability of for some time getting by without gravity. What accounts for this? It is very important to know the answer.

Today gravitational biology is accumulating facts. After all, for precise conclusions it is necessary to have data from repeated experiments. With an increase in the duration of orbital flights there will be a considerable multiplication of the possibilities of research, making it possible to penetrate into many still unsolved secrets of the living organism.

[25]

TASS ANNOUNCES LAUNCHING OF "COSMOS-1042"

Moscow PRAVDA in Russian 8 Oct 78 p 1

[TASS Report: "'Cosmos-1042'"]

[Abstract] The artificial earth satellite "Cosmos-1042" was launched in the Soviet Union on 6 October 1978. The satellite was inserted into an orbit with the following parameters:

- initial period, 89.3 minutes;
- apogee, 326 kilometers;
- perigee, 187 kilometers;
- orbital inclination, 62.8 degrees.

[30]

TASS ANNOUNCES LAUNCHING OF "MOLNIYA-3" COMMUNICATIONS SATELLITE

Moscow PRAVDA in Russian 14 Oct 78 p 3

[TASS Report: "'Molniya-3'"]

[Text] In order to ensure systems of long-range telephone and telegraph communication and transmission of USSR Central Television programs to points in the "Orbita" network, on 13 October 1978 a "Molniya-3" communications satellite was launched. The satellite has an on-board repeater apparatus providing for operation of the system in a centimeter wave range.

The satellite was inserted into an orbit with:

- apogee, 40,825 kilometers in the northern hemisphere;
- perigee, 467 kilometers in the southern hemisphere;

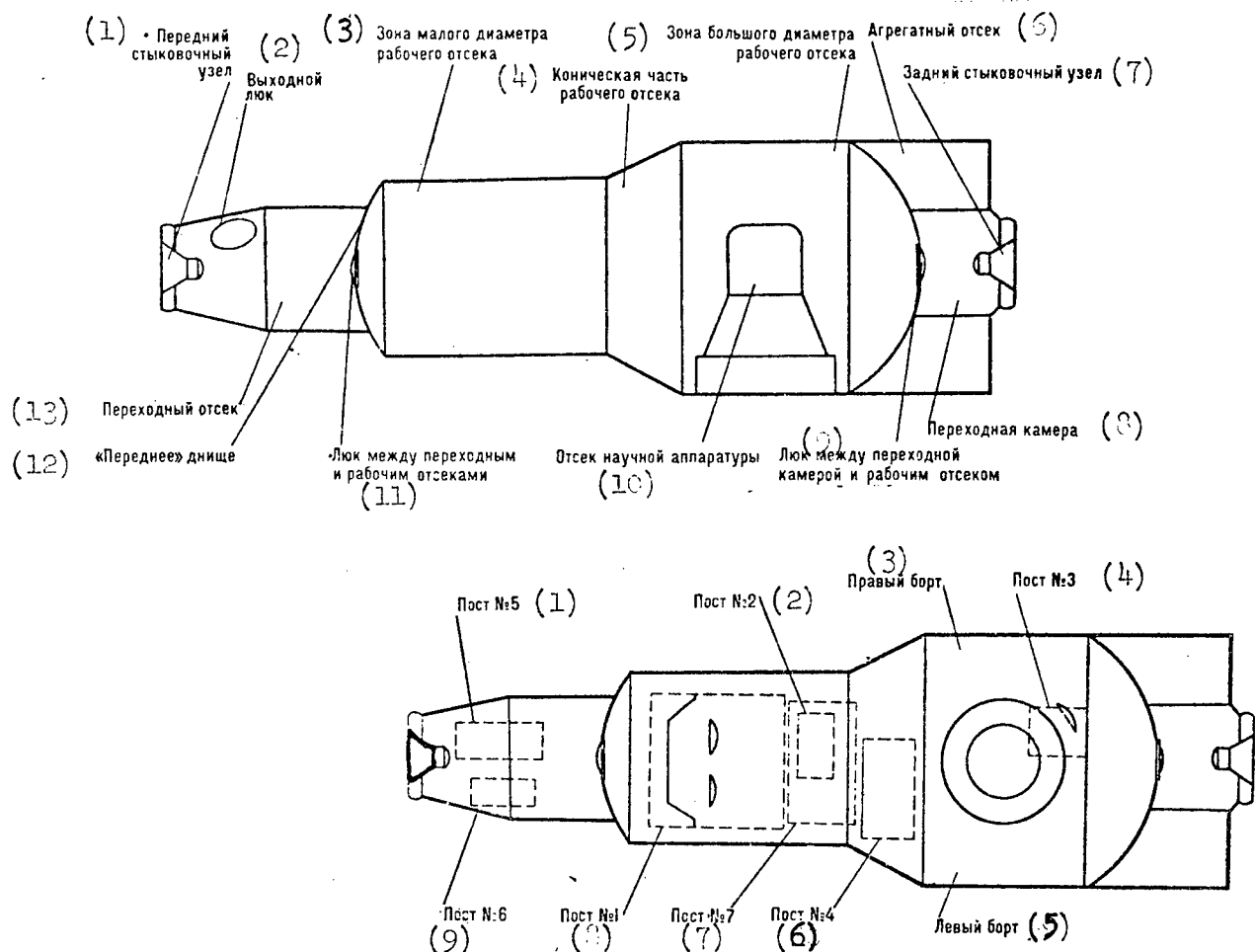
- period of revolution, 12 hours 16 minutes;
- orbital inclination, 62.8 degrees.

Communication sessions using the "Molniya-3" satellite will be conducted in accordance with the planned program. [5]
[31]

BLOCK DIAGRAMS OF "SALYUT-6" STATION

Moscow ZEMLYA I VSELENNAYA in Russian No 5, 1978 p 10

[From article by L. G. Alekseyev, Yu. S. Pavlov and K. P. Feoktistov: "The 'Salyut-6' Orbital Station"]



KEY TO FIGURE I. "SALYUT-6" STATION COMPARTMENTS

1. Forward docking unit
2. Exit hatch
3. Work compartment -- narrow section
4. Work compartment -- conical section
5. Work compartment -- large section
6. Equipment (assembly) bay
7. Aft docking unit
8. Transfer chamber
9. Hatch between transfer chamber and work compartment
10. Compartment holding scientific equipment
11. Hatch between transfer and work compartments
12. "Forward" end plate
13. Transfer compartment

KEY TO FIGURE II. DISTRIBUTION OF WORKING POSTS IN STATION (view from above)

1. Post No 5 ("astropost": orientation controls; communications post)
2. Post No 2 ("astropost": orientation controls -- for astrophysical research)
3. Right side
4. Post No 3 (control post for BST-1M submillimeter telescope)
5. Left side
6. Post No 4 (control post for biomedical equipment and for the station's camera)
7. Post No 7 (bicycle ergometer)
8. Post No 1 (central command post)
9. Post No 6 ("astropost")

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[23]

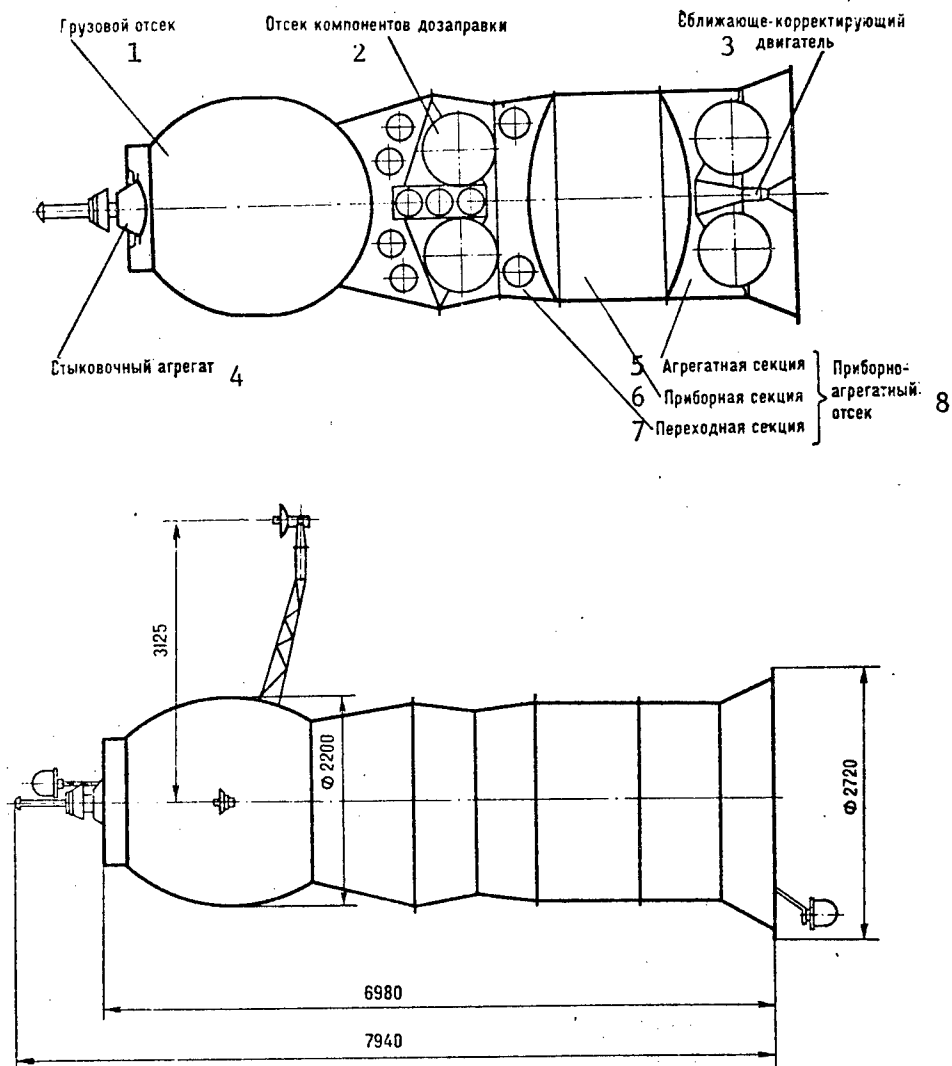
STRUCTURE OF "PROGRESS-1" TRANSPORT SHIP DESCRIBED

Moscow ZEMLYA I VSELENNAYA in Russian No 5, 1978 pp 13-16

[Article by L. I. Ivanov, Yu. S. Pavlov and K. P. Feoktistov: "Space Freighter"]

[Excerpt] Ship structure. There are three principal compartments: cargo compartment with a docking unit, compartment with refueling compartment and instrument-assembly compartment. These make up the "Progress-1" freighter. The name of each of them speaks for itself: all the cargo delivered to the station is placed in the cargo compartment and the compartment for refueling components, whereas the instruments and assemblies of the on-board

systems are placed in the instrument-assembly compartment.



Key:

1. Cargo compartment
2. Compartment for refueling components
3. Approach-correcting engine
4. Docking unit
5. Assembly section
6. Instrument section
7. Transfer section
8. Instrument-assembly compartment

TOP: Structural diagram of "Progress-1" ship

BOTTOM: Principal dimensions of "Progress-1" (in mm)

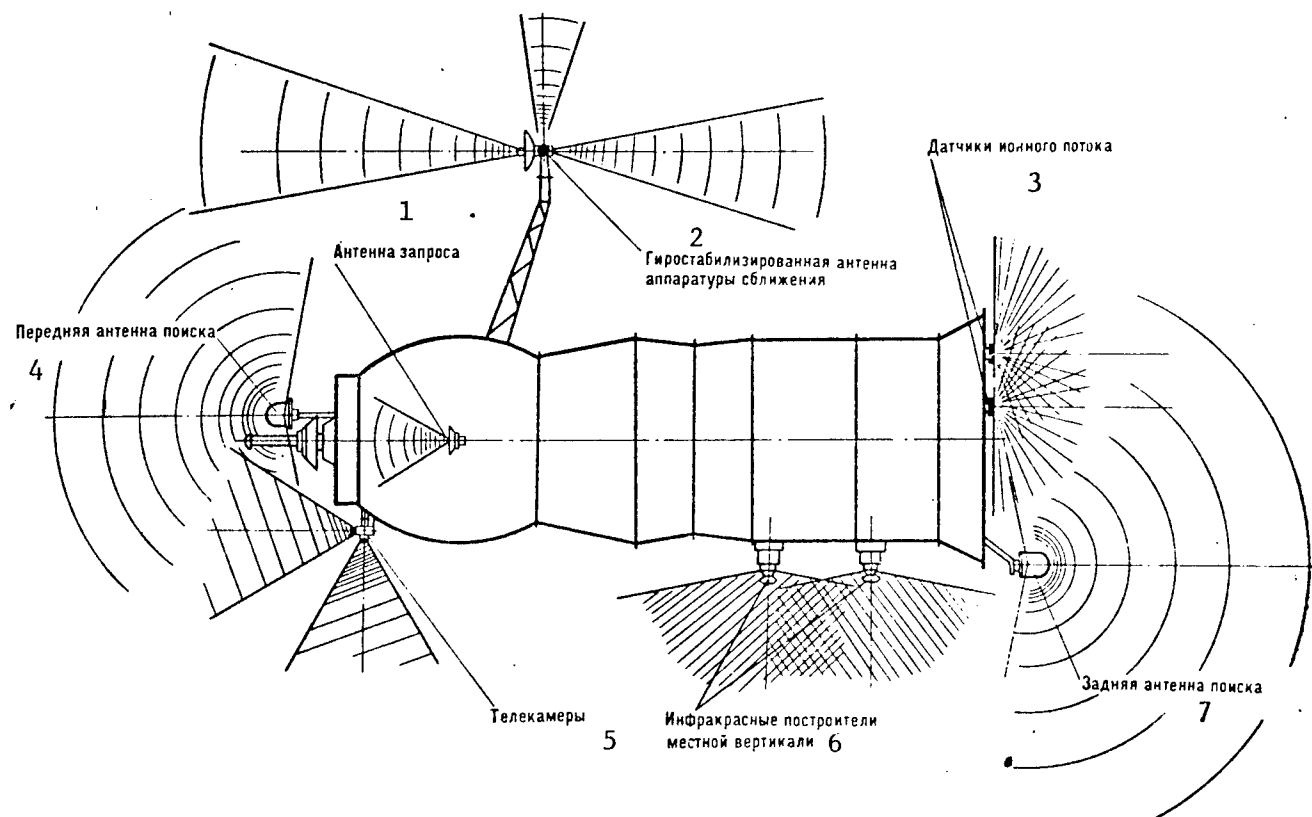


Diagram of fields of view of antennas, approach equipment and sensors in the "Progress-1" ship control system.

Key:

1. Interrogation antenna
2. Gyrostabilized antenna for approach apparatus
3. Ion flux sensors
4. Frontal search antenna
5. Television cameras
6. IR erectors of local vertical
7. Rear search antenna

The cargo compartment is sealed. It consists of hemispherical thin-walled shells connected by a cylindrical insert. In the forward part of the compartment there is a docking unit with an inside hatch. At the opposite end there is an annular shaft which connects the cargo compartment to the compartment with the fuel components. In order to reduce the time spent on unloading and for convenience in transfer all the small freight is placed in containers, whereas the large equipment and instruments are placed in special frames. The containers, in turn, are secured to this framework. It must be said that the "space fastenings" differ considerably from those

used on the earth. You can recall how many times it is necessary to turn a bolt in order to unscrew it from any automatic machine part. On the "Progress-1" it is sufficient to turn the head of the bolt by only a quarter turn.

A man can easily fit into the cargo compartment of the "Progress": the volume of the compartment is 6.6 m^3 , atmospheric pressure is "terrestrial": 760 mm Hg, and the temperature is also completely acceptable -- from 3 to 30°C .

The docking unit of the "Progress-1" differs only a little from its forerunner -- the assembly on the "Soyuz" ship. In connection with the specific problems to be solved, additional automatic hydraulic locks have been introduced for tightly joining the hydraulic lines of the system on the freighter used in the refueling process and the hydraulic lines of the station's engine. The docking unit hatch can be opened automatically and manually.

The compartment for the refueling components is not sealed. It consists of two thin-walled shells having the configuration of a truncated cone connected by the bases. One shell is attached to the cargo compartment and the other is attached to the instrument-assembly compartment. Within the compartment for the refueling components there are four tanks with fuel, cylinders with compressed air and nitrogen, sensors, signaling devices and other components of the system for refueling with fuel and gas. A temperature from 0 to 30°C is maintained within the compartment.

The instrument-assembly compartment has three sections: transfer, assembly and instrument sections. The first two in design and makeup of the equipment are similar to the same sections of the "Soyuz" ship. The volume of the instrument section has almost been doubled.

On the outer surface of the freighter there are numerous antennas of the radioelectronic systems, optical instruments, sensors, and the engines of the orientation and control systems. In order for the crew and specialists at the Flight Control Center to be able to monitor approach, mooring and docking, there are also three light indices (lights) and two television cameras. The axis of the field of view of one camera is directed along the longitudinal axis of the ship, whereas the second axis is directed perpendicularly.

Freighter Systems

The on-board systems of the freighter are similar in purpose to the same systems on the manned "Soyuz" ship. The only exceptions are the refueling and air supply systems.

The programming-timing apparatus, radioelectronic systems, electric supply systems, docking system and internal transfer section were taken from the "Soyuz" ship with very small improvements. The orientation system and the

system for the control of motion, as well as the system for control of the on-board complex substantially changed as a result of appearance of new, completely automatic control regimes and in connection with the necessity of increasing the reliability of their operation. The system for orientation and control of motion, together with the controlling jet engines and the approaching-correcting apparatus, spatially orients the freighter, maintains a stipulated orientation over a long period of time and ensures the possibility of a change in orientation regimes. With a high accuracy it measures the velocity increment during engine operation and sends a command for its shut-down, and finally, together with the radioelectronic apparatus used in approach is responsible for the approach and mooring of the ship to the station. The approach radioelectronic apparatus, due to its complexity, is an object of special concern to designers. In the segment of approach of the ship and station it determines the parameters of relative motion and transmits them to the computer in the control system. It differs from the same apparatus on the "Soyuz" in that information on the approach is transmitted with its assistance to the "Salyut" as well. Therefore, the crew of the orbital station can check on the approach of the freighter.

The approach of the ship to the station is assisted by controlling jet engines -- 14 engines for mooring and orientation, each with a thrust of 10 kg, and 8 precise orientation engines, each with a thrust of 1 kg. They operate on a single-component fuel.

The correcting engines are fired during the forming of an "assembly orbit," the approach of the ship to the station. When the flight program is executed and the ship is separated from the station they return it to the dense layers of the atmosphere.

An electric supply system is necessary for operation of the ship's on-board systems. Since reference is to a d-c current, the freighter carries storage batteries (the group includes six units) and sensors for monitoring the supply of electric current.

The battery capacity suffices for the "Progress" to fly for four days. After docking with the orbital station the obligation for supplying electricity to the freighter is imposed on its electric supply system. At the same time, a charging of the storage batteries on the freighter takes place.

The heat regime within the ship is maintained by a heat-regulating system. Its passive means -- screening-vacuum heat insulation and different coatings on the external surfaces -- reduce to a minimum the unregulated heat exchange between the ship and the surrounding space. The active means make it possible to take heat from internal sources and redistribute it within the ship, and the excess is scattered into surrounding space. Here is how this occurs. The heat from the apparatus is transmitted to the air circulating in the instrument compartment. Circulation is forced, by fans. The

heated air in the gas-fluid heat exchanger is cooled by the fluid in the hydraulic system. The heat regime of some instruments is ensured directly by the fluid in the hydraulic system, passing through channels situated in these instruments. Pumps ensure circulation of the fluid. The excess heat from the hydraulic system is transmitted to the surface of an external radiator from which it is scattered into surrounding space.

The fueling system ensures checking of the tightness of the lines after joining of the hydraulic systems of the ship and station, transportation of fuel and oxidizer, scavenging and vacuum cleaning of the fuel lines after termination of the fueling. It also includes a system for replenishing the station atmosphere through the cargo compartment and hatch. If for any reason the crew cannot itself be engaged in refueling, this is therefore done by specialists at the Flight Control Center (the system can also be operated automatically by commands from the earth).

On earth it is always important to know the position of the ship, to transmit control commands to the ship and receive signals on their implementation, to receive information on the state and operation of the on-board systems, and receive information from the television cameras. For this purpose the ship is outfitted with a complex of radioelectronic systems. The programming-timing apparatus sends commands in a stipulated sequence to the ship's systems during the time of the flight. On the automatic freighter this is the principal control method when carrying out dynamic operations.

Finally, the system for control of the on-board complex. It ensures interaction between the on-board systems and assemblies in the case of control from earth and from the station's control panels and redistributes the electric energy between users.

As already mentioned, in the creation of the "Progress-1" ship plans called for the maximum use of instruments, assemblies or construction parts of the "Soyuz" ship. This was done, but in general the "Progress" turned out to be different. In connection with other objectives and the flight program, the new refueling system, the design of the compartments, electric and pneumohydraulic layouts of the systems were to all intents and purposes all new. Prolonged ground testing of the on-board systems and construction and the use of instruments and assemblies which have undergone tests on the "Soyuz" ship made it possible to combine two tasks -- delivery of cargo to the "Salyut-6" station and the first flight tests of the systems and constructions of the new freighter.

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NOTES ON USE OF BST-1M TELESCOPE IN SPACE

Moscow PRAVDA in Russian 10 Oct 78 p 3

[Article by A. Salomonovich, L. Dul'kin and B. Chemodanov: "Light Invisible to the Eye"]

[Abstract] For the first time a large telescope with detectors sensitive to submillimeter radiation has been mounted on the Soviet orbital station "Salyut-6." This is the BST-1M telescope with a diameter of 1.5 m. In order to receive very weak radiation it is necessary to cool the detectors to temperatures close to absolute zero. As long as the observations are brief it is possible to use for this purpose a cryostat which is filled with liquid helium. This was the technique used by the scientists of the Physics Institute USSR Academy of Sciences who carried out the "Obzor" ["Scanning"] experiment aboard the artificial earth satellite "Kosmos-669" in 1974. However, for long-lived orbital stations such a cooling method is really infeasible because the cryostat cannot long retain liquid helium. Therefore, a special cryogenic system was developed for the BST-1M. This is one of the peculiarities of the telescope created through the joint efforts of the specialists of the Physics Institute USSR Academy of Sciences and workers in Soviet industry. The dimensions of the "Salyut-6" dictated the use of a main mirror with an extremely short focal length, of the projector type, and the sensing detectors of radiation had to be placed behind it in a special chamber. The fluxes of rays focused by the objective enter into this chamber by means of a special projection system. The information received by the telescope is transmitted through the telemetric system to ground receiving stations. The programming-command apparatus makes it possible to vary the operating regimes, and in particular, to change the filters. The system for autonomous control of the telescope, in combination with the systems for orientation of the station, makes it possible to point and hold the instrument axis in a stipulated direction or scan a definite sector of the celestial sphere. The submillimeter radiation gives information which cannot be obtained by other means as to what occurs within well-developed cloud systems. The BST-1M is designed for prolonged work. It can be switched on over the most interesting regions of the earth and during the worst weather conditions. The crew will actively participate. For example, by pointing the telescope the crew can simultaneously photograph and visually evaluate emitting objects in the atmosphere. The telescope has still another peculiarity which is of practical importance. Using an additional receiving channel, sensitive to UV radiation in the ozone absorption band, it is possible to obtain information on the ozone layer of the atmosphere. On 16 September the cosmonauts V. Kovalenok and A. Ivanchenkov measured lunar UV glow during the time of a lunar total eclipse. The processing of the results of this experiment has already begun. Exoatmospheric astronomy requires on-board telescopes of different types. For their creation it is necessary to know how astronomical instruments behave on orbital stations. Experience with the prolonged use of the BST-1M will undoubtedly be a useful step to long-range orbital observatories of the future.

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Abstracts of Scientific Articles

RADIO WAVE FLUCTUATIONS AND TURBULENCE OF CIRCUMSOLAR PLASMA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 241, No 3, 1978 pp 555-558

[Article by M. A. Kolosov, O. I. Yakovlev, V. I. Rogal'skiy, A. I. Yefimov, V. M. Razmanov and V. K. Shtrykov, Institute of Radio Engineering and Electronics, "Investigation of Radio Wave Fluctuations and Turbulence of Circumsolar Plasma in Radio Probing Experiments Using the 'Venera-10' Vehicle"]

[Abstract] The radio probing of circumsolar plasma using the "Venera-10" vehicle was carried out during the period April-July 1976 using a frequency of 928 MHz. The angular distance between the center of the sun and the vehicle during the time of the research varied from 15° to 0.6° . In the experiments a study was made of fluctuations of amplitude, frequency and change in the energy spectrum of radio waves with different values of angular distance ψ . These data are used in determining the characteristics of circumsolar plasma. The investigation of amplitude fluctuations, for example, indicated that for angular distances $\psi > 12^\circ$ there were weak fadings with a "depth" of less than 10%. With a decrease in the distance between the line of sight and the sun the depth of fadings increases and when $\psi = 5^\circ$ it attains a maximum value (about 50%). When $\psi < 4^\circ$ the fluctuations become saturated and their intensity is virtually not dependent on ψ . The different parameters of radio waves analyzed in the study characterize different parts of the spectrum of inhomogeneities of circumsolar plasma and thus supplement one another. Analysis of frequency fluctuations thus gives information on large-scale inhomogeneities with dimensions $8 \cdot 10^2 \text{ km} < l < 5 \cdot 10^4 \text{ km}$. Amplitude fluctuations describe smaller-scale inhomogeneities: $80 \text{ km} < l < 400 \text{ km}$. An analysis of the form of energy spectrum wings makes it possible to establish the behavior of the characteristics of inhomogeneities with still lesser dimensions $l \approx 5-80 \text{ km}$. It was possible to determine the velocity of the solar wind for different distances from the solar wind by two methods.

[549]

SIMULTANEOUS VARIATIONS OF GALACTIC COSMIC RAYS AND LEVEL OF RADIO NOISE

Budapest ACTA GEODAETICA, GEOPHYSICA ET MONTANISTICA ACADEMIAE SCIENTIARUM HUNGARICAE in English Vol 13, No 3-4, 1978 pages not indicated

[Article by G. Satori, Geodetics and Geophysics Research Institute, Hungarian Academy of Sciences, "Interpretation of Simultaneous Variations of Galactic Cosmic Rays and the Level of Atmospheric Radio Noise"]

[Abstract] The author discusses the computation of ionization caused by galactic cosmic rays, the calculation of the electron density from the ionization profiles, the attenuation of VLF electromagnetic waves in the earth-ionosphere waveguide, and the effect on attenuation from changes in electron density. The daytime level of atmospheric radio noise at European receiving locations is produced by discharges at altitudes 1,000-2,000 km. The Forbush effect and a geomagnetic storm cause only slight differences from the undisturbed values, but at the same time the level of atmospheric radio noise increases. Thus, at a given geomagnetic latitude an increase in the radio noise level is caused not only by a decrease in the cutoff rigidity, but also by other effects that appear. One such effect may be an aftereffect. The geomagnetic field affects attenuation, especially in the case of propagation toward the east and west. This effect decreases as the magnetic inclination approaches the vertical, that is, at higher latitudes.
[1852/3]

ANGULAR RESOLUTION OF SPARK DETECTORS FOR COSMIC GAMMA RADIATION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 16, No 4, 1978 pp 614-618

[Article by V. N. Andreyev, V. A. Bezus and Yu. V. Ozerov, "Angular Resolution of Spark Detectors of Cosmic Gamma Radiation"]

[Abstract] The results of computations of the angular accuracies of detectors of high-energy gamma radiation by the Monte Carlo method are given. The computations were made for energies of gamma quanta of 50, 100 and 200 MeV. It was found that the limiting angular accuracy for detectors in which the energies of the components of the pair are not determined separately is 0.8° for an energy of gamma quanta 100 MeV. In the case of a precise determination of the energy of these components this value is reduced to 0.3° . The introduction of sampling of events with respect to the angle of aperture of an electron-positron pair somewhat increases the angular accuracy of the detectors.
[548]

SOUND GENERATION IN NONADIABATIC ATMOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 18, No 4, 1978 pp 598-602

[Article by A. G. Shagalov, Ural Polytechnic Institute, "Sound Generation in a Nonadiabatic Ionosphere"]

[Abstract] A study was made of the generation of sound by thermal sources whose instantaneous intensity is dependent on sound perturbations. The pulsation of sources in this case is no longer a necessary condition for the generation of sonic waves. It is demonstrated in this article that in a nonadiabatic ionosphere there can be an acoustic instability leading to the generation of sonic waves in a broad spectral range. The dependence of the intensity of thermal sources on the sound perturbations generated by them is rather frequently encountered under ionospheric conditions. Such sources are current streams, the Joule heat release in which is dependent on conductivity, and accordingly, on sound perturbations of medium density. Other sources can be heating of the ionosphere by injected particles, whose absorption is proportional to the density of the medium, non-isothermicity of plasma, etc. A condition for the appearance of an acoustic instability in a nonadiabatic gas is the existence of a positive feedback between perturbations of parameters of the medium in a sonic wave and heat release fluctuations. The feedback is ensured by the developing sonic wave, exerting an influence on heat release processes and regulating the transfer of energy of the thermal source into the energy of sound oscillations. The limit of instability and amplitude of the generated waves is determined.
[555]

DOUBLY CHARGED MOLECULAR IONS IN AURORAL IONOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 18, No 4, 1978 pp 652-655

[Article by S. V. Avakyan, State Optical Institute, "Doubly Charged Molecular Ions in the Auroral Ionosphere"]

[Abstract] The invoking of Auger processes for solution of a number of problems in the physics of the upper atmosphere makes possible not only a substantial refinement of the spectra of photoelectrons, but also a study of the possibility of the existence in the ionosphere of a new class of particles -- doubly charged molecular ions N_2^{2+} and O_2^{2+} . In the mass spectrometer experiments on rockets and satellites the peaks relating to such ions coincide with the peaks from N^+ and O^+ . Therefore, before allowance for Auger processes the existence of exoatmospheric N_2^{2+} and O_2^{2+} ions was not suspected. This article analyzes the possibility of appearance of such ions in auroras and an attempt is made to compute the intensity of their optical emission. The author assumes that the principal channel for

their formation and excitation is through the Auger effect, accompanying ionization of the inner shell of atoms and molecules by electron collision (auroral flux of electrons). It is shown that below 150 km in the auroral zone the principal mechanism of formation of N_2^{2+} and O_2^{2+} is Auger processes.

[555]

FORMATION OF ELECTRON CONCENTRATION INHOMOGENEITIES IN E LAYER

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 18, No 4, 1978 pp 731-733

[Article by Yu. A. Ignat'yev, Gor'kiy Radio Physics Institute, "One Mechanism of Formation of Electron Concentration Inhomogeneities in the E and E_s Layers"]

[Abstract] The author discusses the formation of electron concentration (N) inhomogeneities at the altitudes of the E region, taking into account redistributions of charged particles within the limits of a turbulent eddy in the presence of a geomagnetic field. The study is an application of wind shear theory to clarification of the formation of inhomogeneities due to small-scale wind structures. The mechanism described in this paper explains the experimentally observed fact that the inhomogeneous structure of the E_s layer is more strongly developed than the inhomogeneous structure of the E region. In addition, the linear dependence $N' \sim N_0$ makes it possible to explain the frequently observed linear dependence of the frequency parameters of the E_s layer, $f_{0E_s} \sim f_{bE_s}$. This is attributable to the fact that with a sufficiently great range of transparency of the E_s layer, $\Delta f = f_{0E_s} - f_{bE_s}$, the limiting frequency f_{0E_s} is determined by the intensity of scattering on inhomogeneities and the screening frequency is determined by the concentration N_0 in the sporadic E layer.

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