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10 June 1977

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# USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

## GEOPHYSICS, ASTRONOMY AND SPACE

No. 399

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II

JPRS 69236

10 June 1977

# USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

## GEOPHYSICS, ASTRONOMY AND SPACE

No. 399

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

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# I. ASTRONOMY

## News

### REPORT ON NEUTRINO ASTRONOMY INVESTIGATIONS

Moscow IZVESTIYA in Russian 10 March 77 p 5

[Article by Academician V. Ginzburg, Corresponding Member USSR Academy of Sciences G. Zatsepin and Academician M. Markov, "What Neutrinos Tell Us"]

[Summary] A method for the study of neutrinos has been proposed by specialists at the Neutrino Astrophysics Laboratory of the Nuclear Research Institute USSR Academy of Sciences and the principles of its technology have been developed in collaboration with a number of other institutes. The method is based on the use of a gallium target-detector. Nuclei of the isotope gallium-71 absorb neutrinos with an energy exceeding 0.2 million electron-volts. These are transformed into nuclei of germanium-71. By determining the number of atoms of germanium-74 forming in the target it is possible to measure the neutrino flux. The measurement results are not dependent on details of solar structure and are precisely predictable, provided that the sun in actuality is a gigantic thermonuclear reactor and assuming that the neutrinos do not change their properties on the path between the sun and the earth. A positive result of such an experiment would put all of modern stellar astronomy on a solid basis. A negative result would force a radical re-examination of present-day concepts. In the USSR plans call for the creation of both a chlorine-argon apparatus of considerably greater sensitivity than that existing in the United States and a gallium-germanium apparatus. In the USSR there are no sufficiently deep shafts for such apparatus and therefore a room for a neutrino observatory is being created in Kabardino-Balkariya in the Northern Caucasus under a mountain into which a drift is being constructed. In order to solve the solar neutrino problem as quickly as possible everything must be done to accelerate contruction work. It is necessary to obtain from industry approximately five tons of gallium per year in order to create a gallium-germanium apparatus in a short time. In the course of the experiment the rather expensive gallium is preserved virtually intact. It is felt that the speedy termination of construction of the neutrino station of the USSR Academy of Sciences and the creation

of neutrino telescopes should be regarded as one of the most important and promising projects planned in the USSR. The sun will not be the only object of investigations in neutrino astronomy. Plans are already being drawn up for the registry of neutrinos from the flares of supernovae occurring in the modern epoch and also for the creation of neutrino telescopes capable of glancing into the early epochs of formation of galaxies.
[365]

NEW METHODS IN ASTROMETRY DISCUSSED

Moscow PRIRODA in Russian No 7, 1976 pp 112-119

[Article by N. S. Blinov, Physics Faculty, Moscow State University, "New Methods in Astrometry"]

[Abstract] A crisis has arisen in classical astrometry. Or it might be said that there is only a serious period of transition in which some classical methods are gradually being replaced by new methods for obtaining astrometric information. Modern astrometry can be divided into meridian and photographic astrometry and into a time and latitude service. This article, a review of the state of the art, appraises the strengths and inadequacies of each particular aspect of the problem. There are three new tools being introduced into astrometry which are bringing the field up to the level where it can solve problems at the modern level: use of radiointerferometers with superlong bases, use of laser instruments and use of the optical gyroscope. The author discusses the principle of operation of each of these tools and their present and future usefulness. But there are great difficulties to be resolved. For example, the use of radiointerferometers and laser rangefinders is enormously expensive, much apparatus is required and many highly trained personnel are needed. [The article is accompanied by a series of classical astrometric instruments: meridian circle and astrograph of the State Astronomical Institute and zenith telescope and transit instrument of the time and latitude service.]
[332]

Abstracts of Scientific Articles

PREDICTING FLARES USING MAGNETIC FIELD DATA

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 2, 1977
2A141

[Abstract of article by Dzh. Dzh. Lemmon; Moscow, NABLYUDENIYA I PROGNOZ SOLNECH. AKTIVNOSTI, "Mir," year not stated, pp 333-339, "Prediction of Flares from an Indirectly Observed Magnetic Field"]

[Text] The author investigated the correlations between the flare activity of active regions and the parameters of magnetic fields. The flare activity of an F-active region is determined in the following way: each flare is taken with a weight corresponding both to its classification by number and maximum luminosity. The products of these two factors for all flares observed in a specific active region in the course of some time interval are summed. For example, $_{24}F$ (the flare index for a 24-hour period), etc. A study was made of three magnetic field parameters: the first parameter is the number N of points of inflection of the neutral line in an active region selected for evaluating the magnetic complexity of the region; a second parameter, $\Delta B/\Delta S$, is a measure of the horizontal gradient of the longitudinal magnetic field and is determined as the ratio of the field strength of the most powerful spot in the region to the minimum distance from the center of the umbra to the closest neutral line; a third parameter is the rate of change of the horizontal gradient of the magnetic field. These parameters were found for 12 active regions on the disk for the period 25 October 1968 through 15 November 1968. During this time there were more than 250 flares. The results are presented in graphs. Due to the obvious usefulness of the N parameter for predicting flare activity predictions were made in real time for all active regions on the disk during the period from 18 January to 18 February 1970. The capability of this unique parameter for predicting flare activity indicates quantitatively a close correlation between the complexity of configurations of magnetic fields and the flare "potential" of active regions. The considered prediction model stimulates the creation of a simple model which will make it possible to predict the times of occurrence of solar flares. Bibliography of 4 items.
[390]

OBSERVATION OF PREFLARE CURRENT LAYERS ON SUN

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 3, No 3, 1977 pp 133-137

[Article by S. I. Syrovatskiy, Physics Institute USSR Academy of Sciences, "Possibilities of Observing Preflare Current Layers on the Sun"]

[Abstract] The possibilities for timely detection of a preflare situation on the sun are discussed. The existence of a current layer over a relatively long time before a flare makes it possible to predict not only the very fact of a flare, but also with certain parameters of the layer, such important characteristics of a flare as its intensity and total energy release. Now it is possible to use three methods for seeking and investigating preflare current layers in the solar atmosphere. The most complete information on structure of the current layer in principle could be obtained from measurements of the magnetic field at different levels in the chromosphere and in the corona. This requires reconstruction of the potential magnetic field in the solar atmosphere on the basis of its known sources in the photosphere for the purpose of finding the zero points and limiting lines in the region in which the current layers arise. For such reconstruction it is sufficient to determine the radial component of the magnetic field at some level in the lower chromosphere. It is necessary to measure the longitudinal magnetic field simultaneously at different levels in order on the basis of deviation of the field from a potential field to establish the presence and spatial distribution of electric currents in the solar atmosphere. It is necessary to measure the total vector of the magnetic field at one or more levels with the same purpose of finding currents in the solar atmosphere. With respect to the use of observations in the UV range, the energy flux in the C, O, Si lines from a powerful current layer can exceed by several times the flux in these same lines from the undisturbed sun. With respect to radioastronomical observations, at wavelengths $\lambda > 10$ cm the layer can be seen as a cold formation in the corona. On the other hand, at wavelengths $\lambda < 10$ cm the layer can be hotter in emission than the undisturbed atmosphere. The effect of a decrease in brightness temperature at $\lambda > 10$ cm and its increase at $\lambda < 10$ cm can be used for finding current layers on the sun.
[25]

## II. METEOROLOGY

### News

### FEATURE ARTICLE ON WEATHER CONTROL

Moscow KHIMIYA I ZHIZN' in Russian No 11, 1976 pp 25-30

[Article by Yu. S. Sedunov, "First Successes in Weather Control"]

[Abstract] This recent article presents, on a popular level, some materials on different aspects of artificial control of weather and climate. No effort is made at detail and no pretense is made at completeness; the author's objective is to give some indication that man is in fact making progress about weather control. For example, with respect to creating artificial precipitation, it is noted that in the United States clouds over mountains have been seeded for inducing greater quantities of snow and the snowfall in these cases has been 10-15% greater. In the USSR work of this type is carried out in a special meteorological polygon near Dnepropetrovsk. It has been found that over a great lowland area it has been possible to increase precipitation by 10-20%. Also in the USSR the Forestry Ministry RSFSR has four special aerial groups for seeding clouds over forest fires and considerable successes have been obtained. On an international scale, a major experiment is to be carried out under the auspices of the WMO for increasing precipitation over a large area (10,000 square kilometers). The USSR has offered experts, aircraft, rockets and other help for implementing this project. In the Soviet Union significant successes have been achieved in hail prevention. In the Crimea, Moldavia, Caucasus and Central Asia antihail services are safeguarding more than 4.5 million hectares of valuable farm crops. Losses from hailfalls have been reduced by a factor of 4-5 in these areas. The USSR is now giving technical assistance in this field to such countries as Switzerland and Bulgaria. The Moscow, Minsk and Alma-Ata airports are now equipped with generators of crystallization nuclei used in dissipating fogs, for clearing of the airstrips, but the Civil Aviation Ministry still has not introduced this method into everyday practice. Other methods exist for this same purpose. An example: in France fog is dispersed by heated air directed onto the airstrip from a system of gas turbine engines. On the other hand, in the USSR clouds are being created in the Lake Sevan area by use of the "Supermeteotron" apparatus, a system of gas turbine engines which send

aloft a stream of warm air which can generate well-developed clouds. Even in the case of control of such enormous natural forces as hurricanes, some successes have been achieved, as suggested by the American seeding of a hurricane in 1969 when the wind velocity, at least for a time, was evidently reduced by one-third. Another way to modify weather is by modifying the underlying surface. An example of this is the application of surface-active substances to the water, thus making it possible to prevent cold season fogs in such places as in the port of Murmansk.
[246]

## REVIEW OF STATE OF SOVIET LONG- AND SHORT-RANGE FORECASTING

Moscow NAUKA I ZHIZN' in Russian No 1, 1977, pp 88-102

[Article by V. Tyrin, "Weather and the Weather Gods"]

[Abstract] In this review, written at the popular level, Academician G. I. Marchuk, Director of the Computation Center Siberian Department USSR Academy of Sciences, tells of the state of the art of long-range forecasting in the USSR. Russian studies indicate the point of departure is a study of cloud cover, which in its variability governs the nonuniform solar heating of the world ocean in the tropics. If during some period the cloud cover is less than the usual norm corresponding to the climate of a particular region, the surface layer of water is heated more strongly than usual and accumulates a considerable quantity of heat, especially if clouds do not appear for many weeks. Ocean currents, especially the Gulf Stream and Kuroshio, transport heated water to the north and south where the waters meet with cold air and there is intensive heat exchange between the ocean and the atmosphere. The air, heated by the ocean, interacts with the adjacent cold air masses of the polar regions and this leads to the formation of powerful atmospheric disturbances of the cyclonic and anticyclonic type which the planetary air flow of the temperate latitudes draws to the east, onto the continents, creating zones of warming there. The continents are also heated by the sun and impart their heat to the atmosphere, causing substantial weather changes. But this factor is not operative for long and is of importance for predicting weather for not more than a month. The opposite occurs when cloud cover in the tropics is above the norm. This in the long run results in cooling of the continents. These processes transpire slowly, at the rate of the ocean currents, and so strong heating of the tropical ocean is manifested in the weather approximately after a season, that is, after three months. This simple model is complicated by a whole series of factors and variables which Marchuk discusses in the article. At any rate, the "atmosphere-ocean" system is the real "weather god" on the earth. [Note: About half the article is devoted to a description of the methods of short-range forecasting in the USSR and the state of the art.
[281]

## Abstracts of Scientific Articles

### ASYMPTOTIC SOLUTIONS OF PROBLEM OF CUMULUS CLOUD DEVELOPMENT

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 233, No 4, 1976 pp 571-574

[Article by A. S. Kabanov, Institute of Experimental Meteorology, "Spatial and Temporal Asymptotic Solutions of the Problem of Cumulus Cloud Development"]

[Abstract] The author examines the problem of the development of a cumulus cloud forming under the influence of convective movement transporting moisture upward through an inversion layer. The purpose of the study was to determine asymptotic solutions for axially symmetric nonstationary convection and defining the conditions of applicability of these solutions for describing the development of a cumulus cloud above the inversion layer, where the wind gradient is equal to zero, the temperature gradient is dry-adiabatic and where the specific humidity is assumed to be constant and less than its value in the case of saturation in the entire region where convection is investigated. An expression is derived for liquid-water content which makes it possible to determine a number of mesoscale properties of cumulus clouds. The maximum of the liquid-water content is on the cloud axis above the level where vertical velocity is maximum. Convection shifts the liquid-water maximum and the cloud boundary upward. It is possible to determine the time when the feeding of the cloud with moisture through the inversion layer has ended to the time of cloud disappearance and the maximum area of projection of the cloud onto the horizontal plane.
[39]

### MODELING OF ELECTRIFICATION OF THUNDERSTORM CLOUDS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 232, No 5, 1977 pp 1046-1048

[Article by N. S. Shishkin, M. A. Khimach, G. A. Chikirova and T. A. Pershina, Main Geophysical Observatory, "Modeling of the Process of Electrification of Thunderstorm Clouds"]

[Abstract] In 1970 one of the authors of this article expressed the hypothesis (N. S. Shishkin, DAN, Vol 192, No 2, 1970) that a condition for the transition of a cloud into a thunderstorm state is an intensification of the ionization of air due to coronal discharges between the charged particles of precipitation (rain, graupel, hail) entering a cloud. The charge adequate for the appearance of coronal discharge is acquired by the precipitation particles as a result of coagulation with cloud droplets during the charging of the latter due to the adsorption of atmospheric ions under ordinary conditions of air ionization due to cosmic rays and radioactivity. This new paper gives the results of laboratory experiments for studying the charging of a fog in the region of coronal discharges between falling charged droplets and a fixed well-insulated droplet and the charging of large liquid or freezing droplets in the flow of a droplet fog receiving a charge in the coronal discharge region. The experiments were carried out in a special chamber measuring 18·18·18 cm. The authors conducted 364 series of experiments with measurement of the size and charge of 1,623 droplets, among which 76% were charged negatively and 24% positively. The experiments are briefly described. The results of these experiments modeling the electrification of particles in thunderstorm clouds confirm the hypothesis formulated by Shishkin in 1970.
[288]

## III. OCEANOGRAPHY

### News

### REVIEW OF JOINT OCEANOGRAPHIC ASSEMBLY

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1977 pp 121-125

[Article by Academician L. M. Brekhovskikh]

[Abstract] A Joint Oceanographic Assembly was held in Edinburgh during the period 13-24 September 1976; 700 oceanographers from 40 countries were in attendance and the Soviet delegation was headed in this case by Academician L. M. Brekhovskikh. The work was broken down into six general and a great many special symposia. The author briefly reviews what in his opinion are the most important results presented in such sections as history of the oceans, circulation in the ocean and life in the sea, natural variability in the sea, man and the sea, and new methods in oceanic research. The only report of a Russian specialist mentioned was a paper by N. M. Voronin. He examined the problem of dividing the habited medium of the World Ocean into communities associated with definite large-scale circulations. The Scientific Committee on Oceanic Research (SCOR) held elections at the assembly and Ye. N. Fedorov of the USSR was elected president. Present at the port of Leith and open for inspection of participants were the research vessels "Akademik Vernadskiy" (USSR) and "A. Penck" (GDR). The USSR reports at the assembly showed that Soviet scientists have achieved considerable successes in study of the dynamics of the ocean, in the methods and results of hydrophysical experiments. The assembly as a whole revealed that these have demonstrated great achievements in study of the ocean, especially in the field of deep drilling and paleooceanography, the carrying out of large-scale physical experiments, investigations of dynamics of the ocean, large-scale use of new equipment in marine geology, biology and chemistry.
[20]

NOTES ON THE "CHERNOMOR" UNDERWATER VEHICLE IN BULGARIA

Moscow ZEMLYA I VSELENNAYA in Russian No 1, 1977 pp 72-74

[Article by V. P. Nikolayev and V. G. Yakubenko]

[Abstract] In June 1973 the "Chernomor" on board the steamer "Andizhan" was transported from Novorossiysk to Burgas and on 2 July the scientific research vessel "Akademik L. Orbeli" towed the "Chernomor" from Burgas to Cape Maslen (Burgasskiy Okrug, Bulgaria). For the first time along the shores of Bulgaria (and for the 19th time in its existence) the "Chernomor" was placed on the sea floor on 7 July 1973. A Bulgarian-Soviet crew worked underwater for 16 days. On 12 July 1974 the "Chernomor" again was lowered to the floor on its 20th mission. The sealab was serviced by the "Akademik L. Orbeli." Whereas in the first case the commander had been a Russian, the second, Bulgarian-Soviet-German expedition was headed by a Bulgarian, G. V"ychanov, who heads the Underwater Research Laboratory of the Institute of Marine Research and Oceanology Bulgarian Academy of Sciences. The sea floor near the "Chernomor" was transformed into a sort of laboratory with all kinds of instruments for measuring the underwater characteristics. For example, above the sea surface one could see a 22-m mast which was set up on the bottom with instruments for registering the state of the sea surface and its influence on the underwater light regime. There were instruments of several types for registering currents, mounted on special suports. The direction and variation of velocities in the bottom layer were registered. An underwater TV apparatus was tested. The TV videocontrols were situated aboard the "Akademik L. Orbeli." A string of thermocouples on the bottom registered the temperature gradients. The principal purpose of work under the "Chernomor" program was formulating a method for underwater research and obtaining new scientific information on biology, lithodynamics and hydrophysics of the coastal zone of the sea. Medical-physiological information on man under water was obtained. Under the direction of E. Atsev, chief of the Central Laboratory for Cerebral Studies of the Bulgarian Academy of Sciences, specialists made complex neurophysiological and neuropsychological investigations. It was found that the first and most important shifts in the human body under water develop at the level of the nervous system and the process of man's adaptation to high pressure is drawn out and during three weeks of underwater life of aquanauts this process is still not completed.
[356]

## Abstracts of Scientific Articles

### AUTOMATIC CONTROL OF MOTION OF UNDERWATER TOWED SYSTEMS

Leningrad IZVESTIYA VUZOV, PRIBOROSTROYENIYE in Russian Vol 19, No 12, 1976 pp 34-39

[Article by O. S. Popov, O. A. Leont'yev and B. V. Bruslinovskiy, Leningrad Electrical Engineering Institute, "Automation of Control of Movement of Underwater Towed Systems"]

[Abstract] Underwater towed systems can supply effective measurement data only when there is a precise regime of motion of the apparatus. Manual control of motion of such towed apparatus is inadequate. The different methods for the designing of control systems are considered. The authors then propose a method for the synthesis of systems for the control of motion of such apparatus. The structural diagram for such a system is proposed and a typical example of transient processes in controlled spatial motion is presented.
[245]

### HEAT BALANCE OF UPPER LAYER OF OCEAN

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 1, 1977 1V116

[Abstract of article by A. A. Gruglov; Moscow, TRUDY GIDROMETEOROL. N.-I. TSENTRA SSSR, No 182, 1976, pp 71-76, "Evaluation of the Advective Component of the Heat Balance of the Upper Layer of the Ocean"]

[Text] The author analyzes data from hydrometeorological observations carried out on the fourth voyage of the scientific research vessel "Georgiy Ushakov" in the Atlantic Ocean near the boundary of the Gulf Stream and the Sargasso Sea during the period 11-20 June 1973. The article notes the considerable variability of the thickness and temperature of the upper homogeneous layer of the ocean, attaining 20 m after 2 hours and 1.2° after six hours respectively. The authors estimate the horizontal advection

of heat by currents $Q_a$ in the layer 0-50 and 0-100 m by two methods: 1) from the equation of the heat budget for the considered layer $Q_a = \Delta Q_{hc} - Q_{hb}$, where $\Delta Q_{hc}$ is the change in the heat content of the layer in six hours, determined from two successive records of the vertical temperature profile; $Q_{hb}$ is the total heat flux through the ocean surface, computed using data from standard meteorological observations; 2) direct computation using the formula $Q_a = \rho c(V \cdot \Gamma_{tw})$, where $\rho$ and c are the density and specific heat capacity of sea water; V is the mean (for six hours) measured vector of horizontal current velocity in the layer; $\Gamma_{tw}$ is the mean (for five days) horizontal gradient of temperature of the ocean surface. According to estimates, in the region of observations horizontal advection in the upper 100-m layer of the ocean can exceed by an order of magnitude the heat exchange through its surface, attaining 300 cal/cm$^2$·hour and therefore is an important factor determining temperature variability at time scales of about a day.
[276]

DIGITAL APPARATUS FOR MEASURING PARAMETERS OF SEA CURRENTS

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 1, 1977
1V26

[Abstract of article by A. N. Paramonov, V. M. Kushnir, S. I. Golovin and M. V. Ivanchik; Sevastopol', MOR. GIDROFIZ. ISSLED., No 1(72), 1976, pp 104-109, "Some Results of Field Tests of a Digital Apparatus for Measuring the Parameters of Sea Currents"]

[Text] Joint measurements of currents were made from a drifting ship ("Akademik Kurchatov," 21st voyage) and on a long-operating buoy station (on the same voyage) using the DISK apparatus (Marine Geophysical Institute Ukrainian Academy of Sciences) and the BPV-2 current meter under conditions of relatively stable flows. The measurement apparatuses were attached to the cable of a hydrological winch in a DISK-BPV series with a spacing of 2.5-3 m; the duration of registry was eight hours, discreteness was 30 sec and 5 min respectively. Buoy placement was at a depth of 200 m, operating duration of the station was 500 hours, spacing of the instruments under water was 7-9 m, discreteness of the records of the BPV was 30 minutes and for the DISK it was 5 minutes. It was found that the mean square differences between the readings of the instruments for a velocity of 2.7 cm/sec for a direction of 6.5° approximately correspond to the resolution of the BPV-2. Measurements with the buoy coincided only on the average; for the part of the spectrum with periods $\leqslant$ 3 hours the details of the records differed considerably; this was probably caused by the different design of the instruments and their great vertical spacing. In comparison with the BPV-2, the DISK instrument has a greater recorder capacity (registry for 60 days at five-minute intervals). Provision is made in the DISK for the automatic processing of data

and identical averaging for 35-40 sec using both measurement channels. The electronic and mechanical units of the DISK instrument in 600 hours of operation demonstrated a high reliability in the case of great temperature differentials and vibrations. The DISK instrument is briefly described.
[276]

## SMALL-SCALE TEMPERATURE INHOMOGENEITIES IN BALTIC SEA

Moscow OKEANOLOGIYA in Russian Vol 17, No 2, 1977 pp 214-220

[Article by I. D. Lozovatskiy, Institute of Oceanology, "Investigation of Small-Scale Temperature Inhomogeneities in the Southern Part of the Baltic Sea"]

[Abstract] As a result of a statistical analysis of measurements of the vertical temperature profiles in a series of 130 soundings carried out each three minutes the author obtained the characteristics of the spatial-temporal variability of the elements of fine structure of the temperature field under conditions of strong stable stratification characteristic for summer in the southern part of the Baltic Sea. In particular, an examination of the interrelationship between the gradients of small-scale fluctuations and the mean gradients of the temperature field made it possible to conclude that there is a predominating influence of internal waves in comparison with vertical turbulent exchange on the formation of microstructural inhomogeneities of the T(z) profile.
[71]

## DIFFUSION OF IMPURITY IN FLOW WITH FINITE-SCALE VORTICITY

Moscow OKEANOLOGIYA in Russian Vol 17, No 2, 1977 pp 227-231

[Article by G. A. Gol'dberg, Institute of Biology of the Southern Seas Ukrainian Academy of Sciences, "Diffusion of Impurity in Flow with Finite-Scale Vorticity"]

[Abstract] A study was made of the problem of determining the influence of current vorticity on the process of propagation of an impurity in the sea. A model of this process is proposed within the framework of the semiempirical theory of turbulent diffusion. In this model the vorticity is taken into account using the final segment of its Fourier expansion in space coordinates. The behavior of dispersion of the spot of impurity with time is divided into a series of phases. The characteristic periods of existence of these phases are evaluated through the energy and scale of vorticity and the coefficient of turbulent diffusion. The form of the dependence of the effective diffusion coefficient on the scale of the phenomenon,

in particular, the range of scales at which the "4/3" law is applicable, is also related to these parameters. The author indicates a qualitative agreement of the results with observations of propagation of an impurity in the coastal zone of the sea.
[71]

EQUATORIAL CURRENTS IN INDIAN OCEAN DURING MONSOON

Moscow OKEANOLOGIYA in Russian Vol 17, No 2, 1977 pp 181-190

[Article by V. G. Kort, Institute of Oceanology, "Equatorial Currents in the Indian Ocean During the Northeast Monsoon"]

[Abstract] On the basis of large-scale observations of the system of equatorial currents in the Indian Ocean the author has examined the peculiarities of their deep structure (multinuclear nature of deep easterly transfer). An analysis is made of the nature of the spatial and temporal variability of equatorial currents and their dependence on the system and regime of winds over the ocean. It is shown that in the velocity field of the equatorial currents in the Indian Ocean there are local regions of increased and reduced velocity which are caused by hydrodynamic factors, to wit: in the zones of convergence of meridional flows nuclei are formed which have a maximum velocity, whereas in divergence zones regions with a reduced velocity of zonal currents are formed. The analysis indicated that this pattern qualitatively always exists. The principal reason for this regime of the meridional components of the velocity vector of deep easterly transfer is evidently the orographic conditions of the region associated with the meridional strike of abyssal ridges (Arabian Sea-Indian Ocean, Maldive and East Indian Ocean Ridges).
[71]

VARIABILITY OF OCEANOLOGICAL CONDITIONS IN KUROSHIO REGION

Moscow OKEANOLOGIYA in Russian Vol 17, No 2, 1977 pp 200-206

[Article by V. P. Pavlychev, Pacific Ocean Scientific Research Institute of Fisheries and Oceanography, "On the Interannual Variability of Oceanological Conditions in the Kuroshio Region"]

[Abstract] The author gives an analysis of the peculiarities of the geographical circulation of waters on the Pacific Ocean side of the Japanese Islands on the basis of data collected by specialists of the Pacific Ocean Scientific Research Institute of Fisheries and Oceanography during the years 1971-1975. The displacement of the Kuroshio axis at 144°E in a

northerly direction is associated with an intensification of the current (correlation coefficient 0.91). According to data from a spectral analysis the spatial fluctuations of the current axis along the southern shores of Japan occur with a period of 7.5 years. In accordance with this pattern, in the transition period of 1975-1976 a cyclonic meander was formed in this region. In March 1976 the Kuroshio axis at 137°17'E was situated at 31°N, that is, 180 miles from the shores of Honshu Island.
[71]

## MARINE SPECTROMETRIC GAMMA SURVEY DISCUSSED

Moscow OKEANOLOGIYA in Russian Vol 17, No 2, 1977 pp 295-304

[Article by V. V. Kostoglodov, Institute of Oceanology, "Principal Methodological Problems in a Sea Spectrometric Gamma Survey"]

[Abstract] The article describes some of the most important methodological problems involved in a sea gamma-spectrometric survey governed by the specific nature of the continuous measurements and the peculiarities of the object of the investigation (sea floor). The author analyzes the correlations between such parameters of a gamma survey as "depth effectiveness," "scanning radius," sensitivity, etc. and the height at which the gamma radiation detector is situated above the surface of the sediments. The cited dependences and the computed values of the parameters of the gamma survey can be used in practical work. Calibration measurements make it possible to establish a direct relationship: spectrometer readings - content of radioactive elements and the properties of the sediments. However, the interpretation of the results of a gamma-spectrometric survey without the use of additional data on sediments is ambiguous even for the simplest measurement conditions. Specific procedures for solution of the inverse problem in a gamma survey are dependent on the purpose and nature of the investigations.
[71]

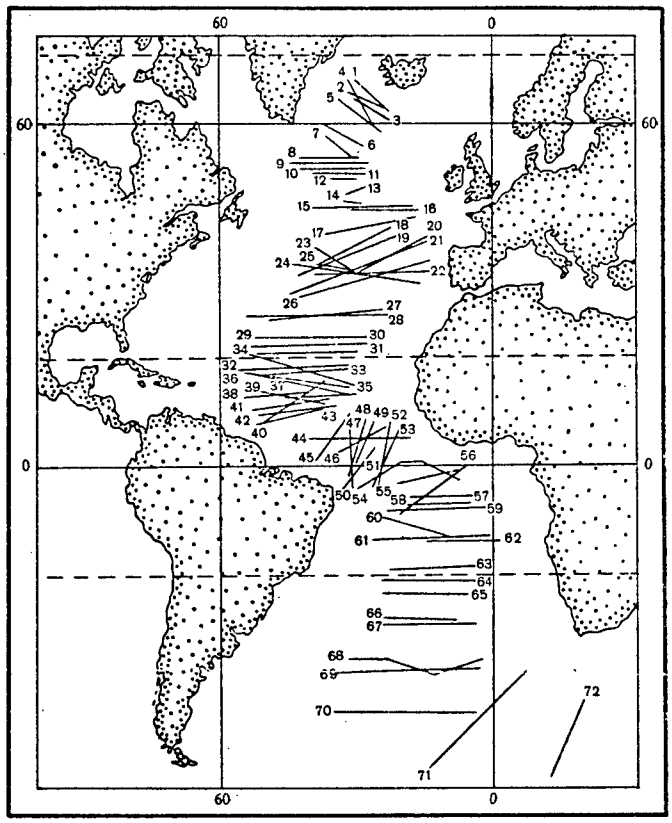
## RELIEF OF ATLANTIC OCEAN RIFT ZONE

Moscow OKEANOLOGIYA in Russian Vol 17, No 2, 1977 pp 263-271

[Article by A. V. Il'in and V. V. Frol', Acoustics Institute, "Spatial-Spectral Analysis of Relief in Rift Zone of Atlantic Ocean"]

[Abstract] This paper is devoted to a clarification of the differences in the limits of the rift zone of the Mid-Atlantic Ridge and their possible explanation. Coinciding topographically with the axial part of the Mid-Atlantic Ridge, the rift zone is clearly separated from its flank sectors

and can be traced along its entire extent, being reflected in the relief by high, exceedingly dissected rift ridges and deep depressions known as rift valleys. Figure 1 in the text shows a large series of relief profiles in the central part of the Mid-Atlantic Ridge; Fig. 2, reproduced below, shows the positions of these profiles, on the basis of which conclusions were drawn.




It is shown that on the basis of of the morphometry of relief the rift zone of the Atlantic Ocean can be broken down into several major structural-tectonic zones with the same type of relief structure in the confines of each of them. Relatively stable regions alternate with regions of strong differentiated block movements. The change in the geomorphological characteristics within the limits of each of the defined regions occurs gradually; a jumplike change in the appearance of the relief is observed with transition to the adjacent region through the zone of a major transverse fault separating them. Accordingly, at least some of the fault zones play the role of structural boundaries separating homogeneous sectors of the rift zone. The latitudinal zones of faults to a certain degree control the course of the riftogenic process in the axial zone of the mid-oceanic ridge and in the last analysis exert an influence on the peculiarities of the forming rift zone relief. A clearly expressed periodicity of

relief forms is characteristic of sectors situated beyond the limits of the fault zones, that is, in places where riftogenetic processes transpire and block movements of the earth's crust are less manifested.
[71]

## DEEP CRUSTAL STRUCTURE NEAR CAPE VERDE

Moscow OKEANOLOGIYA in Russian Vol 17, No 2, 1977 pp 258-262

[Article by G. B. Udintsev, I. N. Yel'nikov and G. N. Lunarskiy, Institute of Oceanology, "New Data on the Deep Structure of the Earth's Crust to the Northwest of the Cape Verde Islands"]

[Abstract] Seismic research by the refracted waves method was carried out in the neighborhood of the Cape Verde Islands during the 20th voyage of the scientific research vessel "Akademik Kurchatov." Data were collected using a seismic radio buoy and a large-volume pneumatic sound source. The volume of the working chamber was 30 liters; working pressure was 110 kg•$cm^{-2}$; compressor productivity was 30 liters•$min^{-1}$. The frequency of triggering of the sound source was 1 min. Most of the energy was concentrated in the band 2-20 Hz with a submergence depth of 15-30 m. The radio buoy was placed at a point with the coordinates 21°21.5'N and 30°8.5'W. It drifted at a speed of 0.4 km•$hour^{-1}$ along a seismic profile oriented from north to south. The following data were obtained on deep structure. The layer of low-velocity sediments has a thickness not greater than 75-100 m. This is followed by a layer consisting of rocks with a velocity of 3.8 km•$sec^{-1}$, which locally emerges at the floor surface. Its mean thickness is 2.3 km. Underneath this are rocks with a velocity of 6.6 km•$sec^{-1}$. The thickness of the latter layer is not less than 3 km.
[71]

## PROGRAMMING UNIT FOR SELF-CONTAINED INSTRUMENTS

Moscow OKEANOLOGIYA in Russian Vol 17, No 2, 1977 pp 354-357

[Article by Yu. M. Gusev, V. Ya. Serykh and B. V. Shekhvatov, Institute of Oceanology, "Multifunctional Programming Unit for Self-Contained Instruments"]

[Abstract] Specialists at the Institute of Oceanology have developed a multifunctional programming unit (MPU) for oceanological instruments. The MPU shapes electric signals at stipulated time intervals and pulses of a fixed duration. The MPU block diagram reproduced and discussed in the text includes a quartz oscillator and a frequency divider with integrating circuits. The MPU has high accuracy, small size and consumes little power (pulse repetition rate from 0.03 msec to 60 min; pulse duration from 15.25 μsec to 30

min; stability in temperature range 0-30°C -- 1 sec/day; current voltage -- 7 V±5%; output signal -- 7 V; measurements -- 100 x 80 x 15 mm; weight -- 30 g. The MPU has been used in an integrating device for measuring current direction and velocity and water temperature. It produced pulses of a fixed duration which were used for the periodic measurement of the frequency of the primary sensors (the number of pulses being stored in a counter and the mean value of the parameter being determined during the measurement). Pulses were also shaped for activating the measurement circuits and interrogating the integrating counters at fixed time intervals. Other signals are produced for registry of data in a binary code on magnetic tape. [71]

PROBE FOR STUDYING OCEAN SURFACE LAYER

Moscow OKEANOLOGIYA in Russian Vol 17, No 2, 1977 pp 358-362

[Article by N. V. Vershinskiy and A. V. Solov'yev, Institute of Oceanology, "Probe for Investigating the Ocean Surface Layer"]

[Abstract] Investigation of the vertical structure of the world ocean by means of different types of sounding devices has become one of the principal means for studying hydrophysical fields. It is characteristic that most of the measuring probes make measurements during the time of submergence. However, this method is ill-suited for making measurements in the surface layer of the ocean close to the discontinuity. This is because there is a considerable impairment of natural conditions when the body of the probe passes through the water-air discontinuity. As indicated in this article, this difficulty disappears when measurements are made under conditions of free floating-up of the probe. The authors have evidently used and describe such a probe designed and fabricated in France for the investigation of relatively large-scale phenomena [it is not clear whether the French instrument was modified in any way in the USSR] (see J. C. Gaillard, "La sonde autonome de mesures oceanographiques," COLLOQ. INT. EXPLOIT. OCEAN, Bordeaux, Theme 5, Paris, 1971). However, the instrument is especially advantageous for studying microscale surface layer processes. Tests in the USSR revealed that with a quite rapid constant rate of floating up it is possible to obtain nearly instantaneous distributions of different physical parameters with depth. In the described model a sensor of conductivity fluctuations was attached to the probe. Vertical profiles of conductivity fluctuations obtained in the North Atlantic revealed the presence of conductivity fluctuations at the sea surface during weak winds. Measurements in a bay with river runoff in the Black Sea revealed a multilayer stratification in the upper meter layer.
[71]

## VARIATIONS OF ELECTROMAGNETIC FIELD ASSOCIATED WITH SEA WAVES

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 2, 1977 pp 362-363

[Article by I. L. Trofimov and V. Yu. Semenov, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "One Reason for the Appearance of Variations of the Electromagnetic Field Associated with Sea Waves"]

[Abstract] As a result of motion of sea water in the earth's permanent magnetic field there are electric and magnetic fields caused by electromagnetic induction. In particular, this applies to wave movements which give rise to variable electromagnetic fields. In this paper a study is made of another possible reason for the origin of variations of the electromagnetic field also caused by sea waves. The article gives an analysis of a horizontally stratified medium (air-motionless water-sea floor). It is assumed that in one of the layers there is an arbitrary source creating a variable or constant electromagnetic field in the medium. This is called the primary field. It is assumed that the horizontality of the air-water boundary is impaired, leading to a distortion of the primary field. The distorted field can be represented in the form of a superposing of the primary field and a secondary field caused by impairment of the horizontality of the water surface. If the form of the water surface changes with time, the secondary field strength is determined by the strength of the primary field and the nature of its change is dependent on the nature of the change of the air-water discontinuity with time and in space. In nature the described situation can occur when there are sea waves. In a general case the role of the primary field can be played by the magnetotelluric field which is observed everywhere. The article gives computations illustrating this phenomenon. [50]

## ELECTROMAGNETIC FIELD OF NONSTATIONARY CURRENTS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 2, 1977 pp 306-310

[Article by G. A. Burtsev, Sverdlovsk Affiliate, Metrology Institute imeni D. I. Mendeleyev, "On the Theory of the Electromagnetic Field of Nonstationary Sea Currents"]

[Abstract] In computations of the electromagnetic fields of stationary sea currents it is common to have to reckon with unsteady currents and therefore the computation of their electromagnetic fields can be of interest for the method for electromagnetic measurements in the sea. In an earlier study (V. V. Litvinenko, MORSKIYE GIDROFIZICHESKIYE ISSLEDOVANIYA, No 4(54), 56, 1971) this problem was formulated and the author presented a solution, but the results cannot be fully applied because they were obtained with an incorrect formulation of the boundary conditions for the electric and magnetic parameters and no numerical evaluations were given. In the article

cited above these shortcomings are in large part overcome. The author has developed the theory and gives numerical computations of the electromagnetic fields of sea currents forming under the influence of a time-varying spatially homogeneous tangential stress of the wind or a variable pressure gradient in a sea of finite depth unbounded by shores.
[50]

## REPORTS AT OPTICS SECTION MEETING OF OCEANOGRAPHIC COMMISSION

Moscow OKEANOLOGIYA in Russian Vol 17, No 2, 1977 pp 372-374

[Article by K. S. Shifrin, "Third Plenary Meeting of Oceanic Optics Section of the USSR Oceanographic Commission"]

[Abstract] The Third Plenary Session of the Ocean Optics Section of the Oceanographic Commission USSR Academy of Sciences was held during the period 11-13 August 1976 at the Limnological Institute at Listvenichnoye. The plenary session was devoted to the use of optical methods in the visible and IR ranges for studying the oceans and internal water bodies. Some of the reports of interest were: G. S. Gurevich, et al. reported on determination of the form of the sea surface from the characteristics of reflected pulses of laser lidars. A. V. Byalko told of computations of the reflection and refraction on a horizontally oriented inhomogeneous random surface. A. P. Ivanov gave a review of investigations of reflection of nonstationary laser radiation from the wave-covered sea surface. A. S. Prikhach examined the influence of waves on fluctuations of light fields in the sea. G. A. Tolkachenko, et al. reported on their method for the remote measurement of the characteristics of waves on the basis of motion of the inhomogeneity of the field of underwater illumination. E. S. Vayndruk examined the possibilities of studying the characteristics of waves from the form of the light ray in the water. Yu. A. Gol'din told of laser sounding of the sea surface from a helicopter. A. I. Grishin told of measurements of the reflective properties of the sea surface in the case of its tangential sounding by a lidar. N. N. Yanter reported on the use of correlation analysis for evaluating the temporal variability of waves on Lake Baykal. A. I. German gave the results of aircraft investigations of the contrasts of the reflective properties of a sea surface contaminated by petroleum. K. S. Shifrin gave the results of computations of the coefficients of brightness of the petroleum film - sea water system. O. A. Abramov, et al. carried out a spectral analysis of radiation of the sea medium when it is irradiated by a UV laser. T. Yu. Sheveleva and M. A. Kropotkin gave the results of measurements of petroleum films using a scanning laser and model computations of the influence of a petroleum film on temperature of the sea surface. B. V. Novogrudskiy, et al. told of the large-scale structures of cross sections of the fields of radiation temperature, air temperature, water and illumination and presented an analysis of the spatial spectra of the field of radiation temperature. A. S. Tibilov, et al. reported on

the use of thermal tracers for measuring the characteristics of small-scale turbulence. Ye. N. Mineyev and G. G. Mel'nikov told about determination of the surface temperature gradient from radiation measurements at two wavelengths. A. A. Zagorodnikov, et al. reported the results of investigations of the influence of waves and foam on radiation temperature. V. V. Sobolev gave a review of methods for computing multiple light scattering in water basins. V. A. Timofeyeva told of determination of illumination by an arbitrarily oriented platform in the sea. E. P. Zege reported on the state of light polarization in the cases of single and multiple scattering in the sea. A. I. Sud'bin and V. A. Mozgovoy told of computations of fluctuations of the light field for different wavelengths. V. B. Bogorodskiy, et al. presented a classification of natural ice on the basis of optical characteristics. V. P. Nikolayev and others demonstrated on the basis of measurements of fluctuations of underwater illumination in the coastal zone of the Black Sea and in the Mediterranean Sea that the principal factor causing fluctuation is the focusing of sunlight by the curvilinear surface of waves.
[71]

## REPORTS FROM SOVIET-AMERICAN SYMPOSIUM ON INTERNAL WAVES

Moscow OKEANOLOGIYA in Russian Vol 17, No 2, 1977 pp 364-367

[Article by Yu. Z. Miropol'skiy and K. D. Sabinin, "Soviet-American Symposium on Internal Waves in the Ocean"]

[Abstract] A Soviet-American Symposium on Internal Waves in the Ocean was held at Novosibirsk during the period 3-8 December 1976. The symposium was organized by the Institute of Oceanology, Computation Center Siberian Department USSR Academy of Sciences and the Hydrodynamics Institute Siberian Department USSR Academy of Sciences. Fifty Soviet and 12 American scientists participated. The session was opened by Academician L. M. Brekhovskikh, chairman of the organizing committee of the symposium. A lecture by K. D. Sabinin, entitled "Singular Regions in the Spectrum of Internal Waves," was devoted to a description of the tidal and high-frequency parts of the spectrum of internal waves in the ocean in which there are significant deviations from a universal spectrum of the Garret-Munk type. It was demonstrated that the narrow-band time spectrum of internal tides corresponds to a broad spectrum of wave numbers, whereas short-period waves are registered in the form of trains of unidirectional or quasistanding waves of primarily the first mode. R. V. Ozmidov, in a report entitled "Experimental Investigations of Turbulence and Internal Waves," presented data on the correlation between the intensity of small-scale turbulence and the parameters of internal waves measured using towed sensors in the Pacific Ocean. A. Yu. Benilov and B. N. Filyushkin told about joint measurements of the statistical characteristics of the wind field and internal waves and there was found to be a considerable cross-coherency of these phenomena

at some frequencies. L. A. Ostrovskiy and Ye. N. Pelinovskiy told about long internal waves of finite amplitude with the earth's rotation taken into account. From a general system of equations in the theory of internal waves it was possible to derive equations similar to the Boussinesq equations in the theory of surface waves and an equation of the Korteweg-de Vries type. A detailed analysis of these equations was made and a number of solutions are presented. A lecture by A. G. Voronovich, et al. was devoted to a description of the propagation of slightly nonlinear packets of internal waves in the ocean. A detailed study was made of the automodulation instability of such packets and it was demonstrated that the fine structure of hydrophysical fields in the ocean can be formed due to nonlinear interactions. A. S. Monin and L. I. Piterbarg told of their statistical theory of free internal waves of an infinitely small amplitude. They derived useful formulas making it possible to compute other statistical characteristics of the field of internal waves. A. G. Voronovich examined the problem of the propagation of infiniteseminal internal waves in an ocean with currents varying in time and horizontal coordinates and with variable bottom relief. It was shown that in the approximation of geometrical optics there is a law of conservation of the adiabatic invariant in this problem. O. F. Vasil'yev, et al. discussed the problem of the radiation of internal waves by a turbulent spot in a stratified fluid. L. V. Cherkesov and A. M. Suvorov examined the generation of internal waves in a flow with a velocity shear. I. V. Sturova and V. A. Sukhorev told of the generation of internal waves by an ellipse placed in a stratified fluid.
[71]

## IV. TERRESTRIAL GEOPHYSICS

### News

### SOVIET-JAPANESE SYMPOSIUM ON INTERNATIONAL GEODYNAMIC PROJECT

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 3, 1977 pp 133-136

[Article by S. L. Solov'yev, "Third Soviet-Japanese Symposium on the International Geodynamic Project"]

[Abstract] The Third Soviet-Japanese Symposium on the International Geodynamic Project was held during the period 2-7 October 1976 at Yuzhno-Sakhalinsk. A total of 65 reports were presented. A group of specialists from the Sakhalin Multidiscipline Scientific Research Institute described and interpreted a land-sea deep seismic sounding profile run at the latitude of Petropavlovsk-Kamchatskiy. The M discontinuity beneath Kamchatka is deeper than assumed earlier. Accordingly, the above-lying layer with reduced velocities of $P_n$ waves can be regarded as part of the earth's crust. The authors established the nature of the joining of the continental and oceanic blocks both in the crust and at the top of the mantle and determined the different nature of the M discontinuity in the continental and oceanic blocks. Two reports by Soviet specialists examined the deep distribution of conductivity. The authors found that the layer of high conductivity is at depths of about 100, 30-50 km and sporadically at 15 km with a general rise from the continent to the ocean. Observations are greatly distorted by electric currents in the sea and also by electric currents in the sedimentary layers. Another Soviet report gave data on the anomalous magnetic field of the Sea of Japan and the distribution of heat flows with a detailed map of fault tectonics on the sea floor. A joint Japanese-Russian report gave a comparison of Soviet and Japanese magnetic data on the Sea of Japan. Whereas there is a general qualitative agreement on the forms of the anomalies, their values according to Soviet data are twice as great as according to Japanese data; this is related to the peculiarities of instrumentation. Two other Soviet reports were devoted to study of movements of the earth's surface by geodetic methods. One of these told of the layout of an extensive geodetic network on Kamchatka and the first results of repeated surveys, especially in the Cape Africa region, where there are residual deformations associated with strong

earthquakes in Kamchatskiy Zaliv. The other report gave a map of recent movements in Primor'ye and Sakhalin, constructed by means of synthesis of geodetic and mareographic data. The change in direction of movements associated with the Moneron earthquake of 1971 is of interest for determining the relationship between mountain-forming and leveling isostatic forces. The relationship between vertical movements of the earth's surface and the formation of deep magma zones was also discussed. Although at the symposium there were no special reports on the development of instrumentation, some reports gave incidental information on the development of telemetric observation systems and on the creation of new bottom geophysical instruments. The reports of this symposium will not be published in Japan, but in the USSR they will be published at some unstipulated date in the form of two collections of articles -- on volcanology and geophysics.
[32]

HELIUM USED AS EARTHQUAKE PREDICTOR

Moscow PRAVDA in Russian 2 April 1977 p 3

[Article by A. Presnyakov, "Helium Service"]

[Summary] A half-century has passed since Academician V. I. Vernadskiy suggested the compilation of a map of the helium field of the planet, which he recognized was like a gigantic x-ray which reflects the deep structure of the solid mantle of our planet. It is now understood that the pattern of distribution of this gas favors a better comprehension of the processes transpiring in the deep layers and facilitates the solution of important practical problems. Teams of Soviet geophysicists are working on helium surveys in a wide range of areas in the USSR, such as the Kuriles, Tadzhikistan, Ukraine and the Volga region. Other work of this nature is being done in the Baltic area, Central Russia, Georgia, Armenia and elsewhere. Observations are being made on the land, in volcanoes, springs, rivers, lakes and seas. Measurements are being made in boreholes and in common wells. In the Helium Laboratory at the All-Union Scientific Research Institute of Mineral Raw Materials (only one of the organizations active in this field) specialists have created a magnetic discharge indicator which makes possible the precise registry in natural waters of even the most insignificant helium concentrations, such as in ground water where there is only one helium atom per million water molecules. But the instrument is also capable of registering very great concentrations of this gas characteristic for the waters of zones of deep faults, where the relationship can be 1:1. And since the intensity of the helium flows penetrating into the water layer is determined to a great degree by movements of the earth's crust, this gas has been found to be a remarkable indicator of water exchange in the hydrosphere and a singular means making it possible for scientists to understand the processes of geodynamics. Only in the late 1960's were scientists able to overcome many technical difficulties and establish a common relationship between

helium anomalies in the surface layer and deep faults. In order to decrease expenditures on geological prospecting work and to increase the effectiveness of deep search it is necessary to ascertain the most promising areas for drilling. A helium survey is beautifully adapted for this purpose. Deposits of many types of minerals are identified by definite combinations of concentrations, both low and high. Ore deposits in a fault zone gravitate toward the maxima of helium anomalies. These places are especially promising for deep search. On the other hand, accumulations of petroleum and natural gas in the sedimentary stratum are associated with minima of the helium field. Thus, helium surveys are helping in pinpointing mineral deposits and thereby are economically advantageous.
[5]

## RECENT CONCEPTS OF EARTH'S UPPER MANTLE REVIEWED

Moscow PRIRODA in Russian No 7, 1976 pp 64-77

[Article by A. S. Alekseyev and V. Z. Ryaboy, Director of the Computation Center Siberian Division USSR Academy of Sciences and All-Union Scientific Research Institute of Geophysical Prospecting Methods,'"New Model of Structure of the Earth's Upper Mantle"]

[Abstract] The changing concepts concerning the earth's upper mantle are discussed. This review is accompanied by excellent graphic materials. A double-page color diagram illustrates the principal features of structure of the upper mantle under different structures of the earth's crust. A series of diagrams shows typical velocity sections of the upper mantle of platform and tectonically active regions. Included is a map of the degree of study of structure of the upper mantle in the USSR and some adjacent countries. A corresponding map shows the distribution of large-scale density and velocity inhomogeneities in the upper mantle in the USSR. A special map shows changes in thermodynamic conditions at the Moho in the USSR; still another shows the boundary velocities of propagation of longitudinal seismic waves along the Moho in the same area. All this material is used in discussing the nature and properties of the upper mantle. This is making it possible to clarify the mechanism of occurrence of earthquakes and the eruption of volcanoes and is useful in seismic regionalization, in particular, in determining the intensity of waves from earthquakes and powerful explosions at great distances from the source of oscillations. The results of deep seismic soundings agree with data from petrology, according to which the upper part of the mantle consists of stratified and complexly alternating ultrabasic rocks and eclogites, rocks close in composition to basalts but containing minerals with a denser packing of atoms. To a considerable degree the change in mineralogical composition can explain velocity inhomogeneities at depths of less than 80-100 km. The variations in velocity parameters at great depths where the temperature can exceed 1100-1200°C evidently are caused by phase transitions arising as a result

of a change in thermodynamic conditions. Thick layers with reduced velocities, discriminated on the basis of seismic data at a depth greater than 100 km, are probably caused by partial melting or transition of matter into a more amorphous state. The horizontally inhomogeneous model of the mantle still is of a fragmentary character, but in five or ten years it can be hoped that the ambiguities will be resolved. Then it will become possible to use the new model for solving global problems in geodynamics. [332]

## REPORT ON WORK AT INTERNATIONAL PHOTOGRAMMETRIC CONGRESS

Moscow REFERATIVNYY ZHURNAL 52. GEODEZIYA I AEROS"YEMKA, OTDEL'NYY VYPUSK in Russian No 12, 1976 12.52.2

[Abstract of article by F. Ackermann; Berlin, BILDMESS. UND LUFTBILDW., 44, No 4, 1976, pp 122-128, "Development of Work of Commission III from 1972 to 1976"]

[Text] In a report prepared for the 13th International Photogrammetric Congress (Helsinki, 1976) it is stated that Commission III, in accordance with a resolution of the 12th Congress, was given a new name -- "Mathematical Bases for Data Processing." During the report period within the Commission a new working group was established on "Geometrical Principles for the Investigation of Space." In 1974 the Commission held at Stuttgart an international symposium dedicated to the 80th birthday of Professor W. Schermerhorn, who has made a major contribution to the development of aerial triangulation. The symposium was attended by more than 120 representatives of different countries in the world. Thirty-five of 55 reports were presented. Most of these were devoted to aerial triangulation. Fifteen reports examined the problems involved in the exploration of space and the formulation of digital terrain models. Over a period of 45 years different methods of aerial triangulation have been used successfully in practical work of photogrammetric surveys. There has been particularly broad development of the analytical method of block aerial triangulation using independent models with measurement of the coordinates of photograph points on analog instruments. Ever-broader use is being made of analytical block aerial triangulation with measurement of the coordinates on mono- and stereocomparators. The unsolved problems in the field of aerial triangulation are noted. During the report period aerial triangulation has been adjusted for the most part by programs prepared earlier. Several new programs are variants of the well-known program for the adjustment of blocks using independent models with self-calibration and the use of additional parameters. During recent years there has been a tendency to use low-capacity electronic computers in the adjustment of aerial triangulation. In practical work use is also being made of the method of adjustment of blocks employing higher-degree polynomials. Investigations have confirmed the high accuracy of this method. In a number of countries research has continued on the

adjustment of photogrammetric nets with use of readings of a statoscope and radio profilograph. The use of these instruments in small-scale mapping (1:100,000, 1:50,000) makes it possible to dispense with the geodetic determination of control points within blocks of any size. A study was made of the influence of systematic errors on the accuracy of aerial triangulation and methods were developed for their elimination. It was possible to establish a rigorous dependence between distortions of aerial photographs and models on the parameters of the aerial photographic survey and processing procedures. Allowance for systematic errors to a considerable degree increases the accuracy of photogrammetric determination of coordinates. The best method for the correction of systematic errors is the self-calibration method. In the field of automatic detection and exclusion of blunders the first theoretical and methodological investigations have been taken and work has begun on the formulation of corresponding programs. In the reports devoted to the formulation of numerical models it was demonstrated that the rectification of a photographic image into digital form has passed from the stage of experimentation into an independent branch of photogrammetry. The numerical terrain models are finding extensive application in different fields of technology and the economy. The work of the new Working Group is concentrated on a study of the accuracy of radar images. The errors in determining coordinates on the basis of radar photographs fall within the limits of triple the value of the resolution of the photographs (±50 m); this corresponds to the requirements on the accuracy in maps at a scale of 1:250,000. Encouraging data were obtained indicating the possibility of using radar photographs in the compilation of maps at larger scales. Further investigations by the group involved investigations of the processes of compilation of special maps from photographs taken using IR and multispectral scanning devices carried aboard artificial earth satellites. It was established on the basis of test investigations that the accuracy in determining coordinates with the use of these images falls within the limits of resolution of the photographs. The development of this field involves the digital processing of images. It is necessary to solve the problem of differential orientation and rectification of elements of the photograph, study of the geometric properties of images, mapping with the use of analytical plotters and different sensors.
[392]

## MONOGRAPH ON SEISMIC ENERGY AND ITS DETERMINATION

Moscow SEYSMICHESKAYA ENERGIYA I METODY YEYE OPREDELENIYA (Seismic Energy and Methods for its Determination) in Russian Izd-vo "Nauka," 1975, 151 pages

[Abstract of monograph by S. Ya. Kogan]

[Abstract] This monograph examines spherical and axially symmetric sources of seismic energy and gives a determination of the energy emanating from them in seismic waves. The author gives a general method for computing

seismic energy in the focus. Using this method it is possible to establish a correlation between seismic energy and the principal parameters of the source and the properties of the medium in which the source is operative. The monograph is intended for specialists in the fields of geophysics and seismology. Sixteen tables, 61 illustrations and bibliography of 141 items.

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Abstracts of Scientific Articles

GENERATION OF HYDROCARBON GASES IN ATLANTIC SEDIMENTS

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 1, 1977 pp 59-64

[Article by V. V. Veber, M. L. Sazonov, S. N. Morozova, All-Union Scientific Research Institute of Hydromachinery Construction, D. Ye. Gershanovich, I. P. Zarikhin, All-Union Scientific Research Institute of Sea Fisheries and Oceanography, V. I. Chernov, Moscow Geological Prospecting Institute, "Generation of Hydrocarbon Gases in Recent Sedimentary and Volcanogenic-Sedimentary Formations of the Eastern and Southern Atlantic Ocean"]

[Abstract] In earlier years a study was made of the gas phase of recent marine and oceanic sediments, primarily terrigenous, taken in the Pacific and Atlantic Oceans (V. V. Veber, et al., GEOLOGIYA NEFTI I GAZA, No 10, pp 56-62, 1974 and V. V. Veber, et al., GEOLOGIYA NEFTI I GAZA, No 6, pp 49-53, 1971). The study of recent gas formation has continued on the basis of extremely diversified facies of sediments, including calcareous and volcanogenic-sedimentary. In all cases there was found to be generation of hydrocarbon gases not only on a narrowly regional basis, but also as a general phenomenon. Tables 1 and 2 give a comparison of gases of volcanogenic-sedimentary, terrigenous and calcareous formations. Taking into account the $Fe^{2+}/Fe^{3+}$ ratio, it can be said with assurance that there are pronounced tendencies in the direction of oxidative conditions for volcanogenic-sedimentary formations; for terrigenous and calcareous deposits these tendencies are either less clear or are replaced by clearly expressed reduction conditions. The table gives a detailed breakdown by stations occupied (a map accompanies the text) and the different components by volume (hydrogen, methane, ethane, ethylene, propane, isobutane, butane, pentane, hexane, etc.).
[376]

SEISMOGENIC STRUCTURES OF LITHOSPHERE

Moscow REFERATIVNYY ZHURNAL, GEOLOGIYA, SVODNYY TOM in Russian No 12, 1976
12A405

[Abstract of article by A. A. Borisov, M. K. Polshkov, A. V. Polyakov and Yu. K. Shchukin; Moscow, MEZHDUNAR. GEOL. KONGR. XXV SESSIYA. DOKL. SOV. GEOLOGOV. GEOFIZ. ISSLED. ZEMN. KORY, "Nedra," 1976, pp 58-64, "Seismogenic Structures of the Lithosphere"]

[Text] A statistical complex analysis of 18 geophysical parameters carried out for some seismically dangerous structures in the southern USSR demonstrated that only a part of the geophysical parameters are informative for seismic danger. For such parameters it was possible to define the ranges of values (gradations) characteristic for seismically dangerous and seismically safe standard structures. Such gradations are indicators of the structures of the corresponding degree of seismicity. The gradation indicators of seismogenic structures are found in 14 of 18 geophysical parameters among the parameters considered for the Caucasus and in 11 of the 18 for the Tien Shan. However, for not one of the parameters is there a gradation corresponding to all the structures of a stipulated class of seismicity. There is also not a single seismically dangerous structure which would correspond to all the gradation-indicators of high seismic danger. Seismogenic structures even of an equal degree of seismic danger are characterized by individual combinations of parameters constituting 50-80% of the total number of gradation-indicators, that is, differ considerably from one another in their structural geology characteristics. The authors propose and apply a system of transformations of the totality of all geophysical parameters into a single criterion S -- the "measure of similarity." The S values were used in carrying out regionalization of the Caucasus and Tien Shan. A linear regression was established between S and the seismic intensity $I_0$ of the investigated territories. Two tables.
[42]

TECTONOPHYSICAL STUDY IN PRIKOPETDAGSKIY SEISMICALLY ACTIVE REGION

Moscow REFERATIVNYY ZHURNAL, GEOLOGIYA, SVODNYY TOM in Russian No 12, 1977
12A410

[Abstract of article by V. I. Lykov, D. N. Osokina, O. A. Odekov, M. K. Kurbanov, N. Yu. Tsvetkova, E. L. Shikhanovich and O. I. Gushchenko; Tashkent, POISKI PREDVESTNIKOV ZEMLETRYASENIY, "Fan," 1976, pp 151-163, "Tectonophysical Formulation of a Complex of Prognostic Observations in the Prikopetdagskiy Seismically Active Region"]

[Text] The level of seismic activity is determined by the nature of the tangential stresses ($t_{max}$). The article presents a study made using polarization-optical modeling of anomalies of the tectonic field arising as a

result of regional compression around a system of deep faults in Turkmenia and Iran separating regions with different tectonic history. The axis of maximum compression has a horizontal submeridional direction, as is confirmed by an analysis of earthquakes with $M > 6$ by the O. I. Gushchenko method. It revealed that 84% of the earthquakes coincide with the region of tangential stresses. The earthquake energy is dependent on the length of the dislocation sector, the magnitude of the initial stresses and friction of the sides. A stronger earthquake occurs when there is an identical strength of the entire sector. The principal purpose of the prognostic observations is compilation of a map of the distribution of the degree of readiness for destruction and the time to destruction of the dangerous sector as a result of the long-term exposure to stresses and decrease in strength or friction as a result of hydrochemical processes (in the example of the earthquake of 15 November 1968 in Ashkhabad). Bibliography of 19 items.
[42]

BREAKDOWN OF ANOMALOUS MAGNETIC FIELD INTO COMPONENTS

Moscow REFERATIVNYY ZHURNAL, GEOLOGIYA, SVODNYY TOM in Russian No 12, 1976
12A432

[Abstract of article by T. A. Gorshkova; Kiev, MAGNIT. ANOMAL. ZEMN. GLUBIN, "Nauk. Dumka," 1976, pp 46-54, "On the Problem of Regional Anomalies"]

[Text] For the purpose of separating the anomalous magnetic field into components the author has made a study of the frequency makeup of the field on the basis of data from a highly precise absolute aeromagnetic survey along the flight lines of control and cartographic networks and also on the basis of data from a hydromagnetic survey made aboard the scientific research ship "Zarya." A continuous profile was also run along 56°N. The spectral densities of strength $S(\tau)$ were computed using a length of the record about 4,000 km, the sampling interval was 2 km, the maximum length of the correlation function from which the spectral densities of strength were computed was $\tau_{max} = 1/8L$, and the normal field used was that synthesized by Cain using Gauss coefficients to $n = 9$. The filter used was moving averaging with the interval varying from 160 to 300 km. The oriented low-frequency field component (long-period anomaly) was understood as a regional field. The total error in separation was 78 gammas. Positive anomalies with an intensity of 200-300 gammas or more (Kol'skaya, Mezenskaya, Kaspiyskaya, Kasskaya, and others) were defined. The defined regional magnetic anomalies were compared with anomalies defined earlier by other authors. This is followed by a joint analysis of the defined regional magnetic anomalies, gravity and heat fields. There was found to be a definite correlation between these fields. This can be regarded as an indirect confirmation of the physical reality of their sources. Bibliography of 19 items.
[42]

## SECULAR VARIATIONS OF GRAVITY IN UKRAINE

Moscow REFERATIVNYY ZHURNAL 52. GEODEZIYA I AEROS"YEMKA, OTDEL'NYY VYPUSK in Russian No 12, 1976 12.52.58

[Abstract of article by V. R. Sidorenko and V. I. Somov; --, GEOD., KARTOGR. I AEROFOTOS"YEMKA. RESP. MEZHVED. NAUCH.-TEKHN. SB., No 24, 1976, pp 110-122, "Secular Variations of Gravity in the Territory of the Ukraine"]

[Text] On the basis of a confidence analysis of independent repeated measurements carried out by different organizations in different years with different apparatus and using different methods, and taking into account the peculiarities of geological structure of regions, it was possible to formulate a composite model of change in gravity $\Delta g$ in the territory of the Ukraine for the period 1962-1970. The isoline interval was 0.05 mgal. The initial measurements (1962) are characterized by a mean square error of ±0.06 mgal; subsequent measurements (1963-1970) had errors which for the most part fell in the range ±0.02-0.04 mgal. The range of change in $\delta g$ attains 1.0 mgal. In the eastern part of the republic $\Delta g$ varies from -0.58 mgal (Dmitrieev L'govskiy) to +40 mgal (Lozovaya). A series of positive and negative $\Delta g$ regions was detected. Within the limits of the Carpathian region there is a marked differentiation of $\Delta g$ in direction and intensity. Here the gradient locally attains 0.40 mgal/50$\gamma$. It is asserted that the results of the investigations demonstrate the existence of secular variations of gravity over the territory of the Ukraine and indicate the reality of the physical nature of these changes. The authors define a number of factors which can be the cause of this phenomenon: the processes of transformation of matter in the upper mantle, the migration of the Moho, the processes in the earth's crust and deformations of the figure of the earth. Bibliography of 30 items.
[392]

## ASYMPTOTIC METHOD FOR DETERMINING EARTH'S VELOCITY CROSS SECTION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 233, No 2, 1977 pp 312-315

[Article by M. A. Brodskiy and A. L. Levshin, Institute of Physics of the Earth, "Asymptotic Method for Determining the Earth's Velocity Cross Section from the Frequencies of its Characteristic Oscillations"]

[Abstract] During the last decade considerable information has been obtained on the frequencies of the characteristic spheroidal and torsional oscillations of the earth excited by strong earthquakes. Specialists now know of about a thousand characteristic frequencies of the earth with a relative accuracy of about tenths of a percent. These data are used for determining the earth's velocity and density cross sections. However, the interpretation methods used are based either on a refinement of some initial

model by the methods of the theory of perturbations or involve a directed or random search for models agreeing with observational data collected recently. These solutions of the inverse problem obtained in this way are dependent on a priori information concerning the model of the earth. In this paper the authors propose a method for direct inversion of all available information on the characteristic oscillations of a spherically symmetric elastic sphere into the distribution of velocities of elastic waves within the sphere. The method essentially uses the asymptotic properties of the high-frequency part of the spectrum; it can be used for studying the velocity cross section of the earth and other planets and also in similar inverse problems in mathematical physics (for example, in scattering theory). The following are considered: inverse problem of torsional oscillations, monotonic case, nonmonotonic case, model example and duality of inverse problems of characteristic oscillations and geometrical seismics.
[4]

WANDERING OF POLES DUE TO CONTINENTAL DRIFT

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 233, No 2, 1977 pp 316-319

[Article by V. P. Keondzhin and Corresponding Member USSR Academy of Sciences A. S. Monin, Institute of Oceanology, "Wandering of the Poles as a Result of Continental Drift"]

[Abstract] L. P. Zonenshayp, et al. (GLOBAL'NAYA TEKTONIKA, MAGMATIZM I METALLOGENIYA, Moscow, "Nedra," 1976) compiled a series of maps of the distributions of the continents and oceans during different geological periods of the Phanerozoic. Using these maps, the authors have ascertained the Phanerozoic trajectories of the centers of gravity of the continental blocks relative to the paleopoles (the trajectories of six of these blocks -- Africa, North America, South America, Australia, Siberia and Eastern Europe -- are shown in a figure with points along the trajectories being plotted at 50-million year intervals. However, the trajectories relative to the paleopoles do not give a complete idea concerning the movements of the continents because the poles themselves could move over the earth's surface. The principal reason for movements of the poles was the movement of the continents. The earth strives to rotate relative to its axis of rotation in such a way that the greatest number of continental blocks will be in the equatorial zone. The authors show that the characteristic motion of the poles can be computed using the Liouville equations. It was found that the pole moved from a position close to its modern location approximately along the meridian 180° and returned somewhat to the west so that a repeated loop has seemingly begun at the present time. A map shows the movements of the north pole for different values of the earth's effective viscosity.
[4]

STRUCTURE OF CAUCASUS-TAURUS REGION INTERPRETED FROM SPACE PHOTOS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEOLOGIYA I RAZVEDKA in Russian No 11, 1976 pp 14-25

[Article by V. Z. Sakhatov, Moscow State University, "Peculiarities of Structure of the Caucasus-Taurus Region Determined by Interpretation of Space Photographs"]

[Abstract] The Caucasus-Taurus region of the Alpine geosynclinal zone is almost completely covered by a photographic survey from space from manned spaceships. Nevertheless, the quality of the space photos and the volume of information deduced from them differ. This is due to the different scale of the survey and in some cases the great angles of inclination at the time of photography. On this basis the author presents a detailed tectonic map of the region compiled on the basis of an interpretation of space photos and television photos supplemented by surface geological and geophysical materials. Specific information is presented on a great number of the geological features illustrated on the map. It is shown that the use of space and TV photographs in combination with standard data provides new information of great value in the study of such regions. For example, photo interpretation revealed earlier unknown latitudinal, east-northeasterly, meridional and northeasterly lineaments to a large extent determining the formation of the structural plan. Most of the lineaments agree with geological and geophysical data. It was established that the most extensive linear lineaments undergo a transition in strike from longitudinal to transverse in sectors of general change in the strike of the geosynclinal belt. The present structure of the Caucasus-Taurus region has a clearly expressed folded block character caused by a system of faults and lineaments of different strikes. It is shown that the space photos at an initial scale 1:7,000,000 used in compiling the tectonic map are effective for small-scale tectonic analysis.
[259]

LINEAMENTS OF EASTERN ALPINE ZONE DETECTED FROM SPACE PHOTOS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEOLOGIYA I RAZVEDKA in Russian No 11, 1976 pp 26-34

[Article by M. L. Kopp and L. M. Rastsvetayev, Moscow State University, "Lineaments Detected from Space Photographs in the Eastern Part of the Alpine Belt"]

[Abstract] Many special studies have been devoted to the interpretation of space photos and many deal with the interpretation of tectonic lineaments. In the article cited above the authors make an attempt at an integrated

examination of the entire network of cosmographic lineaments in the territory of the eastern part of the alpine zone extending over the countries of the Near and Middle East and adjacent regions of the Soviet Union. Figure 1 is a map of the lineaments in this zone as interpreted from space photographs. The authors made use of all possible materials in the compilation of this map. However, it is noted that in order to obtain comparable results it is necessary that the photographs have an approximately identical scale and that they uniformly cover the entire investigated territory. For the eastern part of the alpine zone these conditions are completely satisfied only by television photographs from the Soviet meteorological satellites "Kosmos" and "Meteor" (negative scale 1:10,000,000-1:15,000,000). The synthesis of data was made using the greatest number of TV photos obtained at different times (not less than three to five for each region). A classification of lineaments is given and all aspects of the different features are considered. It is concluded that the overwhelming majority of the cosmographic lineaments reflect the deep megafissuring of the lithosphere, evidently of a planetary nature, and manifested in the landscapes of the present-day earth's surface through the mechanism of neotectonic activation.
[259]

## JOINT USE OF TV SPACE PHOTOS AND GEOLOGICAL DATA IN GEOLOGICAL STUDIES

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEOLOGIYA I RAZVEDKA in Russian No 11, 1976 pp 129-134

[Article by L. M. Gerasimov, V. Ya. Yeromenko and V. F. Al'tman, All-Union Scientific-Production Combine "Aerogeologiya," "Joint Use of Television Photographs and Geophysical Materials in Geological Investigations of Yenisey Ridge and Western Part of the Siberian Platform"]

[Abstract] One of the ways to increase the effectiveness of regional geological reconnaissance work for petroleum and gas in Eastern Siberia is the joint use of materials from space surveys and geophysical investigations, making it possible in a short time to cover great areas and detect major structures of the sedimentary cover and basement. The interpretation of TV photographs of individual regions of Western and Eastern Siberia revealed earlier unknown faults and fault systems, annular structures, uplifted and down-dropped blocks of the basement and sedimentary cover. The article gives many specific details concerning these newly discovered structures. The article describes the results of joint interpretation of space surveys for the area of the Yenisey Ridge and the western part of the Siberian Platform, together with data from a high airborne magnetometer survey carried out by specialists of the Aerial Methods Laboratory during 1970-1974. The results of this work, serving as the basis for the text, are shown in Fig. 1, a structural geology map of the western part of the Siberian platform.
[259]

ANOMALOUS ERRORS IN OPTIMUM DETECTION OF SEISMIC SIGNALS

Moscow REFERATIVNYY ZHURNAL, GEOLOGIYA, SVODNYY TOM in Russian No 12, 1976 12D84

[Abstract of article by Yu. K. Postoyenko, Ye. S. Sinitsyn and V. N. Soldatov; Minsk, DOKLADY AN BSSR, 20, No 8, 1976 pp 745-748]

[Text] The methods for discriminating signals of a stipulated shape against a background of random noise by the use of optimum filtering are based on the maximizing of the signal-to-noise ratio. However, there is no proof that in this case there is a minimizing of the dispersion of the error in measuring the arrival time of the useful signal. In some cases the reverse can be demonstrated. For example, when discriminating a signal $m(t) = \cos \omega (t - \tau)$, $t \in [-\sim, \sim]$ against a background of white noise the optimum filter, whose weighting function coincides with the signal shape, maximizing the signal-to-noise ratio, simultaneously maximizes the dispersion of the evaluation of the arrival time $\tau$. Since in seismic investigations the problem of signal detection is always related to measurement of its arrival time, it is necessary that both problems be solved simultaneously. For this purpose the authors propose a method for transforming multiextremal signals into monoextremal signals and give an analytical solution of this problem. Also given are the results of an analysis of the theory of seismic records on an electronic computer confirming the fundamental feasibility of the proposed algorithm. Bibliography of two items.
[42]

PRINCIPAL TECTONIC STRUCTURES OF THE WESTERN USSR

Moscow REFERATIVNYY ZHURNAL, GEOLOGIYA, SVODNYY TOM in Russian No 12, 1976, 12A421

[Abstract of article by N. A. Belyayevskiy, B. S. Vol'vovskiy, I. S. Vol'vovskiy, A. V. Yegorkin, M. K. Polshkov, V. Z. Ryaboy, V. B. Sollogub, A. V. Chekunov, N. M. Chernyshev and Yu. G. Yurov; Moscow, MEZHDUNAR. GEOL. KONGR. XXV SESSIYA. DOKL. SOV. GEOLOGOV. GEOFIZ. ISSLED. ZEMN. KORY, "Nedra," 1976, 48-58, "The Earth's Crust and the Principal Tectonic Structures in the Western USSR (Along the Black Sea-Kara Sea Profile"]

[Text] The article gives the results of deep seismic sounding along the profile Black Sea-Kara Sea. The profile intersected the principal tectonic structures of the eastern part of the European platform and the structures of the Alpine belt in the southern USSR. The earth's crust and the upper mantle of the European platform are characterized by considerable horizontal inhomogeneities which are manifested in a marked change in the structure and physical properties of the sedimentary cover and the basement and also in appreciable variations of the velocity parameters of the consolidated crust and upper mantle. Comparison of the results of seismic observations with magnetic and gravity data shows that magnetic anomalies for the

most part are associated with inhomogeneities of the upper part of the consolidated crust and for all practical purposes do not correlate with deeper-lying objects. The absolute values of the regional component of the Bouguer anomalies reflect the mean depth of the M discontinuity and their local components are associated with inhomogeneities of the upper part of the crust. There is an increase in the depths to the Moho in regions of occurrence of early Proterozoids and an appreciable reduction in depths under Archaean blocks. Within the limits of strongly uplifted and deeply eroded Archaean blocks the Moho is situated at relatively lesser levels than in regions of occurrence of Proterozoic structures. For the Pre-Riphean structures of the basement of the European platform it is necessary to assume an Early Proterozoic and in individual sectors (Archaean blocks with early stabilization) a more ancient age of formation of the Mohorovicic discontinuity. For the Pechora syneclise the age of the Mohorovicic discontinuity can correspond to the epochs of formation of early baykalids of the Timan and hercynids of the Urals. The hercynids or formations of an earlier stage are possibly associated with the formation of the Moho in the region of the Scythian-Turan platform and the Crimean meganticlinorium. The structures in the relief of the basement are reflected in the internal structure of the earth's crust and in the relief of the Moho. An exception is a major superposed structure of the Dnepr-Donets aulacogen, whose development was accompanied by the uplifting of the Moho. At the same time, many major tectonic structures having a dissimilar age and history of geological development are characterized not only by the peculiarities of distribution of thicknesses of layers in the earth's crust and the differences in their velocity parameters, but also significant velocity inhomogeneities along the Moho. This indicates that in their formation a role was played not only by the entire thickness of the earth's crust, but also the upper mantle. Bibliography of 12 items.
[42]

PATTERNS OF DISTRIBUTION OF CRUSTAL FAULTS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 233, No 2, 1977 pp 451-453

[Article by V. N. Semov, All-Union Scientific Research Institute of Geophysical Prospecting Methods, "Patterns of Distribution of Faults in the Earth's Crust"]

[Abstract] This paper is devoted to a clarification of the general patterns of distribution of crustal faults. If the total number of faults in the USSR is assigned the value 100%, 30% of them known at the surface can be identified with deep faults; 10% of the faults known at the surface cannot be identified with deep faults; 60% of the faults observed in the earth's crust are not reflected at the earth's surface. These data make it possible to classify all the observed faults in two major groups: penetrating and developing in the earth's crust and penetrating to the earth's surface

and those not penetrating to the earth's surface -- deep and developing only in the crust or upper mantle. On the basis of the peculiarities of distribution of faults in the earth's crust the author proposes their classification, represented by a large diagram accompanying the text. The classification embraces the two major fault groups: those arising and developing under conditions of predominant compression and those forming under conditions of predominant dilatation. In the first fault group the decisive criterion is position in the earth's crust (horizontal rows of diagram); in the second group the important characteristic is the depth of penetration of the faults (vertical rows of diagram). The proposed quantitative classification of faults develops and refines the concepts of many authors who earlier have proposed similar variants for the classification of faults on a qualitative basis.
[4]

REVIEW OF REPORTS AT THE INTERNATIONAL GEOLOGICAL CONGRESS

Moscow IZVESTIYA AN SSSR, SERIYA GEOLOGICHESKAYA in Russian No 3, 1977 pp 5-21

[Article by A. V. Sidorenko, V. V. Menner, V. I. Smirnov, N. P. Laverov and I. M. Varentsov, "Twenty-Fifth Session of the International Geological Congress"]

[Abstract] The 25th session of the International Geological Congress was held at Sydney, Australia, during the period 16-25 August 1976. The session was attended by 2,800 delegates, 73 of them from the Soviet Union. A total of 1,000 reports were presented in 17 sections. The authors give concise comments on what they feel were the most important materials reported in the following sections: Precambrian Geology, Petrology, Tectonics and Structural Geology, Mineral Deposits, Mineral Fuels, Stratigraphy and Sedimentology, Paleontology, Geophysics, Geochemistry, Quaternary Geology, Engineering Geology, Mineralogy, Geological Education and the History of Geology, Field Geological Excursions, Scientific-Organizational Problems. In general, emphasis is on the contributions of non-Soviet geologists, with but few substantial summaries of communications presented by Russian scientists. In the Geophysics section, for example, mention is made of the new gravity map of Australia which is based on the results of a Soviet-Australian airborne gravimeter expedition. In the Mineral Deposits section only a few lines are devoted to a mention that 11 reports were submitted by Soviet geologists, etc.
[18]

STUDY OF BAYKAL RIFT USING SPACE PHOTOGRAPHS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEOLOGIYA I RAZVEDKA in Russian No 11, 1976 pp 36-41

[Article by V. V. Kozlov and Ye. D. Sulidi-Kondrat'yev, Moscow State University, "Investigation of the Baykal Rift and the Teletskiy Graben by Remote Sensing Methods"]

[Abstract] The authors made a study of space photographs of the Baykal rift obtained from the "Salyut-4" station in the summer of 1975 and also photos taken in a high-altitude aerial survey and in part ordinary aerial photos. These data were supplemented by aerovisual observations from helicopters and aircraft covering the entire area of the Baykal rift and also ground observation routes. As a result of interpretation of the small-scale photographs it was possible to characterize some peculiarities of the Baykal rift and postulate a rift nature of the Teletskiy graben. Figure 1 in the text is a map of structural geology interpretation of the Baykal rift system. The article gives a description of the Baykal rift and the Teletskiy graben based on interpretation of the space photographs, aerial photographs and previously available data. These materials demonstrate the great value of remote methods for studying the structure of continental rifts which are the latest tectonic elements clearly expressed on small-scale images of the earth's surface. Analysis of such images will facilitate detection of isolated and relatively small rifts.
[259]

TRANSVERSE FAULTS IN THE CAUCASUS VISIBLE ON SPACE PHOTOGRAPHS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEOLOGIYA I RAZVEDKA in Russian No 11, 1976 pp 42-53

[Article by R. A. Agamirzoyev, B. V. Grigor'yants, M. L. Kopp and N. N. Kurdin, Moscow State University, "Transverse Faults in the Southeastern Caucasus and Their Expression on Space Photographs"]

[Abstract] Interzonal longitudinal faults are clearly visible on space photographs. This article discusses their presence on space photographs of the southeastern Caucasus. Figure 2 in the text is a map of geological interpretation of this area and serves as the basis for description of interpreted features (particular emphasis is on the Dzheyran-Kechmezskaya depression). In particular, such photos make it possible to detect and analyze transverse faults which are relatively poorly expressed in the relief. Interpretation, as demonstrated in this paper, makes it possible to refine their direction, width and extent. In this region there are transverse faults which in some cases are perpendicular to the general strike of the Caucasus or diagonal (40-60° and 320-340°).
[259]

USE OF THEORY OF ISOSTASY IN GEODESY

Moscow REFERATIVNYY ZHURNAL 52. GEODEZIYA I AEROS"YEMKA, OTDEL'NYY VYPUSK in Russian No 12, 1976 12.52.86

[Abstract of article by Chan Bak Chang; Sofiya, IZV. GL. UPR. GEOD. I KARTOGR., No 4, 1975, pp 33-38, "Possibility of Use of the Theory of Isostasy in Geodesy"]

[Text] A method is proposed for the approximate computation of the potential attracting the layer of the earth's crust. Using the proposed method, based on use of the theory of isostatic adjustment in accordance with the Pratt-Hayford model, it was possible to compute the influence of topographic masses which must be excluded from the free-air gravity anomaly values. The derived formulas, making it possible to take into account anomalous masses under the seas and oceans, was convenient for preparing a program for computations on an electronic computer. The convergence of the series characterizing the sought-for potential in the form of an expansion in spherical functions with values of the coefficients computed using the derived formulas is satisfactory for points selected outside a sphere, covering all the external masses, but is questionable for points lying on the surface of the earth or in its immediate neighborhood.
[392]

DETERMINING ISOSTATIC COMPENSATION SURFACE

Moscow REFERATIVNYY ZHURNAL 52. GEODEZIYA I AEROS"YEMKA, OTDEL'NYY VYPUSK in Russian No 12, 1976 12.52.87

[Abstract of article by G. A. Kharkevich; Novosibirsk, TRUDY NOVOSIB. IN-TA INZH. GEOD., AEROFOTOS"YEMKI I KARTOGR., 34, 1975, pp 25-28, "Determining Isostatic Compensation Surface"]

[Text] The isostatic compensation surface is determined as the surface limiting downward the upper layer of the earth of minimum thickness which includes the earth's entire crust. The depths of points of such a surface are computed on the assumption that the distribution of densities is known, and also the depth of the sea floor, on the basis of a statistical analysis of data from deep seismic sounding, taking into account the curve representing the empirical correlation between the mean velocities of seismic waves and the density of crustal layers. The depth values for different points vary in the range 77-90 km. The distances between the bottom of the crust and the determined isostatic compensation surface attain 60-70 km for oceanic territories with a mean depth for continental regions of 83 km. The accuracy in determining depth by the proposed method for the time being is considerably lower than the accuracy in determination using gravimetric data. In order to increase accuracy by two orders of magnitude it is necessary to increase the density of deep seismic sounding and the reliability

in registry of the Moho discontinuity by the seismic method. Comparison of the results of determination of the compensation surface by different methods of comparable accuracy can be used in evaluating deviations of the earth's surface from a state of hydrostatic equilibrium.
[392]

VERTICAL REFRACTION OVER SEA SURFACE

Moscow REFERATIVNYY ZHURNAL 52. GEODEZIYA I AEROS"YEMKA, OTDEL'NYY VYPUSK in Russian No 12, 1976 12.52.40

[Abstract of article by A. V. Alekseyev; --, GEOD., KARTOGR. I AEROFOTOS"YEMKA. RESP. MEZHVED. NAUCH.-TEKHN. SB., No 24, 1976, pp 3-8, "Investigation of the Vertical Refraction Over the Sea Surface"]

[Text] This paper gives the results of parallel geodetic and meteorological measurements of the coefficient of vertical refraction over an embayment of the sea carried out during the period 13 June-1 July 1973 near Feodosiya. The geodetic part of the program consisted of a periodic determination of the zenith distances of a special light at a distance of 8,046 m using a UV 2"12" astronomical universal instrument. The elevations of the terminal points, equal to about 42.4 and 23.5 m, were determined by geometric leveling. On 15, 17, 20, 22 and 27 June the observations were made around-the-clock. During the daytime the zenith distances were registered each 30 minutes and at nighttime each one hour. In the meteorological measurements specialists registered temperature, air pressure and also wind direction and speed. Temperature measurements were made using a series of TSP-351 sensors (the error in an individual reading was $\pm 0.1°C$), mounted on a gradient mast (the heights were 0, 2, 5, 10, 15, 20 and 25 m). The mast was situated at the water at a distance of 50 m from the light source. Directly at the source was a 2-m mast with psychrometers and anemometers (heights of placement of instruments 0.5 and 2 m). Air pressure was determined at both ends of the path. Some of the measurements were carried out during rain. The results revealed that the diurnal variation of vertical refraction follows the diurnal variation of the vertical temperature gradient. A similar picture is observed in a comparison of the "geodetic" and "meteorological" refraction coefficients, but the amplitudes of the diurnal changes of these coefficients are substantially different. Such a difference is attributable to the inadequate representativeness of meteorological data registered at a limited number of points along the path since the diurnal variation of the coefficient of vertical refraction over the embayment is determined by the total effect of the temperature fields over the land and over the sea. It is noted that during a rain the angle of vertical refraction decreases by about 50%. With a height of the ray above the water surface of about 15 m or more the negative values of the vertical refraction are not observed. The most favorable time for determining zenith distances is the time from 1200 to 1600 hours.
[392]

## V. UPPER ATMOSPHERE AND SPACE RESEARCH

### News

### BACKGROUND NOTES ON COSMONAUTS GORBATKO AND GLAZKOV

Moscow IZVESTIYA in Russian 9 Feb 77 pp 1,2

[Article by B. Konovalov, "Night Sun of Baykonur"]

[Summary] This is the second time that the "Soyuz-24" ship commander Viktor Gorbatko has entered orbit; this was the first time for ship's engineer Yuriy Glazkov. The code name "Terek" has been assigned to the crew in honor of the of the home of the ship's commander, who grew up in the region of the Kuban cossacks. With respect to psychological compatability, the two latest cosmonauts work together and supplement one another beautifully. Gorbatko is a man of action, and Glazkov is an analytical thinker. Gorbatko is a lover of hockey, soccer and tennis. Glazkov's favorite diversion is books and woodcarving. At the cosmonaut training center Gorbatko learned to pilot a helicopter, whereas Glazkov defended his Candidate's dissertation. Thus, they would appear to be completely different personalities, but their relationship during training was excellent and they expressed a desire to enter space together. Gorbatko and Glazkov were standbys for Zudov and Rozhdestvenskiy, but on this day in February, after their many years of training, both entered space together.
[235]

### ADDITIONAL NOTES CONCERNING COSMONAUTS GORBATKO AND GLAZKOV

Moscow TRUD in Russian 8 Feb 77 p 3

[Article by V. Golovachev, "Into Space to Work"]

[Summary] As is common in the Soviet press prior to space launchings, a number of articles appeared prior to the entry of Gorbatko and Glazkov into space. The article cited above gives some vignettes from their life, some background biographical details, the writer making an effort to cast

some light on their personalities. The two began their joint flight preparation program in the summer of 1974. During the last 2 1/2 years the two have scarcely been separated from one another. During this time it became increasingly clear that they were very psychologically compatible, despite many differences in interests and temperaments. Being fellow crew members was their own idea. After graduating from middle school Viktor Gorbatko graduated from aviation schools and then served for three years as a fighter pilot. In the autumn of 1959 he was proposed for cosmonaut training and on 14 March 1960 he was enrolled in the first group of cosmonaut candidates, together with Gagarin. He participated in preparations for many space flights. In the autumn of 1969 he was an engineer-researcher in the three-man "Soyuz-7." On this occasion he was in space for five days, about 120 hours. While at the Cosmonaut Training Center he graduated from the Air Engineering Academy imeni Zhukovskiy. Then he learned to be a helicopter pilot. Nonetheless, most of his time was spent in space trainers. He combined such activity with such tasks as being Chairman of the Society of Soviet-Mongolian Friendship and Chairman of the USSR Federation of Parachute Sport. He has two grown daughters, one in college and the other in the 10th grade. Yuriy Glazkov went from high school to army artillery school and later attended the Khar'kov Higher Aviation Engineering School. After being considered for cosmonaut training, he arrived at Zvezdnyy in 1965. His dissertation prepared during training dealt with the professional activity of a cosmonaut outside his ship in open space. A woodcarver and avid reader, a clear and precise thinker, he and his space comrade complement one another beautifully and assured success of the new space mission.
[239]

EARLY DETAILS OF SPACE MISSIONS RECALLED IN SERIALIZED BOOK

Moscow PRAVDA in Russian 12 Mar 77 p 3

[Article by M. Gallay, "Thank You, 'Vostok'"]

[Abstract] The Soviet newspaper DRUZHBA NARODOV is publishing a serialized version of a book entitled S CHELOVEKOM NA BORTU (With Man on Board), by M. L. Gallay, Doctor of Technical Sciences, honor test pilot and Hero of the Soviet Union, a participant in the training of the first cosmonauts and a witness of the first space flights, a comrade of the most famous of the Soviet cosmonauts. This article in PRAVDA does not constitute a review of the book or indicate much concerning the nature of its contents or in how many installments the book will be published. Instead the article represents unpublished excerpts from a forthcoming excerpt: it deals with rather superficial comments concerning the personality and work of the Chief Designer S. P. Korolev, minor difficulties and malfunctions of spacecraft, launching of the "Vostok-5" and the cosmonaut V. F. Bykovskiy, the design of the "Vostok" ships and their primitiveness in comparison with modern craft, and the "Vostok" contribution to the subsequent space program.
[373]

SOVIET-FRENCH SPACE COOPERATION

Moscow PRAVDA in Russian 10 Apr 77 p 4

[Article by A. Pokrovskiy, "Space and Cooperation"]

[Summary] Soviet journalists were invited to France by the directors of the French National Space Research Center for touring space research facilities there. In one visit they saw the work at an enterprise near Toulouse where the most famous French balloons are produced. Some of these are so large that there will hold Notre Dame cathedral. They are capable of raising a payload of a half-ton to an altitude of 40 kilometers. One French specialist expressed the hope that these balloons will be used in the atmospheres of other planets. French scientists noted that their European colleagues are somewhat envious of the productive Soviet-French space research cooperation which has been so beneficial to the French. This cooperation now has flourished for a decade, since the foundation for it was laid by the Moscow visit of Charles De Gaulle. At Toulouse the newpapermen visited a shop where a French satellite is housed and is undergoing testing under near-space conditions. The satellite is girdled by a gold band which is an integral part of the heat-regulating system. The example of French-Soviet cooperation shows that two countries with different social systems can work together successfully in this field. During the last ten years French instruments have been carried aboard the Soviet "Lunokhod," "Mars" and "Venera" vehicles. Soviet rockets have put French "technological" satellites into orbit. The field of meteorology has been enriched by the launching of meteorological rockets and geophysics has profited from the launching of balloons. Cooperative work is being done in the biology field under the "Tsitos" program. There is some thought that the most significant of all past work was the installation of French laser reflectors aboard the "Lunokhod" vehicles. At Toulouse work was at that time proceeding successfully on the "Sneg-3" satellite which was to be launched by a Soviet carrier-rocket for detecting sources of strong gamma radiation. The French are committed to developing a strong space program and regard their working relationship with the Soviet Union to be a vital link in that task.
[34]

REPORT ON EXPERIMENTS AND EQUIPMENT ON BOARD "SALYUT-5"

Moscow SEL'SKAYA ZHIZN' in Russian 22 Feb 77 p 3

[Article by A. Bachmanov, "The Routine of Space Watch"]

[Summary] The "Salyut-5" has a twin which is remaining on earth during the space flight. In the twin there is complete simulation of the entire flight except for a vacuum and weightlessness. Several men alternately occupy the positions of commander and ship's engineer. They duplicate all the operations which are provided for in the daily programs of the "Salyut-5."

Under conditions coming as close as possible to those prevailing in space they measure the consumption of electric power and fuel and operate all the mechanisms and scientific instrumentation. Aboard the station there is a massive metal sphere capable of rotating in different planes and suspended in a magnetic field. If various sensors indicate that the axes of the instruments are deflected from the center of the earth, after fractions of a second a computer feeds commands for a change in the velocity of rotation of the flywheel-sphere. In order to obtain information on the state of the environment, in addition to photography, the cosmonauts by means of a hand spectrograph (RSS-2M) measured the brightness and degree of polarization of sunlight reflected by different natural features. Such measurements are necessary for evaluating the state of the cloud cover, moisture content of the surface layer of the soil and contamination of the surface of water bodies. Now, during winter, when most of the USSR is covered by snow, these investigations are important for predicting flood waters and moisture reserves in the soil. In one experiment the cosmonauts have six test tubes, two of which are kept in the light and four in the darkness. These tubes hold fungi the size of a match box and are already beginning to develop. Special thermostat apparatus contains ampules with the eggs of a common river fish. The change in the vestibular apparatus of the hatched fish, caused by the absence of gravity, will be checked against observations of similar stages of development under terrestrial conditions. Experiments with the influence of weightlessness are devoted to studies of shoots of Crepis, an ordinary field weed. The cosmonauts took some of the seeds with them and some of them had been aboard the "Salyut-5" since the time of its launching on 22 June of the preceding year. The sprouted seeds have been fixed for subsequent genetic investigations on earth. In another experiment, a heated cylinder contains the organic substances dibenzyl and tolan. The results of these experiments will be compared with data from similar terrestrial experiments. While the experiments and other work continue, the cosmonauts are being constantly monitored themselves. For example, the "Polinom-2M" multifunctional apparatus is used in carrying out ECG examinations. A week after the launching the cosmonauts underwent functional investigations at a state of rest and while performing a measured physical load. Cardiovascular activity is investigated using a vacuum container. A reduced pressure is created on the lower part of the body and blood is drawn there, thereby simulating terrestrial gravity.
[341]

TASS ANNOUNCES LAUNCHING OF "KOSMOS-905"

Moscow PRAVDA in Russian 27 April 77 p 3

[TASS Report: "'Kosmos-905'"]

[Abstract] The artificial earth satellite "Kosmos-905" was launched in the Soviet Union on 26 April 1977. The satellite was inserted into an orbit with the following parameters:

-- initial period, 89.7 minutes;
-- apogee, 366 kilometers;
-- perigee, 179 kilometers;
-- orbital inclination, 67.1 degrees.

TASS ANNOUNCES LAUNCHING OF "KOSMOS-906"

Moscow PRAVDA in Russian 28 Apr 77 p 3

[TASS Report: "'Kosmos-906'"]

[Abstract] The artificial earth satellite "Kosmos-906" was launched in the Soviet Union on 27 April 1977. The satellite was inserted into an orbit with the following parameters:
-- initial period, 94.3 minutes;
-- apogee, 523 kilometers;
-- perigee, 466 kilometers;
-- orbital inclination, 50.7 degrees.

INFORMATION ON "ORBITA" SYSTEM PRESENTED

Moscow PRAVDA in Russian 7 May 77 p 1

[Unsigned article: "Today is Radio Day"]

[Excerpt] Since January three-zone broadcasting has been in operation using the "Orbita" system. This system enables broadcasts of Central Television's first program to be received in many areas of Siberia, the Far East and the Far North in autumn.

From year to year the material-technical base of television and radio broadcasting is expanding. Approximately 400 power and 1,700 other television repeater stations and also more than 70 "Orbita" ground stations are operating in the country. [5]

TASS ANNOUNCES LAUNCHING OF "KOSMOS-907"

Moscow PRAVDA in Russian 6 May 77 p 3

[TASS Report: "'Kosmos-907'"]

[Abstract] The artificial earth satellite "Kosmos-907" was launched in the Soviet Union on 5 May 1977. The satellite was inserted into an orbit with the following parameters:

-- initial period, 89.9 minutes;
-- apogee, 388 kilometers;
-- perigee, 187 kilometers;
-- orbital inclination, 62.8 degrees. [5]

## "SALYUT-5" STATION COMPLETES TENTH MONTH IN ORBIT

Moscow PRAVDA in Russian 23 April 1977 p 3

[TASS Report: "'Salyut-5': Ten Months in Orbit"]

[Text] Flight Control Center, 22 April. The "Salyut-5" scientific station, which was inserted into near-earth orbit on 22 June 1976, has successfully completed 10 months in controlled flight.

By 1400 hours Moscow time the station had completed 4,885 revolutions around the earth. After a trajectory correction performed on 15 April the orbital parameters of the station are:
-- apogee, 273 kilometers;
-- perigee, 260 kilometers;
-- period of revolution, 89.6 minutes;
-- orbital inclination, 51.6 degrees.

In accordance with the program of operations in an automatic mode, further tests of on-board systems, apparatus and units under conditions of prolonged spaceflight are continuing. In addition, scientific and technical studies and experiments are being performed.

Parameters of the microclimate in the station's compartments are within the required limits. Atmospheric pressure is 800 mm Hg; temperature is 21°C. According to telemetry data, the on-board systems of the station are functioning normally. The data received on the ground are being processed.

The flight of the "Salyut-5" station is continuing. [4]

## TASS ANNOUNCES LAUNCHING OF "MOLNIYA-3" COMMUNICATIONS SATELLITE

Moscow PRAVDA in Russian 29 Apr 77 p 3

[TASS Report: "'Molniya-3' is in Flight"]

[Text] In accordance with the program for further development of communication systems using artificial earth satellites, on 28 April 1977 a "Molniya-3" communications satellite was launched from the Soviet Union into a high elliptical orbit. The satellite has an on-board repeater apparatus providing

for operation of the system in the centimeter wavelength range.

The "Molniya-3" communications satellite is intended for operation in the system of long-range telephone and telegraph radio communication in the Soviet Union, for transmission of USSR Central Television programs to points in the "Orbita" network, and for international cooperation.

The satellite was inserted into an orbit with the following parameters:
-- apogee, 40,817 kilometers in the northern hemisphere;
-- perigee, 467 kilometers in the southern hemisphere;
-- period of revolution, 12 hours 16 minutes;
-- orbital inclination, 62.8 degrees.

In addition to apparatus for transmission of television programs and for providing long-range multichannel radio communication, the satellite carries a command and measurement complex and also systems for orientation, orbital correction and power supply for the satellite.

Communications sessions using the "Molniya-3" satellite will be conducted in accordance with the planned program. [4]

Abstracts of Scientific Articles

INHOMOGENEITIES OF ELECTRON CONCENTRATION IN LOWER IONOSPHERE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 233, No 1, 1977 pp 85-88

[Article by G. M. Teptin and Yu. M. Stenin, Kazan' State University, "Spectrum of Inhomogeneities of Electron Concentration in Lower Ionosphere"]

[Abstract] Recent experimental and theoretical investigations indicate the following picture of the spectral distribution of the scales of turbulent inhomogeneities of the principal factors exerting an influence on the evolution of inhomogeneities in a temperature-inhomogeneous atmosphere for the case of stationary ionization. Scales less than the internal Kolmogorov scale $\ell_0$ are destroyed under the influence of viscous forces. Measurements by the method of radar observations of meteor trails have shown that at altitudes 80-100 km the value $\ell_0 \sim 15$-25 n. The region of predominant influence of inertial forces on evolution of inhomogeneities extends from $\ell_0$ to dimensions r = 400-600 m. Then, to scales r = 4.5-5 km there is a region of operation of Archimedes forces in which turbulence is no longer isotropic, but is axially symmetric. With an increase in dimensions the anisotropy increases. At the considered altitudes 80-100 km already with $r \sim 6$ km there is a maximum vertical scale of turbulent inhomogeneities, whereas in the horizontal plane the external scale of turbulence attains 50 km. The maximum scale of synoptic changes in the lower ionosphere is about 3,000 km. Large-scale inhomogeneities can be assigned to the class of quasi-two-dimensional movements for which the law of conservation of the square of vorticity or enstrophy is satisfied. The authors obtained the form of the spectrum of fluctuations of N in the entire interval of the scale of inhomogeneities existing in the lower ionosphere. A similar approach also makes it possible to find the temporal spectral functions. There was found to be a good agreement between experimental and theoretical data.
[353]

## ALGORITHMS FOR DETECTING SIGNALS AGAINST NOISE BACKGROUND

Moscow REFERATIVNYY ZHURNAL 62. ISSLEDOVANIYE KOSMICHESKOGO PROSTRANSTVA, OTDEL'NYY VYPUSK in Russian No 3, 1977 3.62.481K

[Abstract of article by L. S. Gurin and K. A. Tsoy; Moscow, MNOGOUROVNEVAYA SISTEMA ALGORITMOV OBNARUZHENIYA I VYDELENIYA SIGNALOV NA FONE POMEKH (Multilevel System of Algorithms for the Detection and Discrimination of Signals Against a Noise Background), Space Research Institute USSR Academy of Sciences, Preprint 276, 42 pages]

[Text] In a number of cases (in particular, when carrying out a controlled space experiment) the problem of detecting and discriminating signals against a background of noise must be solved in several stages. First the information is processed using less precise, but also less time-consuming algorithms, and then, on the basis of the results of such processing a part of the information is subjected to further processing using more precise algorithms. The authors have investigated such a system of algorithms and give a comparative evaluation of a number of lower-level algorithms and the corresponding characteristics of the upper-level algorithm.
[61]

## SOFT X-RADIATION OF SOLAR FLARES

Moscow REFERATIVNYY ZHURNAL 62. ISSLEDOVANIYE KOSMICHESKOGO PROSTRANSTVA, OTDEL'NYY VYPUSK in Russian No 3, 1977 3.62.118

[Abstract of article by O. M. Kovrizhnykh, N. I. Nazarova, V. M. Pankov and L. M. Chupova; Moscow, SOLNECHNYYE DANNYYE, No 7, 1976, pp 44-51, "Soft X-Radiation of Solar Flares in March 1973"]

[Text] This is an analysis of information on the X-radiation of the sun in the region 5-30 keV during the period 1-29 March 1973 obtained using the RS spectrometer on the artificial earth satellite Prognoz-3. X-radiation was registered using a proportional counter with an entrance window of Be ($\sim 70\,\mu$m) filled with a mixture of 90% Xe + 10% $CH_4$ at a pressure of 0.85 atm. The spectrometer had four energy channels: 2-5, 5-10, 10-20, 20-30 keV. During the indicated time interval it was possible to register 72 increases in the intensity of X-radiation with $E > 5$ keV with a duration of $\sim 3$ min. The mean duration of the considered bursts is $> 22$ min. The mean times of increase and dropoff are 6.6 and 15.8 minutes respectively. The authors give a comparison of X-ray bursts with optical flares, type-III radiobursts and bursts in the microwave range. It is noted that according to data from the Prognoz 3 artificial earth satellite only 17% of the subflares are accompanied by X-radiation with an energy of 5-10 keV with a duration $\gtrsim 3$ min and an intensity exceeding by a factor of more than two the background level.
[61]

REVIEW OF THE SOLAR WIND

Moscow REFERATIVNYY ZHURNAL 62. ISSLEDOVANIYE KOSMICHESKOGO PROSTRANSTVA, OTDEL'NYY VYPUSK in Russian No 3, 1977 3.62.212

[Abstract of article by M. Drayer and S. Kuperman; Moscow, NABLYUDENIYA I PROGNOZ SOLNECH. AKTIVNOSTI, "Mir," 1976, pp 173-201, "The Solar Wind. A Review"]

[Text] This is a concise review of the measured parameters of the solar wind and hydrodynamic models of its escape. The article gives the parameters of the inner and outer solar corona for heliocentric distances 1.02-30 $R_{\odot}$. Bibliography of 57 items.
[61]

REMOTE SENSING BY THERMOGRAPHIC METHOD

Moscow REFERATIVNYY ZHURNAL 62. ISSLEDOVANIYE KOSMICHESKOGO PROSTRANSTVA, OTDEL'NYY VYPUSK in Russian No 3, 1977 3.62.265

[Abstract of article by Anton Sindik; Belgrade, TEHNIKA, 31, No 7-8, 1976, pp 1099-1104, "Remote Sensing by the Thermography Method"]

[Text] The author notes the universality of the methods used in scanning surveys, making it possible to obtained images of the earth's surface in a broad region of the spectrum of electromagnetic oscillations, including thermography -- obtaining images of the thermal IR spectral region. The article describes the fundamental peculiarities of thermographic systems and the possible fields of their applicability. Bibliography of three items.
[61]

MICROPHOTOMETRIC MEASUREMENTS OF MULTIZONAL TV IMAGES

Moscow REFERATIVNYY ZHURNAL 62. ISSLEDOVANIYE KOSMICHESKOGO PROSTRANSTVA, OTDEL'NYY VYPUSK in Russian No 3, 1977 3.62.270

[Abstract of article by G. I. Borisoglebskiy, N. N. Koptseva and G. A. Malakhova; Moscow, TRUDY N.-I. TSENTRA IZUCH. PRIROD. RESURSOV, No 2, 1976, pp 38-45, "Results of Microphotometric Measurements of Multizonal Television Images of the Underlying Surface"]

[Text] A study was made of the possibility of using microphotometric measurements in an interpretation of TV images obtained from artificial earth satellites. The article gives the values of the optical densities of the

images of a number of physiographic zones in different spectral sectors. Bibliography of seven items.
[61]

PRINCIPAL DIRECTIONS IN SPACE TECHNOLOGY

Moscow REFERATIVNYY ZHURNAL 62. ISSLEDOVANIYE KOSMICHESKOGO PROSTRANSTVA, OTDEL'NYY VYPUSK in Russian No 3, 1977 3.62.309

[Abstract of article in rotaprint; Moscow, OSNOVNYYE NAPRAVLENIYA I ZADACHI KOSMICHESKOGO TEKHNOLOGII (Principle Directions and Tasks in Space Technology), Space Research Institute USSR Academy of Sciences, Preprint 300, 1976, 35 pages]

[Text] The authors note the great possibilities of development of a new field of science and technology -- space technology when using such properies of space as weightlessness and a deep vacuum. The principal technological processes in space are determined by the patterns of behavior of matter under weightlessness conditions. Therefore the most important task is study of the peculiarities of the course of a whole series of physicochemical phenomena under these conditions. Included among these phenomena are diffusion, surface tension, heat transfer, crystallization in the liquid phase of matter, etc. Also considered are the peculiarities of the course of these phenomena. Their mathematical description is given. It is assumed that the conditions of weightlessness attainable at the center of mass of the artificial earth satellite are characterized by an acceleration of $10^{-6}$ g; beyond its center of mass the acceleration is up to $10^{-3}$ g.
[61]

MOTION OF BODY OF VARIABLE REST MASS IN GRAVITY FIELD

Moscow REFERATIVNYY ZHURNAL 62. ISSLEDOVANIYE KOSMICHESKOGO PROSTRANSTVA, OTDEL'NYY VYPUSK in Russian No 3, 1977 3.62.314

[Abstract of article by B. K. Fedyushin; Moscow-Leningrad, DINAMIKA I EVOLYUTSIYA ZVEZDN. SISTEM (Ser. Probl. Issled. Vselennoy, No 4, 1975, pp 200-207, "Motion of a Body of Variable Rest Mass in a Constant Plane Gravity Field"]

[Text] A study is made of the one-dimensional motion of a body of variable rest mass in a constant plane gravity field on the basis of the general theory of relativity formulated by Einstein. The author examines and analyzes cases of a one-dimensional flight of a relativistic flightcraft of variable rest mass using interstellar hydrogen, a Bussar apparatus and a

relativistic rocket. The author gives a limiting transition to the special theory of relativity and it is shown that on the basis of the general theory of relativity it is possible to formulate a new relativistic rocket dynamics which will have a far more general character than the presently existing rocket dynamics. Bibliography of nine items.
[61]

ORBITS IN APPLIED PROBLEMS OF CELESTIAL MECHANICS

Moscow REFERATIVNYY ZHURNAL 62. ISSLEDOVANIYE KOSMICHESKOGO PROSTRANSTVA, OTDEL'NYY VYPUSK in Russian No 3, 1976 3.62.321

[Abstract of article by A. K. Platonov and R. K. Kazakova; Moscow, SISTEMA PROYEKTIROVANIYA ORBIT V PRIKLADNYKH ZADACHAKH NEBESNOY MEKHANIKI (System for the Planning of Orbits in Applied Problems of Celestial Mechanics), Institute of Applied Mathematics USSR Academy of Sciences, Preprint No 106, 1976, 39 pages]

[Text] The article describes a system designed for the forming of orbits in space and obtaining the characteristics of motion using man-machine dialogue methods. The planning of orbits is based on use of interactive machine graphics techniques. Also considered is the problem of defining the base operations of the planning language and examples of the formulation of flight orbits to the planet Venus are given.
[61]

SATELLITE OSCILLATIONS IN PLANE OF ELLIPTICAL ORBIT

Moscow REFERATIVNYY ZHURNAL 62. ISSLEDOVANIYE KOSMICHESKOGO PROSTRANSTVA, OTDEL'NYY VYPUSK in Russian No 3, 1977 3.62.329

[Article by N. V. Mel'nik; Moscow, 2-$\pi$ PERIODICHESKIYE KOLEBANIYA SPUTNIKA V PLOSKOSTI ELLIPTICHESKOY ORBITY PRI NALICHII SOPROTIVLENIYA ATMOSFERY (2 -Periodic Oscillations of a Satellite in the Plane of an Elliptical Orbit in the Presence of Atmospheric Drag"), Moscow, Institute of Applied Mathematics USSR Academy of Sciences, Preprint No 119, 1976, 46 pages]

[Text] A study was made of $2\pi$-periodic oscillations of an artificial earth satellite in the plane of an elliptical orbit with allowance for the influence of atmospheric drag. The author determined the regions of existence and stability of these solutions for different values of the aerodynamic parameter $\varkappa_0$.
[61]

## SUBMILLIMETER RADIATION OF CONVECTIVE CLOUD SYSTEMS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 13, No 4, 1977 pp 391-398

[Article by Ye. P. Dombkovskaya, A. Ye. Salomonovich, S. V. Solomonov and A. S. Khaykin, Physics Institute USSR Academy of Sciences, "Investigation of Submillimeter Radiation of Convective Cloud Systems of the Tropical Region from Aboard the 'Kosmos-669' Artificial Earth Satellite"]

[Abstract] This paper discusses the results of observations of cloud concentrations in the tropical region from the AES "Kosmos-669" carried out in two parts of the submillimeter range: 450-650 and 80-140$\mu$m. These cloud formations in the submillimeter range cause a marked decrease in brightness occurring on a common slowly changing background. The extent of such regions of reduced brightness is considerably less than the extent of the cloud fields on the IR images causing this decrease and the decrease in brightness in them, usually being from 10 to 30°K, is dependent on the stage of development of the cloud system. The form of these regions reveals finer details evidently characterizing the fine structure of the corresponding cloud systems. The results of synchronous observation in two spectral regions of the very same cloud systems over a period of several days make it possible to assume that the observed brightness changes can be caused by a redistribution of the height of the radiating layers in convective cells. On the basis of this hypothesis and using the results of the experiment on the "Kosmos-669" AES it can be concluded, in particular, that there is a complex convective structure of cloud systems in the tropical zone and in the Intratropical Convergence Zone.
[70]

## COMBINED BRAKING OF SPACECRAFT IN ATMOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 2, 1977 pp 179-185

[Article by V. G. Konyayev, "Analysis of the Possibilities of Combined Braking of a Spacecraft in the Atmosphere"]

[Abstract] The author examines the problem of combined braking of a spacecraft having a hyperbolic velocity during flight approach to the earth. It is assumed that the braking of the spacecraft can occur both beyond the atmosphere and in it. Outside the atmosphere the spacecraft is braked by means of a rocket engine and in the atmosphere the braking occurs passively, without an engine, during which due to ablation there is an eroding away of the outer layer of the heat-shielding layer. Limiting himself to spacecraft having a simple configuration of a body of revolution, in an earlier study (UCHENYYE ZAPISKI TsAGI, 4, No 6, 1973) the author demonstrated that in the atmospheric segment the erosion of mass of the heat-

shielding layer and the velocity of motion of the spacecraft in the first approximation are related by a simple differential expression dependent on the spacecraft trajectory parameters in the atmosphere and the physical properties of the heat-shielding layer but are not explicitly dependent on the spacecraft configuration. This circumstance makes it possible to reduce the general problem of combined braking to a simpler form in mathematical respects. Further investigations demonstrated that such a simplified problem allows an analytical solution and in explicit form it is possible to obtain not only the optimum trajectories, but also to determine the conditions under which exoatmospheric segments of spacecraft braking are desirable. The author obtains the optimum conditions for motion of the vehicle in the atmosphere and a parameter is found which determines the extent of the aerodynamic and active braking segments. The total losses of vehicle mass are computed for the period of the braking maneuver.
[57]

GYROSCOPIC STABILIZATION OF SPACECRAFT DURING RE-ENTRY

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 2, 1977 pp 186-191

[Article by A. V. Sorokin, "Gyroscopic Stabilization of a Spacecraft During Atmospheric Re-entry"]

[Abstract] A study was made of the rotational motion of a gyrostabilized spacecraft of the ballistic type during atmospheric re-entry. Asymptotic expansions of solutions of the equations of motion are obtained and they are analyzed. In the case considered here use is made of a pair of gyroscopes with three degrees of freedom with a so-called conical suspension. The theory and functioning of such a system are considered in detail. The results presented here demonstrate the possibility of damping of the angular oscillations of a spacecraft during atmospheric re-entry by use of gyroscopic apparatus. The conclusions drawn concerning the influence of a gyrostabilizer on the motion of a spacecraft can be applied to other systems of gyrostabilizers having a symmetrical design. Examples of such systems are two pairs of gyroscopes with two degrees of freedom whose axes of stabilization are directed along the transverse axes of the spacecraft and two gyroscopes with two degrees of freedom in which in the initial position the kinetic moments of the gyroscopes are directed along the longitudinal axis and the stabilization axes are directed along the transverse axes of the coordinate system coupled to the spacecraft body. The motion of a spacecraft with such gyrostabilizers is described in a linear approximation by equations similar to those presented in this paper.
[57]

COLLECTION OF PAPERS ON IONOSPHERIC RESEARCH

Moscow IONOSFERNYYE ISSLEDOVANIYA. REZUL'TATY ISSLEDOVANIY PO MEZHDUNARODNYM GEOFIZICHESKIM PROYEKTAM (Ionospheric Research. Results of Research on International Geophysical Projects) in Russian, No 23, Izd-vo "Nauka," 1975, 96 pages

[Abstract of collection of articles]

[Abstract] This collection contains papers devoted to experimental and theoretical investigations of the ionosphere. Experimental investigations of different parameters of the ionosphere were carried out by the partial reflections method, the method of incoherent scattering of radio waves in the ionosphere, the ground vertical sounding method and by observing the radio beacons of different satellites. The theoretical studies are devoted primarily to an investigation of the physical mechanisms of the seasonal anomalies and the effects of disturbances in the electron concentration of the F region and the outer ionosphere. The collection is of scientific and practical interest for a wide range of geophysicists and radiophysicists and also engineers and students in advanced courses in physics.

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PAPERS ON PHYSICS OF THE UPPER ATMOSPHERE

Yakutsk FIZIKA VERKHNEY ATMOSFERY VYSOKIKH SHIROT (Physics of the Upper Atmosphere in the High Latitudes) in Russian No 3, Izdaniye Yakutskogo Filiala SO AN SSSR, 1975, 264 pages

[Abstract of collection of articles]

[Abstract] This collection of papers continues the publication of the results of complex investigations of the upper atmosphere carried out in the northeastern USSR. The collection is of interest for specialists in the field of planetary geophysics, students in advanced courses in physics-mathematics faculties of universities and engineering-technical workers engaged in the construction and operation of geophysical apparatus.

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## TRAPPED ELECTRONS IN AURORAL ZONE DURING SUBSTORMS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 2, 1977 pp 267-272

[Article by S. N. Kuznetsov, L. L. Lazutin and V. Ye. Tsirs, Nuclear Physics Institute, Moscow State University, "Dynamics of Trapped Electrons in the Auroral Zone During Substorms"]

[Abstract] The purpose of this study was a determination of the principal variations in the outer radiation belt in the course of a magnetospheric substorm. The authors use data from measurements of trapped electrons with $E_e$ = 20 keV-1.4 MeV in four local time sectors of the magnetosphere on the "Kosmos-426" satellite. The study was based on 49 fly-throughs during the magnetic storm of 22-25 November 1971, during the quieter period 11-12 November 1971 and the magnetically quiet day 15 November 1971. The following picture was obtained for the dynamics of behavior of high-energy electrons

during magnetospheric substorms. The preparatory phase is a decrease in the region of trapping of electrons in all LT sectors. The active phase is characterized by the acceleration of electrons from the nighttime side (with an increase in the intensity of the process it can take in the morning side). The maximum phase is very short, is observed relatively rarely and is evidently a part of the active phase. During the restoration phase on the nighttime, morning and evening sides the region of registry of electrons can attain considerably greater L than during a quiet period (acceleration of the collapse type). On the daytime side of the magnetosphere the increase in the flux of electrons during a substorm is probably determined by two mechanisms -- drift of particles injected on the nighttime side and acceleration of the collapse type.
[50]

## STRUCTURE OF ELECTRIC FIELD OF POLAR ELECTROJET

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 2, 1977 pp 280-285

[Article by L. L. Van'yan, V. G. Dubrovskiy, S. A. Kramarenko and Ye. P. Kharin, Institute of Physics of the Earth and Atmosphere Turkmen Academy of Sciences, Institute of Oceanology and World Geophysical Data Center, "An Evaluation of the Spectral Structure of the Electric Field of the Polar Electrojet"]

[Abstract] A study was made of the possibility of a stochastic approach to an evaluation of the spectral structure of the electric fields of the auroral electrojet and fluctuations of its conductivity within the framework of a stochastic model approximating the variable geomagnetic field of a locally stationary random process. The experimental data presented in this paper indicate a closeness of the relative spectral composition of the interplanetary electric field, fluctuations of auroral electric currents and fluctuations of conductivity in the ionosphere. This supports the theory proposed by S. I. Isayev that postulates that the electric field of the solar wind is the only source causing the leakage of auroral electrons and generating auroral electric currents as a result of interaction with the geomagnetic field.
[50]

## DIURNAL VARIATIONS OF GEOMAGNETIC FIELD IN MAGNETICALLY CONJUGATE REGIONS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 2, 1977 pp 286-290

[Article by Kh. D. Kanonidi and N. K. Osipov, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "Quiet Diurnal Variations of the Geomagnetic Field at Magnetically Conjugate Points"]

[Abstract] This paper gives an analysis of experimental data on the relationship of the phases and amplitudes of $S_q$ variations in magnetically conjugate regions and on this basis a study is made of the correlation of peculiarities in the structure of the field of $S_q$ variations and variations of the interplanetary magnetic field. For solution of this problem the authors used data for Kerguelen station (southern hemisphere) and a number of stations in the northern hemisphere. All the stations whose data were used are located within the closed magnetosphere, but during periods of moderate magnetic activity also within the plasmopause. Only data for the period of the spring equinox (March 1968, 1971, 1974) were used. The analyzed data presented here make it possible to postulate that the reason for change in structure of the $S_q$ variation and the appearance of magnetically conjugate effects in $S_q$ variations within the plasmopause is variations of the interplanetary magnetic field.
[50]

## MAGNETIC EFFECTS OF CHROMOSPHERIC FLARES

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 2, 1977 pp 291-297

[Article by V. A. Sergeyev, Physics Institute, Leningrad State University, "Magnetic Effects of Chromospheric Flares and the Electric Field in the High-Latitude Ionosphere. I. Polar Cap Region"]

[Abstract] A study of current systems in magnetic disturbances of the crochet type was made for the purpose of obtaining the global picture of electric fields in the high-latitude ionosphere for different conditions. It was found that under definite conditions (completely illuminated polar cap) the investigation of the current systems in intensive crochets makes it possible to obtain approximately the global pattern of distribution of electric fields in the illuminated high-latitude ionosphere. Under quiet conditions (with a northerly Z component of the interplanetary magnetic field) in the polar cap the main system is a system of meridional E currents directed in both hemispheres to the north with $B_Y > 0$ and to the south with $B_Y < 0$. The corresponding Pedersen currents are closed by longitudinal currents. Under conditions of disturbance of the DP-2 ($B_Z > 0$) type the system of electric fields discriminated from the crochets shows a Hall nature of the currents responsible for ordinary DP-2 variation.
[50]

## AURORAL X-RADIATION AND VLF EMISSION OF UPPER ATMOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 2, 1977 pp 298-300

[Article by A. M. Novikov, Yu. G. Shafer and V. D. Sokolov, Institute of Space Physics Research and Aeronomy Yakutsk Affiliate Siberian Department USSR Academy of Sciences, "Interrelationship of Auroral X-Radiation and VLF Emission of Upper Atmosphere"]

[Abstract] Investigations of the interrelationship between auroral X-radiation and the very low-frequency emission of the upper atmosphere can give information on the mechanism of leakage of particles because particles and waves effectively interact in the earth's magnetosphere. In this paper the authors give an analysis of the time relationships between these effects on the basis of data from a series of synchronous observations of x-bremsstrahlung in the stratosphere and ground measurements of VLF emission during the period 1967-1969. The registry of x-radiation was accomplished using pilot balloons with gas-discharge and scintillation counters in the Tiksi Bay region ($\Phi$ = 65.6°N, $\lambda$ = 195.2E, L = 5.57). First, the authors examine isolated bursts of x-radiation and VLF emission. (By isolated bursts of x-radiation is meant bursts with a duration of several minutes which are observed with a time interval considerably exceeding their duration and which can have a fine structure.) Then the article examines prolonged bursts of x-radiation and VLF emission (tens of minutes) which occur during the time of considerable magnetic disturbances ($K_p$ = 2-8) and a number of other auroral effects. It is shown that the earth's atmosphere is penetrated by fluxes of x-radiation (electrons) with energies from several tens to hundreds of keV exhibiting a correlation with VLF emission. This in turn indicates the existence of a correlation between dynamic processes in the field of acceleration of electrons and the generation of VLF emission.
[50]

## SECONDARY ELECTRONS REGISTERED AT EQUATOR BY SATELLITE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 2, 1977 pp 338-339

[Article by R. N. Basilova, N. L. Grigorov, L. F. Kalinkin, G. I. Pugacheva, I. A. Savenko, Nuclear Physics Institute Moscow State University, "Fluxes of Secondary Electrons at Equator According to Data from the 'Kosmos-428' Artificial Earth Satellite"]

[Abstract] The "Kosmos-428" artificial earth satellite was used in carrying out investigations of secondary electrons in the energy range 80-3,000 MeV. The instrumentation employed was similar to that which was carried aboard many earlier satellites. This satellite was launched on 24 June 1971 into an orbit with an apogee 300 km, perigee 200 km, orbital inclination 51.5°, period of revolution about 90 minutes. The axes of the instrument telescopes were oriented to the zenith. A table in the text gives the relative and absolute magnitudes of the fluxes of secondary electrons for four energy thresholds of the instrument determined in the region of geomagnetic cutoff rigidities $R_c \geqslant 10$ GeV/sec. It is shown that the intensity of the fluxes of secondary electrons with $E_e > 80$ MeV is about 50% of the flux of protons in primary cosmic rays; this coincides with the conclusions drawn from experiments on earlier "Kosmos" and "Proton" experiments. The table also gives the total fluxes of electrons determined for four energy thresholds of the instrument. A figure shows the integral energy spectrum and

the fluxes of secondary electrons in the energy range 80-3,000 MeV, determined in an experiment on the AES "Kosmos-428," as well as other satellites. The integral energy spectrum is approximated by a power law with the exponent $\gamma = 1.0 \pm 0.1$. The fluxes of secondary electrons determined in these experiments are in satisfactory agreement. This confirms the existence of earlier detected considerable fluxes of secondary electrons at altitudes 200-300 km in the region of the geomagnetic equator.
[50]

## TURBIDITY COEFFICIENT FOR AURORAL IONOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 17, No 2, 1977 pp 350-352

[Article by N. F. Blagoveshchenskaya, D. V. Blagoveshchenskiy and Yu. A. Kurchenko, Siberian Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation Siberian Department USSR Academy of Sciences, "On the Turbidity Coefficient for the Auroral Ionosphere"]

[Abstract] In the high latitudes in the variations of the turbidity coefficient ($\beta^2$) one should expect differences associated with peculiarities of the auroral ionosphere. The author of this paper describes the patterns of temporal changes in the turbidity coefficient for the auroral ionosphere obtained on the basis of experimental data for three high-latitude paths during the winter and equinoctial periods. Radio path 1 passes along the auroral zone, path 2 lies across the auroral zone and path 3 has a subauroral meridional direction. The working frequencies on the first path were in the range 9-11 MHz, on path 2 -- 5-7 MHz and on path 3 -- 4-6 MHz in the nighttime hours and 6-10 MHz in the daytime hours. The authors processed records of the envelope of the reflected signal R(t) with a duration from fractions of a minute to several minutes. It was found that the diurnal variation of the turbidity factor on auroral and subauroral paths differs from the middle-latitude variation during both quiet and disturbed periods. The values of the turbidity factor for the auroral ionosphere during the daytime hours are considerably lower and during the nighttime hours are greater than in the middle latitudes. During disturbed periods in winter and the equinox on the high-latitude paths in the evening and nighttime hours there are maximum values of the turbidity factor, whereas in the morning and daytime hours minimum values are observed. The mean $\beta$ level during the nighttime hours falls in the range $1.5 < \beta < 2.5$ and the daytime hours were in the range $0.8 < \beta < 1.5$. The highest values of the probability P are observed on a subauroral path; the lowest are observed on a path across the auroral zone.
[50]

MONOGRAPH ON RADIO CONTROL OF SPACECRAFT RENDEZVOUS

Moscow RADIOUPRAVLENIYE SBLIZHENIYEM KOSMICHESKIKH APPARATOV (Radio Control of Spacecraft Rendevous) in Russian "Sovetskoye Radio," Moscow, 1976 240 pages

[Abstract of monograph by V. S. Goncharevskiy]

[Abstract] In this book the author examines the principles for the designing of spacecraft radio control systems intended for use in the operation of rendezvous of spacecraft in orbit. General information is given on the rendezvous and approach maneuvers. Also given are the characteristics of individual elements of the on-board system for the radio control of approach. The problems involved in developing programming and correcting controls of the approach maneuver are given. Particular attention is devoted to an analysis of the two principal groups of methods and systems for the radio control of approach most widely employed in practical work: the methods and systems of free trajectories and also the methods and systems for approach along the line of sight. The author gives examples of the construction and use of Soviet and foreign systems for the radio control of approach and also their on-board measurement complexes. The book is intended for a broad range of readers interested in the control and radio control of space vehicles. Eighty-one figures and bibliography of 129 items.

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SPECTROMETER FOR COSMIC ELECTRONS

Moscow REFERATIVNYY ZHURNAL, 62. ISSLEDOVANIYE KOSMICHESKOGO PROSTRANSTVA, OTDEL'NYY VYPUSK in Russian No 3, 1977 3.62.109

[Abstract of article by S. A. Voronov, A. F. Kustovskiy, B. I. Luchkov and V. A. Fedorov; Moscow, ELEMENTAR. CHASTITSY I KOSMICH. LUCHI, No 4, Atomizdat, 1976, pp 11-15, "Cosmic Electron Spectrometer Operating in Energy Range 100-1,000 MeV"]

[Text] The article describes a spectrometer for measuring the charge makeup and energy spectrum of cosmic particles aboard an artificial earth satellites and high-altitude balloons with a magnetized block of matter. It is characterized by extreme simplicity, a great effective area of small mass and an insignificant power consumption. The instrument consists of a telescope formed by scintillation counters and a directed Cerenkov counter, electromagnet with a core in the form of a steel plate with a thickness of

2 cm, constituting a block of magnetized matter, and spark chambers at the top and bottom of the magnet and a shower spark chamber at the bottom. Multiple scattering in the block of matter limits the resolution of such a spectrometer and the charge makeup and the energy spectra in it are determined only indirectly, as a result of a statistical analysis of the collected material. For checking the method for measuring the charge composition and spectrum of electrons the authors carried out calibration of the instrument using electron accelerators in the energy ranges 100-500 MeV and 200-2,000 MeV. The results of the calibration showed that the instrument makes it possible to measure the charge makeup and spectrum of electrons in the energy range 100-1,000 MeV with an error of about 10% with observation statistics for 1,000 particles. The instrument was used in 1972-1973 for measurements on balloons to an altitude of 33 km. [61]

STRATOSPHERIC CONTENT OF NITROGEN DIOXIDE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 13, No 4, 1977 pp 417-420

[Article by G. Ye. Sinel'nikova and M. S. Kiseleva, "Experimental Estimates of the Stratospheric Content of Nitrogen Dioxide"]

[Abstract] This communication represents a continuation of earlier work by the authors (see TRUDY TsAO, 11, No 6, 1975). The authors now give the results of estimates of the concentration of nitrogen dioxide and its dimer $N_2O_4$ at altitudes 11-26 km obtained on the basis of data from measurements of solar spectra made from stratospheric balloons. The solar spectrograms were registered prior to sunset from altitudes as great as 30 km in the region of the $2\nu_1$ and $\nu_1 + \nu_2$ absorption bands near 3.83 $\mu$m. The measurements were carried out during the summer (July 1971, 1972) in the Ryl'sk region. The instrumentation was described in the earlier paper. In this article the authors limit themselves to an estimate of the probable levels of the $NO_2$ concentrations in the stratosphere. It is shown that the estimates reveal an increase in the $NO_2$ concentration with an increase in altitude and agree with data from most theoretical and experimental studies. [70]

COSMIC RADIATION UNDER EARTH'S RADIATION BELTS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 2, 1977 pp 223-228

[Article by Yu. A. Aleksandrov, S. P. Kuznetsov, Yu. I. Logachev and V. G. Stolpovskiy, "Cosmic Radiation Under the Earth's Radiation Belts"]

[Abstract] Using the single gas-discharge counter carried aboard the "Kosmos-426" artificial earth satellite it was possible to ascertain the distribution of cosmic rays at latitudes from the equator to the polar cap at altitudes greater than 400 km. Whereas in the polar caps the vertical distribution of cosmic rays is attributable only to the presence of two components (primary cosmic radiation and albedo radiation emanating from the atmosphere), at latitudes from the equator to $\lambda \approx 50°$ a significant role is played by the capture of albedo particles. Such "quasitrapped" particles evidently do not survive more than one drift revolution. A mechanism for the quasitrapping of albedo particles is proposed.
[57]

COSMIC RAY MEASUREMENTS ABOARD "MARS" PROBES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 2, 1977 pp 316-321

[Article by Ye. Ya. Volodin, I. V. Getselev, Ye. V. Gorchakov, A. V. Dunayevskiy, V. A. Iozenas, P. P. Ignat'yev, N. N. Kontor, G. P. Lyubimov, Yu. A. Rozental', M. V. Ternovskaya, V. I. Tkachenko, V. P. Chashin, T. Ye. Shvidkovskaya and V. A. Yakovlev, "Measurement of Cosmic Rays Aboard the 'Mars-4, 5, 6, 7' Space Probes"]

[Abstract] The space probes "Mars-4, 5, 6, 7" carried identical charged particle counters for the registry of cosmic ray protons in the energy range from 0.3 to 500 Mev. At the same time it was possible to register electrons from 50 keV to 7 MeV. Data on cosmic rays were registered with a frequency of once each 20 minutes, but due to the great volume of information the counting rates were averaged for four hours and only for the main counters. The flights were made during the continuing decline in solar activity after the secondary maximum of the 20th solar cycle. A figure shows the changes in solar activity and also the fluxes of galactic cosmic rays and solar cosmic ray protons with energies of 1-5 MeV during the 20th solar cycle. In 1973 there was an increase in the intensity of galactic cosmic rays. At the same time there was a record high flux of galactic cosmic rays, exceeding by approximately 10% the maximum level for the 19th cycle. Then in late February and March 1974 there was a local dropoff in the flux of galactic cosmic rays. The activity of the northern and southern hemispheres was approximately identical and was slightly above the activity level at the onset of the 20th cycle. The greatest increase in the flux of solar cosmic rays began on 7 September 1973. This increase was associated with a flare of importance 2B. The results of these space probe measurements revealed new paths of propagation of particles in the interplanetary medium and indicated a substantial asymmetry of space in the direction perpendicular to the plane of the ecliptic. These flights demonstrated that during periods of low solar activity there can be great bursts of solar cosmic rays with injection of fluxes with energies up to 500 MeV or more.
[57]

REVIEW OF PRESENT STATUS OF GEOLOGICAL RESEARCH FROM SPACE

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEOLOGIYA I RAZVEDKA in Russian No 11, 1976 pp 5-13

[Article by V. Ye. Khain, V. K. Yeremin, Ya. G. Kats, A. G. Ryabukhin and D. M. Trofimov, Moscow State University, "Present Status of Geological Research from Space"]

[Abstract] Issue No 11 of the journal cited above is entirely devoted to the use of space photographs, in combination with other methods, in practical geological studies. This review is an in-depth summarization of their economic importance and the progress being made in this field. There is much which can be done to increase the economic effectiveness of this method. The information yield can be increased by improving the quality of space images by improving survey equipment, by increasing the diversity of types of surveys from space and obtaining images during different seasons and at different times. Geological agencies must be routinely supplied with survey results. Methods must be developed for the interpretation of space photographs using electronic computers and special apparatus must be created for processing them and transfer of the interpretation data to topographic maps. More specialists must be trained who are especially qualified for this work. It is necessary to prepare manuals and instructions on the interpretation and processing of aerial and space information. The interpretation work must be done more quickly and the results must be made available more rapidly. The data obtained from space cannot replace the information obtained by other methods, but space observations are putting into the hands of geologists a key to clarification of the patterns of distribution and formation of geological structures on a regional and global scale and are creating an objective basis for the prediction of the locations of possible mineral resources.
[259]

## VI. MISCELLANEOUS

### News

### LINEAR ELEMENTS OF RELIEF OF SEA ICE

Moscow IZVESTIYA VSESOYUZNOGO GEOGRAFICHESKOGO OBSHCHESTVA in Russian Vol 109, No 1, 1977 pp 74-78

[Article by V. N. Kupetskiy, "Linear Elements of Relief of Sea Ice"]

[Abstract] All ice specialists are familiar with the linear formations in the relief of sea ice: fissures, hummocks and leads which extend for many tens of kilometers without changing direction. A thorough analysis of the problem shows that linear faults or their modifications are characteristic of all ice, marine or continental, drifting and fixed. The linear relief elements in natural ice, by analogy with geological-geomorphological terminology, can be called physiographic lineaments. The article cites many special cases of such phenomena. For example, aerial photographs of Greenland glaciers taken with special optical filters revealed a system of mutually intersecting fissures which could not be seen from a surface inspection. Another example discussed is the regular pattern of faults in the ice shelves clearly seen in the configuration of their seaward edge. There is fissuring of Arctic and Antarctic ice which cannot be attributed to tidal, wind or frost phenomena. In other Arctic and Antarctic regions there are cracks of great length which are a direct continuation of tectonic faults. Various special studies of such phenomena are discussed: in 1972 a survey was made of all lineaments in the ice cover in the region from Tiksi to Anadyrskiy Zaliv. Processing of 1,100 measurements indicated that in this particular region the lineaments have a predominantly diagonal direction -- 305-315° and 55-65°. These and many similar phenomena are apparently associated with planetary fissuring. The pattern of fissuring noted in the northern seas, for example, can be used on a practical basis for the more rational use of icebreakers along the Northern Sea Route.
[7]

IL-8 AIRPLANE COMPLETES EXPERIMENTAL ARCTIC DUTY

Moscow PRAVDA in Russian 7 May 77 p 6

[Article by N. Utkin: "It Passed the Test"]

[Summary] An Il-8 aircraft has been used in connection with the "Sever-77" scientific expedition at the Arctic drifting station "Severnyy Polyus-22." It is also reported that the last group of participants of the "Sever-77" expedition were recently removed from the "Severnyy Polyus-22" station. [5]

SCUBA DIVERS STUDY ICE AT NORTH POLE

Moscow IZVESTIYA in Russian 30 Apr 77 p 6

[Unsigned article]

[Text] For the first time in the history of arctic studies scuba divers from the Arctic and Antarctic Scientific Research Institute have carried out a series of underwater studies at the geographic point of the North Pole. V. Uglev, director of the group of specialists, reported that the scientific unit which was brought to the "roof of the planet" by airplane made observations of the physical properties of the ice cover and the structure of its underwater section. [4]

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