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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS  
 GEOPHYSICS, ASTRONOMY AND SPACE

No. 387

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

### Abstracts of Scientific Articles

#### MORPHOLOGY OF SOLAR SPOT FORMATION

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 53, No 5, 1976, pp 1046-1051

[Article by V. S. Berdichevskaya, Physics Department, Moscow Civil Engineering Institute, "Morphology of Spot Formation on the Sun in the Nineteenth and Twentieth Solar Activity Cycles"]

[Abstract] The areas of sunspots during the years of the nineteenth and twentieth cycles (from 1953 to 1972) were distributed in 90- and 30-degree intervals of heliographic longitude with subdivision into high- and low-latitude spots ( $|\varphi| > 20^\circ$ ,  $|\varphi| < 20^\circ$ ). It is shown that in accordance with the conclusions of Waldmeier the nineteenth and twentieth cycles have opposite signs of the phase shift. There is a difference in the longitude distribution of spots in years close to the maximum and in the first years after the minimum: in the northern hemisphere on the ascending branch of the cycle the areas of the spots were concentrated near one longitude (for high-latitude spots  $\sim 200^\circ$ ); near the activity maximum the areas were distributed into two sectors (with centers near  $90^\circ$  and near  $270^\circ$ ). In some years equally distant from the commencement of the cycle the distribution of the spots in longitude in both cycles is qualitatively identical (especially in the northern hemisphere).

[119]

#### SOLAR OBSERVATIONS WITH RATAN-600 RADIO TELESCOPE

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 53, No 5, 1976, pp 1017-1026

[Article by Yu. N. Pariyskiy, D. V. Korol'kov, O. N. Shivris, N. L. Kaydanovskiy, N. A. Yesepkina, Yu. K. Zverev, A. A. Stotskiy, Sh. B. Akhmedov, V. M. Bogod, S. I. Boldyrev, G. B. Gel'freykh, I. A. Ipatova, A. N. Korzhavin and V. V. Romantsov, Special Astrophysical Observatory, "Solar Observations with the RATAN-600 Radio Telescope. First Results"]

[Abstract] The paper cited above gives some results of the first trial observations of solar radioemission using the RATAN-600 radio telescope. The article gives a brief description of the antenna, instrumentation and observation methods. Precise information is given on low-contrast details, discrimination of narrow sources, radiogranulation, flocculae and other weak sources, observations of filaments, spots, limb and transition layer, corona and solar wind. The first observations thus made it possible to obtain information for a broad range of phenomena from supergranules to the solar wind. One phenomenon which remains beyond the capabilities of the radio telescope is radioemission bursts. This direction will be accessible only after completion of work on multisided automation of the radio telescope. The carrying out of observations with a resolution of about  $10''$  in one coordinate in combination with a relatively high resolution of about  $1'$  in the second coordinate when using registry methods ensuring measurements of low-contrast details will make it possible to investigate a whole series of new classes of objects and to refine the parameters of such objects known in the radio range as floccular areas, dark filaments, etc.

[119]

#### RADIOIMAGE OF SGR-A

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 2, No 9, 1976, pp 419-424

[Article by A. B. Berlin, V. Ya. Gol'nev, N. A. Yesepkina, Yu. K. Zverev, A. V. Ipatov, N. L. Kaydanovskiy, A. I. Kopylov, E. I. Korkin, D. V. Korol'kov, Yu. N. Pariyskiy, N. S. Soboleva, A. A. Stotskiy, G. M. Timofeyeva and O. N. Shivris, Special Astrophysical Observatory, "Multifrequency Radioimage of the Source Sgr-A According to RATAN-600 Observations"]

[Abstract] This paper gives the results of observations of the distribution of intensity and polarization of the emission of the center of the Galaxy using the RATAN-600 radiotelescope at wavelengths 2.08, 3.9 and 6.52 cm with a resolution of  $13'' \times 5'$ ,  $25'' \times 10'$  and  $40'' \times 14'$  respectively. The response of the radiotelescope to details of both small and large angular dimensions was close, in contrast to aperture synthesis systems by means of which during recent years several images have been obtained of the center of the Galaxy. An example of the transmission curve for Sgr-A through the directional diagram of the radiotelescope at a wavelength of 3.9 cm is shown in Fig. 1. Figure 2 shows one-dimensional images of Sgr-A at wavelengths 2.08, 3.9 and 6.52 cm. It is shown that the real images of this source differs from the images constructed by the aperture synthesis methods and are closer to the images obtained by occultation methods. At the center of the Galaxy at a wavelength of 2 cm there is a "point" source which has a plane spectrum.

[120]

## II. METEOROLOGY

### News

#### AMERICAN SCIENTISTS VIEW WORK ABOARD SOVIET WEATHER SHIP

Moscow KOMSOMOL'SKAYA PRAVDA in Russian 27 Nov 76 p 4

[Article by D. Abovskiy: "Survey Beyond the Clouds"]

[Text] The storm raged in the night; the winds were 15 m/sec. In the morning the sky was leaden. Cold autumn rain splattered every now and then. Gathering for breakfast the American guests were sailing but it was obvious that the pitching was a serious trial for them. After breakfast there was a small excursion around the ship's scientific laboratories, a short discussion of the tasks facing Soviet meteorological ships, and the problems which occupy the six scientific teams of the "Georgiy Ushakov."

"Already for several years," stated L. A. Aleksandrov, Director of the Administration for Space Systems of the USSR Main Hydrometeorological Service, "cooperation between the USSR Academy of Sciences and NASA (USA) has developed in several directions of space research. This cooperation involves, in particular, development of various problems in space technology and utilization of meteorological satellites and rockets. The third meeting of the Joint Soviet-American Working Group for Space Meteorology was held from 9 to 22 November in Moscow."

After the meeting concluded Dr. Tepper, leader of the American side of the Working Group and director of the NASA Meteorological Administration, and other specialists in rocket investigation of the atmosphere arrived in Odessa to become acquainted with the work carried out by Soviet scientists and specialists on ships equipped with systems for the launching of meteorological rockets.

Eleven o'clock. Everyone is on the bridge. Attention is on the stern where a four-meter rocket stands.

Several seconds more. The rocket slowly rises as we have seen many times in television reporting of spacecraft launches. However, things proceeded quite differently. A flash, a puff of smoke, and in an instant the light vanishes in the clouds. The solid-fuel meteorological rocket, used for temperature and wind probes, attains an altitude of 60 km in less than two minutes! Then the last stage separates and descends by parachute.

The next morning the "Georgiy Ushakov" is moored at the Odessa marine terminal. In taking their leave, Soviet and American specialists expressed their firm confidence that cooperation between the two countries in space meteorology has good prospects.

#### TASS REPORTS INTERNATIONAL CONFERENCE ON ATMOSPHERIC STUDIES HELD

Moscow PRAVDA in Russian 21 Nov 76 p 6

[TASS Report: "Planetary Experiment"]

[Text] Leningrad, 20 November. Participants in an international conference held in Leningrad have discussed a program for the preparation of the first global experiment on the study of atmospheric processes. Specialists from the following countries took part in this meeting which was held under the aegis of the World Meteorological Organization: England, Brazil, GDR, Canada, Norway, USSR, USA, France and Switzerland.

Dozens of research ships sailing under the flags of different countries, off-shore and drifting research stations, flying laboratories and weather satellites will participate in this expedition, which is scheduled to be carried out in 1978. Commenting on the goals of the future experiment, the director of the USSR Hydrometeorological Center, Professor M. A. Petrosyants stated that this research operation will make it possible to improve existing models of forecasts and to clarify the nature of circulation of the air envelope over the entire globe. Results of expeditions of past years have confirmed the fact that further progress in the development of reliable methods of weather forecasting is only possible if we have a proper understanding of the mechanism of thermal energy exchange between the tropic, temperate and polar latitudes. [5]

### Abstracts of Scientific Articles

#### DIFFUSE REFLECTION AND TRANSMISSION OF LIGHT BY PLANETARY ATMOSPHERE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 12, No 11, 1976, pp 1168-1182

[Article by O. I. Smoktiy, Leningrad Hydrometeorological Institute, "Precise Solution of the Problem of Diffuse Reflection and Transmission of Light by a Planetary Atmosphere in the Case of a Three-Term Scattering Function"]

[Abstract] In the general case of an arbitrary scattering function the author has proposed a new, simpler method for finding analogs of the Ambartsumyan functions and the polynomials corresponding to them. The article gives precise analytical expressions for the reflection and transmission coefficients for a plane-parallel planetary atmosphere of finite optical thickness in the case of a three-term scattering function. On the basis of use of similarity expressions and the obtained precise solution the author has proposed an effective approximate method for determining the intensities of diffusely reflected and diffusely transmitted radiations respectively at the level of the upper and lower boundaries of the atmosphere for arbitrary scattering functions and probabilities of survival of a quantum not dependent on altitude. The article gives computations of the principal functions (including the atmosphere - underlying surface transfer function) and presents their precise values for definite sets of optical parameters of the scattering and absorbing medium.

[134]

#### HEAT AND MOISTURE EXCHANGE IN OCEAN-ATMOSPHERE SYSTEM

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 12, No 11, 1976, pp 1130-1142

[Article by V. K. Petukhov, Institute of Atmospheric Physics, "Zonally Averaged Model of Heat and Moisture Exchange in the System Atmosphere-Underlying Layer of the Ocean"]

[Abstract] The process of heat and moisture exchange on a spherical earth covered by the ocean and polar ice is considered. Zonally averaged equations are used. A simple parameterization of mean meridional circulation is adopted with use of the meridional temperature field. On the basis of experimental data a relationship is established between zonally averaged specific humidity and temperature of the atmosphere. When solving the problem in the first approximation an analytical formula for the meridional temperature profile in an equilibrium regime is obtained. With real values of the parameters the temperature fields in the ocean and atmosphere, as well as the extent of cloud coverage and the position of the pack ice boundary are close to the mean annual values. The influence of variation of the parameters on the variables is studied and the main parameters are revealed. In a nonequilibrium regime the disturbances have a wavelike character. The periods and the specific times of diverging (damping) of the oscillations are about several months.

[134]

#### DETERMINING CHARACTERISTICS OF LIQUID-DROP AEROSOL

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8B92

[Abstract of article by S. D. Pinchuk, A. M. Skripkin and A. A. Suplakov; Moscow, TRUDY IN-TA EKSPERIM. METEOROLOGII GUGMS, No 13(58), 1976, pp 162-170, "Possibility of Use of a Laser Anemometer for Determining the Characteristics of a Liquid-Drop Aerosol"]

[Text] A study was made of the possibility of using a laser anemometer for investigating the liquid-droplet fluxes of aerosol particles. In the experiment the authors used a differential model of an optical Doppler measuring instrument for determining velocity. The performance of the apparatus was demonstrated by the simultaneous measurement of flow velocity by the optical method and using a "Disa" thermoanemometer. The developed anemometer is used for measuring the size of the water particles generated using a special apparatus. The dimensions of the particles are determined by two methods: by measuring the velocity of free falling (Stokes velocity) and also on the basis of the known dependence of the Doppler signal on the relationship between particle size and the period of the interference pattern. Bibliography of nine items.

[109]

#### LASER SOUNDING OF WATER VAPOR

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian, No 8, 1976, 8B96K

[Abstract of article by O. K. Boytsekhovskaya, V. N. Marichev, I. V. Samokhvalov, Yu. S. Maushkin, A. A. Mitsel' and A. V. Sosnin; Tomsk, METODICHESKIYE VOPROSY LAZERNOGO ZONDIROVANIYA VODYANOGO PARA ATMOSFERY S ISPOL'ZOVANIEM EFFEKTA REZONANSNOGO POGLOSHCHENIYA, Preprint Institute of Atmospheric Optics Siberian Department USSR Academy of Sciences, No 5, 1974, 24 pages]

[Text] The authors evaluated the absorption of laser radiation at the wavelength 6943.8 Å, taking into account the different spectral width of the pulses sounding the atmosphere. Also considered are the problems involved in interpreting data from laser sounding of the concentration of water vapor in the atmosphere for homogeneous and inhomogeneous paths. The authors investigated some possibilities of three-frequency sounding of water vapor and the advantages of mathematical processing of data from three-frequency sounding. An investigation was also made of the possibilities of using for such purposes the contour of the absorption line of water vapor. The authors evaluated the influence of shift of the center of the emission line relative to the absorption line on the error in the reconstructed profile of the absorbing gas.

[109]

#### REMOTE DETERMINATION OF HUMIDITY

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8B97 P

[Abstract of patent awarded to V. I. Shlyakhov, A. F. Kuznekov and R. I. Bogdanov, Central Aerological Observatory; Moscow, Author's Certificate USSR, No 1977044, published 24 December 1975, "Method for Remote Determination of Humidity"]

[Text] The patent describes a method for remote determination of humidity by means of measurement of selective absorption of radiation by water vapor. For the purpose of increasing measurement accuracy it is possible to determine the spectral density of the radiation in the neighborhood of the absorption line of water vapor and the radiation temperature of the surface of clouds with subsequent determination of the sought-for parameter using the relationship between the density of water vapor emission and the radiation temperature of the clouds.

[109]

#### INDICATOR OF PHASE STATE OF CLOUDS

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8B101 P

[Abstract of patent awarded to G. M. Zabrodskiy, A. P. Cherenko and L. I. Chapurskiy; Moscow, Author's Certificate No 473973, published 15 September 1975, "Indicator of Phase State of Clouds"]

[Text] Measurements of the intensity of reflected solar radiation are made in narrow spectral bands 1.4, 1.9 and  $2.85\mu\text{m}$  and 1.5, 2.0 and  $3.1\mu\text{m}\pm 0.02\mu\text{m}$ . The focused and modulated flux of solar radiation is fed to a separating prism and the two formed parts of the flux are focused through spectral filters onto individual sensing areas of the photoresistor. In the presence of a liquid-drop cloud one part of the flux (channel) is for measurements; in this case the flux reflected from the cloud creates a considerable signal; the second channel is for comparisons, since the resulting signal is small. The output instrument registers a signal of the same polarity. In the presence of an ice cloud the opposite picture is observed and the output instrument registers a signal of a different polarity, different from the first case. The radiation detectors are connected into a differential circuit.

[109]

#### BANDED STRUCTURE OF CLOUD SYSTEMS

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8B283

[Abstract of article by M. V. Burkova; --, TRUDY SREDNEAZ. REGIONAL'N. N.-I. GIDROMETEOROL. IN-TA, No 33 (114), 1975, pp 38-44, "Banded Structure of Cloud Systems Over the Southern USSR on the Basis of Observations of Meteorological Satellites"]

[Text] The banded structure of clouds in the winter half-year is the usual picture over the southern USSR. Banded clouds are associated with fronts, primarily cold fronts, or occluded fronts, less frequently with the warm fronts of cyclones. Zones of banded clouds are observed primarily in regions of linear or slightly curved fronts. In the case of highly curved fronts such a banded structure is rarely observed. The areas of banding extend along the front and their dimensions along the normal to the front (width) are far less than the dimensions along the front (ratio approximately 1:10). In the process of active cyclogenesis the width of the banded zone is not the same. It is wider toward the center of the cyclone and becomes narrower with increasing distance from it. Almost all the zones of banded structure exceeding 1,000 km in length are accompanied by jet streams. The banded zones do not follow all the curvatures of the front. On a front there can be two cyclonic waves, but the banded zone will be almost linear, combining both these waves. Zonal or nearly zonal regions of banding frequently pass to the right and left or simultaneously along both sides into zones of continuous clouds. It was not possible to detect the patterns of this transition. Meridional regions of banded clouds at the

southern ends, usually to the south of 35°N, end with characteristic "tails" of an irregular configuration. The tails are oriented in a meridional direction, but different bands have different lengths, creating the impression of cut-offs. Bibliography of three items.

[109]

#### DISTRIBUTION OF CLOUD COVER FIELDS IN JANUARY AND JULY

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8B284

[Article by M. L. Arushanov, N. O. Belorussova and L. S. Komarenko; --, TRUDY SREDNEAZ. REGIONAL'N. N.-I. GIDROMETEOROL. IN-TA, No 33(114), 1975, pp 50-61, "On the Problem of the Peculiarities of Distribution of the Cloud Cover Field in January and July Obtained Using Data from Meteorological Satellites Over the Southern Part of Central Asia"]

[Text] The paper gives a statistical generalization of television photographs of cloud cover for the winter and summer months during the period 1968-1972 for a territory bounded by longitudes 30-90°E and latitudes 40-15° N. The spatial distribution of cloud fields has an essentially zonal nature. The zones of the cloud cover maxima in January are associated with frontal and cyclonic activity (Asia Minor, Near East, Iran, Iraq, Lebanon) and in July with monsoonal circulation and the peculiarities of orography. Comparison of the mean maps of cloud cover constructed on the basis of satellite data with climatic maps gave a good agreement. Satellite data can be used quite successfully for detecting the physiographic peculiarities of the distribution of cloud fields over territories poorly covered by meteorological and aerological data. Bibliography of 15 items.

[109]

#### EFFECT OF CO<sub>2</sub> LASER ON CLOUDS

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8B269

[Abstract of article by O. A. Volkovitskiy, V. V. Denisova, Ye. V. Ivanov and M. P. Kolomeyets; Moscow, TRUDY IN-TA EKSPERIM. METEOROL. GUGMS, No 13 (58), 1976, pp 95-107, "Experimental Investigation of the Condensation Effect Under the Influence of Radiation of a CO<sub>2</sub> Laser on Cloud Media"]

[Text] The article gives the results of an experimental series of investigations which demonstrate the significance of the role of condensation during interaction of a beam of laser radiation with cloud particles. It

has been shown that trails consisting of fine particles are formed near individual cloud particles (both ice crystals and water droplets) during interaction with laser radiation with  $\lambda = 10.6 \mu\text{m}$  with an intensity of  $400-1,000 \text{ W/cm}^2$  when the medium has negative temperatures. With radiation intensities  $\geq 3 \cdot 10^3 \text{ W/cm}^2$  a similar phenomenon is also observed when the medium has a positive temperature. It is demonstrated that this phenomenon, interpreted as the condensation of vapor on natural or spontaneously formed condensation nuclei, can lead to a turbidity of the zone of the effect in the visible range of wavelengths when the cloud medium is exposed to the radiation of a  $\text{CO}_2$  laser. A study was made of the temporal course of development of turbidity for different initial levels of fog density. It was possible to clarify the principal trends in the dependence of the turbidity level on the initial optical thickness of the medium for different radiation intensities, temperatures of the medium and dimensions of the cloud particles. Data are cited which indicate that the radius of the forming particles is close to  $1 \mu\text{m}$ . Bibliography of 15 items.

[109]

#### TRANSFORMATION OF RADAR METEOROLOGICAL INFORMATION

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8B124

[Abstract of article by Arnold Kawecki; Warsaw, WIAD. METEOROL. I GOSP. WODNEJ, 2, 1975, pp 33-46, "Some Problems in the Transformation of Radar Meteorological Information"]

[Text] The necessity for a rapid analysis of a thunderstorm cloud by the use of radar for obtaining a great amount of information on this meteorological object made it necessary to develop an apparatus for the automatic processing of a radar signal. This processing is reduced to averaging of the signal in each elementary volume of space and then reducing it to digital form. The transmission of radar information to remote users is accomplished using a device for processing the radar signal which makes it possible to transmit this information using narrow-band lines (telephonic, telegraphic). In this case as well the averaging of the signal was a necessary operation. Analog and digital data transmission systems are now available. In addition, the primary processing of the radar signal can be accomplished in analog or in digital form. In an analog apparatus the signal is integrated in range in the limits 1-2 km and is averaged in azimuth in a range equal to the width of the radar ray ( $1-2^\circ$ ). The averaged signal is introduced into a threshold device from which it passes to an indicator where a quantized analog signal image is obtained. The averaged, quantized signal can be converted into digital form by introduction into an A/C converter, from whence the digital data can be used in a digital computer for further processing. In digital computers used for primary processing the analog signal is introduced directly into the A/C converter

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and averaging in azimuth is carried out in the digital unit. At the present time there are several types of specialized apparatuses of this type. Bibliography of eight items.

[109]

### III. OCEANOGRAPHY

#### News

#### PROBLEMS IN OBTAINING INSTRUMENTS FOR MARINE GEOLOGY RESEARCH

Moscow PRAVDA in Russian 23 Nov 76 p 4

[Article by O. Leont'yev: "The Land Under the Ocean"]

[Excerpt] The division of the ocean floor into the underwater margin of the continent, ocean bed, transition zone and mid-oceanic ridge is not arbitrary. It reflects the peculiarities of structure of the earth's crust caused by internal geological processes.

Until recently it was postulated that surface processes (on land they are caused, for example, by the activity of glaciers or the work of river flows) cause little activity at great depths. During recent years it has become clear that this is not the case. In particular, turbidity currents are operative on the continental slope; they transport tens and hundreds of millions of cubic meters of sediments. The finds of submarine valleys incised by bottom currents have become a sensation.

Soviet science has potentialities for retaining and strengthening its leading place in studies of the ocean floor. We have the world's best scientific research ships, excellent depth sounding equipment and underwater instrumentation. But oceanologists also have their difficulties. Many instruments and apparatuses until now are being fabricated in the field or are being acquired abroad at very great cost. This is slowing down the scale of the investigations. For the successful development of marine geology and geomorphology in the USSR it is necessary to establish one or more centralized design offices and industrial enterprises for the development and small-scale standard production of special instruments, apparatuses and devices.

It is essential to know how the ocean floor is constructed and what is presently transpiring there. The time is approaching when the earth beneath the oceans will become an arena of man's direct economic activity. Moreover, in theoretical respects this knowledge will assist in formulating a general

theory of the origin and history of development of the earth's crust and its surface relief, a theory which in its turn will be the basis for the search for mineral resources.

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## Abstracts of Scientific Articles

### FORMATION OF PERIODIC STRUCTURE OF CONVECTIVE CURRENT

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 12, No 11, 1976, pp 1191-1200

[Article by V. N. Nekrasov, V. A. Popov and Yu. D. Chashechkin, All-Union Scientific Research Institute of Physical-Technical and Electronic Measurements, "Formation of the Periodic Structure of a Convective Current in Lateral Heating of a Stratified Fluid"]

[Abstract] Probe and optical methods were used in investigating the structure of a nonstationary convective current arising with the activation of lateral heating in a laboratory basin filled with a stratified fluid with a constant vertical density gradient. If the Rayleigh number is  $Ra = g\alpha\Delta T(\alpha\Delta T\Lambda)^3/\nu\chi > Ra_{cr} = 4,500\pm 1000$ , the developing convective current breaks down into a periodic (vertically) system of convective elements. The formation of these cells begins in regions with a reduced value of the density gradient. The height of such a cell is slightly dependent on the rate of change in temperature of the heated wall, depth of the basin and is equal to the height of rising of the heated fluid to the level of neutral buoyancy  $h = (1\pm 0.1)\alpha\Delta T\Lambda$ . The current in the cell consists of a system of eddies forming at the heated wall and gradually moving within the unperturbed fluid. The current with a velocity shear at the boundaries of the cells is stable, the Richardson number is  $Ri = N^2d^2/U_{x\max}^2 > 2.5$ ; for a current within the cells  $Re = U_x h/\nu < 2$ . The region of the convective current excites a system of internal waves in the remaining fluid. Their frequency is close to zero, the length is equal to the height of the cell, and propagation velocity is greater than the velocity of motion of the boundary of the region of convective flow.

[134]

### GRAVITATIONAL FIELD OF OCEANIC BLOCK RIDGES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 11, 1976,  
pp 32-43

[Article by M. G. Kogan, Institute of Physics of the Earth, "Gravitational Field of Oceanic Block Ridges"]

[Abstract] The gravitational field of the western part of Walvis Ridge (South Atlantic) is easily attributable to regional downwarping of the rigid lithosphere under the excess loading of the ridge. An estimate of the effective deformation of the lithosphere gives one and the same value for all profiles intersecting the ridge if one uses one and the same model of the oceanic crust. However, depending on the assumptions made concerning the density of the ridge, the  $D$  estimate for a particular profile can vary in the range from  $2 \cdot 10^{28}$  to  $8 \cdot 10^{28}$  dynes·cm. This value on the average is an order of magnitude less than for the Pacific Ocean in the region of the Emperor seamount chain. In both cases the time of operation of the loads is entirely comparable, 60-80 million years, so that the differences in deformation probably reflect regional variations in the rheology of the lithosphere. The evaluations obtained for the Walvis Ridge region correspond to the concept of the lithosphere as being a Maxwellian medium with a time relaxation of the order of hundreds of thousands of years.

[133]

#### MICROWAVE EMISSION OF WAVE-COVERED SURFACE

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8B131

[Abstract of article by D. T. Matveyev and V. S. Samoylenko; Moscow, REZULTATY METEOROL. ISSLED. PO MEZH DUNAR. PROGRAMME "TROPEKS", 1975, pp 99-107, "Relationship Between the Mean Characteristics of the Wave-Covered Sea Surface and its Microwave Emission"]

[Text] On the basis of regular measurements of the radiobrightness temperature of microwave emission of the ocean surface carried out on the 13th voyage of the scientific research vessel "Akademik Kurchatov," a study was made of its dependence on the dispersion of the slopes of the sea surface and on wind velocity. The determined dependences confirm the possibility of a separate determination, using data from microwave sounding from an artificial satellite, of the temperature of the ocean surface and the characteristics of the degree of its coverage by waves. Bibliography of eight items. [109]

#### METHODS FOR MEASURING TURBULENCE

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8V23

[Abstract of article by S. R. Stefanov; Sevastopol', ISSLED. TURBULENT. STRUKTUR Y OKEANA, 1975, pp 210-218, "Ultrasonic Methods for Measuring Local Turbulence Characteristics"]

[Text] A study was made of active and passive, probe and probeless sensors for measuring the parameters of turbulent fluctuations in a fluid and hydrophysical fields in the ocean. Instruments for measuring the Doppler frequency shift of oscillations scattered by the medium are considered promising, as are sensors simultaneously using the advantages of the optical and ultrasonic methods. It is noted that the use of secondary interference is one of the most sensitive methods ( $10^{-6}$ ) for measuring the speed of sound; the instrument developed at the Marine Hydrophysical Institute Ukrainian Academy of Sciences on the basis of this method for measuring the two components of flow velocity and the speed of sound has undergone tests at sea. Bibliography of six items.

[109]

#### MODELS OF OCEANIC TURBULENCE

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8V53

[Abstract of article by A. Yu. Benilov and I. D. Lozovatskiy; Sevastopol', ISSLED. TURBULENT. STRUKTUR Y OKEANA, 1975, pp 102-112, "Spectral Models of Oceanic Turbulence"]

[Text] The authors have examined the spectral balance equations for turbulent energy and the intensity of temperature fluctuations. These are solved using the Heisenberg closure as generalized by A. S. Monin for the case of a turbulent flow with mean velocity and temperature gradients. For the inertial transport of temperature fluctuations the authors use a hypothesis making it possible to obtain the temperature spectrum  $E_T(K) \sim K^{-1}$ , found by Batchelor (1959). It has been noted that in the ocean, as a result of the dependence on local background conditions, even with a finite sufficiently large Reynolds turbulence number ( $Re_T$ ), in the case of a strong stable stratification the inertial interval of scales can be absent in the turbulence spectra. Bibliography of 16 items.

[109]

#### TEMPERATURE AND SPEED OF SOUND FIELDS IN SEA

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8V108

[Abstract of article by V. I. Babiy; Sevastopol', ISSLED. TURBULENT. STRUKTURNY OKEANA, 1975, pp 147-160, "Cross Characteristics of Temperature and Speed of Sound Fields in Sea"]

[Text] On the basis of theoretical investigations and experimental measurements in the Mediterranean and Black Seas, in the Atlantic and Indian Oceans it was possible to determine the parameters of fluctuations (F) of the speed of sound in the range of macro- ( $K < 0.1 \text{ m}^{-1}$ ), meso- ( $0.1 \text{ m}^{-1} < K < K_0$ ) and microscales ( $K > K_0$ , where  $K_0$  is the wave number, having the order of magnitude of the internal scale of turbulence) and it is shown that in the latter range the level F is always greater than if it was caused only by F of water temperature. The article gives expressions for computing the dispersion of F. The author introduces the dynamic temperature coefficients of the speed of sound characterizing the relationships among the components in a nonequilibrium ocean thermodynamic system. It is noted that an increase in F of the speed of sound can be caused by the corresponding effect of acceleration during mixing of the components. Bibliography of four items.

[109]

#### OCEAN INHOMOGENEITIES INFLUENCING SPEED OF SOUND

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8V119

[Abstract of article by L. M. Nefedov; --, TRUDY SAKHALIN. KOMPLEKS. NII DAL'NEVOST. NAUCH. TSENTRA AN SSSR, No 34, 1975, pp 44-52, "Inhomogeneities in the Ocean Exerting an Influence on Propagation of Sound"]

[Text] This is a review of experimental data obtained by different authors relating to investigations of random inhomogeneities of the sea medium -- fluctuations in water temperature, turbulent fluctuations of current velocity, variations of the refractive index and fluctuations of the speed of sound in the ocean associated with them. The article gives an analysis of the principal patterns of temperature fluctuations. Also considered are data obtained both with the use of direct methods for measuring random inhomogeneities and indirect acoustic methods -- by means of solving the inverse problem. The article gives an analysis of the parameters of inhomogeneities in the range of scales exerting a substantial influence on the scattering of sound in the ocean. Bibliography of 40 items.

[109]

SOUND BACKSCATTERING BY TEMPERATURE INHOMOGENEITIES

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8V125

[Abstract of article by I. A. Leykin, A. A. Lyubitskiy, A. D. Rozenberg and V. G. Ruskevich; Sevastopol', ISSLED. TURBULENT. STRUKTUR Y OKEANA, 1975, pp 140-146, "Backscattering of Sound by Small-Scale Temperature Inhomogeneities in the Thermocline"]

[Text] The authors have determined the correlations between the amplitude and phase characteristics of a hydroacoustic signal scattered by small-scale inhomogeneities in the thermocline and changes in the parameters of the medium caused by internal waves. Also considered are the results of model experiments ( $f = 37.5$  KHz;  $\lambda = 4$  cm;  $\tau = 0.25$  sec), carried out with a total error of  $\pm 2$  db. Analysis of the results of measurements in the Caspian Sea, carried out using a gradient system (response  $0.0005^\circ$ ; distance between thermistors 2.5 cm; rate of sounding 30 cm/sec; sea depth 40 m; depth of the jump layer 30 m) is given and it is postulated that in some cases the presence of an echo signal under natural conditions can be associated with the scattering of sound by small-scale temperature inhomogeneities and not any reflection from sound-scattering layers. Bibliography of four items.

[109]

#### IV. TERRESTRIAL GEOPHYSICS

##### News

#### SECOND PHASE OF DRILLING OPERATIONS AT KOLA SUPERDEEP BOREHOLE

Moscow PRAVDA in Russian 4 Nov 76 p 6

[Article by Zh. Chesnokov: "Storming the Depths"]

[Text] A white road runs from Murmansk to the west. Alongside it are piles of snow and scrubby vegetation. The young city of Zapolyarnyy, which was established only twenty years ago, appears as a beautiful sight amidst the white silence. Here one finds the Kola Geological Prospecting Expedition's superdeep borehole. In its time PRAVDA told how the personnel of this expedition has drilled in ancient crystalline rocks the world's deepest borehole to a depth of 7,263 meters. Even today the information which has been collected is helping in the solution of a number of problems related to the search for and exploration of minerals. New methods of geophysical research have been developed in the borehole. The most modern drilling equipment has come into use. World practice until now has not had such experience.

For almost 1 1/2 years the borehole has been in mothballs. During this time specialists carried out intensive preparations for the second stage of the drilling. The task has been set to reach greater depths during the Tenth Five-Year Plan.

On the day of our arrival at Zapolyarnyy the drillers had made preparations for penetrating the first meters in the second stage. The chief of the expedition, David Mironovich Guberman, explained:

"With the old drill rig we could not go any deeper. A new one was needed. It was designed and constructed by Uralmashzavod. We were assisted greatly by one of the senior specialists of Uralmashzavod, one of the leading designers of the apparatus, Georgiy Vasil'yevich Alekseyevskiy. Two months ago the drill rig was accepted by the state commission with the evaluation "good."

What was the fundamental difference between the new drill rig and the old? The present one is more powerful -- its load-lifting capacity is greater than 300 tons and it has an automatic system. All this makes possible a marked increase in the speed of lowering-raising operations. This means that less time will be expended in raising the worn-out bit from the face and replacing it. The apparatus is equipped with control-measuring instruments...

The drill rig itself is situated amidst the hills fifteen kilometers from the city. We drive there. Here is a remarkable metal tower with a star at the top. It is connected by a gallery with a repair-mechanical workshop into a unified complex. Therefore the workers are not hindered by snow drifts. Now all the equipment from the repair-mechanical workshop is moved to the tower through the gallery on a bogie.

A strongly built, broad-shouldered male in a nylon jacket and a dark green helmet is in charge of the control panel. This is Aleksey Fedorovich Batishchev, the chief of the drill dig. His "home" resembles the cabin of an aircraft. There are just as many instruments here. There is even television.

"We see everything which is being done at the drill rig. Our television can see everywhere except into the deep layers, to the face," says Aleksey Fedorovich.

More than forty men are now under his direction.

Specialists have now demothballed the borehole. The temperature in it was at the former level -- about 120 degrees. And now the hour has arrived to begin the second stage of the drilling. This honor fell to the lot of Master Anatoliy Yegorovich Govorukhi. The experienced masters of their work Mulvarey Kalimullin and Nikolay Lyubka were on duty. Soon they reported that the drill had touched the face...

The core is obtained. It is sawed along its axis. One part goes for inviolable state storage and the second part is divided among the laboratories and institutes for investigation. The revealing of the secrets of the earth's deep layers is continuing.

[105]

#### NOTES ON "CHEREPAKHA" SEISMOLOGICAL INSTRUMENT

Baku BAKINSKIY RABOCHIY in Russian 4 Nov 76 p 4

[Article by N. Barskiy: "First Steps of the 'Cherepakha'"]

[Text] The tortoise, as is well known, due to the "built-in" natural mechanism which it has, sooner than other animals feels the approach of a strong earthquake. The seismological instrument known as the tortoise [cherepakha], which has taken its name from it, is now the most sensitive of the instruments responding to the breathing of the earth's deep layers. For the first time in the system of academic scientific institutes of the country it has been used for research by the specialists of the Geology Institute Azerbaydzhan Academy of Sciences.

By means of this new Soviet instrumentation it has been possible to register and interpret the first "interviews" of several earthquakes in the Shemakhinskiy region of the republic, although the inhabitants of this mountainous district did not even sense them. Never before had the scientists of the Azerbaydzhan Republic been able to register a "cardiogram" of the earth to a depth of 200 km.

Stillness prevails in the laboratory. The last preparations have ended: specialists of the seismology and physics of the earth's deep layers group are beginning the processing of the information collected by the "tortoise." The director of the group, Candidate of Technical Sciences Farid Kuliyeu solemnly -- for the first time -- gives the command: "Activate!"

Greenish flashes pulsate on the oscillograph screen; a loud howl, increasing more and more, emanates from the loudspeaker system. A surprising sensation arises: outside the windows a warm sun shines which is not customary in autumn, scientific workers bustle about in their white gowns, and one's eyes and hearing transport you to the underground realm and you become sort of a witness to the processes transpiring at enormous depths.

The seismologists listen closely to the voices of the deep layers. It is necessary to be attentive as possible in order to differentiate the sounds of an earthquake from foreign noise. Indeed, the instrumentation is so sensitive that it registers even the footsteps of a man walking at a distance of 50 meters from it.

The oscillations of the soil, converted into electrical signals, were clearly printed on magnetic tape. The green figures jump in the registers, like the pictures change in a kaleidoscope, and using them it is possible to determine the day and the precise time of any of the earthquake "segments." Scientists select segments of the record which carry definite information. The composite tapes prepared on their basis are fed in the form of working seismograms to interpreters. For them these are not simply curves drawn by the automatic recorder, but an exhaustive picture of structure of the earth's crust. Interpreting the images, they determine the locations of the earthquake foci, the principal forces acting at them, the physical properties of the medium.

The acting director of the Institute of Geology, Doctor of Geological-Mineralogical Sciences A. A. Alizade, states: "Work is now continuing on the processing of the data collected in the territory of the geophysical station 'Pirkuli.' The first working tests confirmed the high sensitivity of the 'tortoise,' which makes possible a thorough study of the earth's crust and upper mantle. And it is important that we carry out an important national economic task which is standing before us during the Tenth Five-Year Plan: creation of a seismological model of Azerbaydzhan."

"These data will also be used for prediction and evaluation of the mineral resources situated at great depths in Azerbaydzhan and in territories adjacent to it, for seismological regionalization of large populated places, investigations of industrial and high civilian structures."

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## Abstracts of Scientific Articles

### DEEP STRUCTURE OF BAYKAL REGION

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8G50

[Abstract of article by V. A. Perepelitsa and V. V. Gazukina; Irkutsk, SOVREM. ISSLED. ZEMN. KORY, 1975, pp 98-100; "Study of the Deep Structure of the Baykal Region Using Transmitted Exchange Waves of Distant Earthquakes"]

[Text] The article describes a method for discriminating and analyzing the exchange waves registered at nine seismic stations in the Baykal region. In the southern part of the Siberian platform it was possible to discriminate a discontinuity at a depth of 11 km which corresponds to an exchange boundary in "granites" determined by the deep seismic sounding method. A second boundary at a depth of 34 km is identified with the M discontinuity. At depths of 160 and 190 km it is possible to define two "anomalous" boundaries (corresponding to layers with reduced velocities). In the Baykal rift zone there are discontinuities at depths of 0.7 km (basement) and at 34 km (M) and two anomalous discontinuities at depths of 63 and 115 km. In the mantle there are several layers of reduced velocity. Since the exchange boundaries correlate poorly between the stations, it is postulated that the inhomogeneities in the upper mantle have a lenticular configuration.

[109]

### DEEP SEISMIC SOUNDING ON KAMCHATKA

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8G57

[Abstract of article by S. V. Potap'yev; --, TRUDY SAKHALIN. KOMPLEKS. NII DAL'NEVOST. NAUCH. TSENTRA AN SSSR, No 37, 1975, pp 49-61, "Reconnaissance Investigations by the Deep Seismic Sounding Method in Western Kamchatka"]

[Text] The author has demonstrated the great promise of the use of detonations of aviation bombs and charges in a deep borehole ensuring the obtaining of records related to discontinuities in the earth's crust and in the upper mantle. It was possible to discriminate a refracting surface associated with the top of the consolidated crust. The nature of the seismic discontinuity is assumed to be dual: in the Central Range a seismic discontinuity with the boundary velocity 5.8-6.2 km/sec denotes the level of regional metamorphism and is a physical boundary. In depressions and in downwarps a seismic discontinuity with a boundary velocity of 6.2 km/sec is related to a structural boundary corresponding to the base of sedimentary-volcanogenic formations. The surface and deep structure of the Central anticlinorium are characterized by an inversion: uplifted sectors of the granitic-metamorphic layer correspond to downdropped sectors of the "basalt" layer. The thickness of the earth's crust in Western Kamchatka is 31-39 km. An increase in thickness is observed under the Central Range, being accounted for by the granite-metamorphic stratum. Bibliography of 19 items.

[109]

#### SPECIAL CASE OF LOVE WAVE PROPAGATION

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8G174

[Abstract of article by Dutta Subhas and Roy Priyatoch; Warsaw, ACTA GEOPHYS. POL., 23, No 3, 1975(1976), pp 235-242, "Propagation of Love Waves in an Inhomogeneous Semi-infinite Medium with Absorption Covered by a Homogeneous Isotropic Layer"]

[Text] In a viscoelastic medium the density and also the real and fictitious parts of the shear modulus increase with depth in conformity to quadratic or exponential laws. The half-space is covered from above by a homogeneous layer. The solutions of the equations of motion in both cases are represented by elementary functions. The boundary conditions are used in deriving a dispersion equation; after discrimination of the real and fictitious parts in it the authors were able to derive expressions for the phase velocity and the attenuation coefficient as functions of frequency. Bibliography of eight items.

[109]

#### METHOD FOR SOUNDING MANTLE AND CORE

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8G202

[Abstract of article by L. P. Vinnik and A. A. Godzikovskaya; Bucharest, STUD. TECHN. SI ECON. INST. GEOL. SI GEOFIZ., D, No 10, Part A3-a, 1975, pp 179-185, "Sounding of Mantle and Core by the Conjugate Points Method"]

[Text] The article describes the method and the results of determination (from the records of short-period longitudinal (P) waves from earthquakes) of the values of the quality parameter (Q) for the mantle and core characterizing the absorption of wave energy. The method is based on a comparison of the amplitude-frequency spectra of single P-waves and multiple PP-waves at specially selected registry points (at conjugate points) situated at the ends of one and the same seismic ray. It has been established that for the platform regions the quality of the upper mantle is equal to  $Q = 400$ , whereas for tectonically active regions (region of transition from the Eurasian continent to the Pacific Ocean and the Baykal rift zone) the quality of the upper mantle decreases by a factor of about 5 ( $Q = 80$ ), that is, there is a marked increase in the absorption of the energy of seismic waves. For the earth's inner core it was possible to determine the relatively low value  $Q = 300$ . Bibliography of 2 items.

[109]

#### LONG-PERIOD TIDAL VARIATIONS OF GRAVITY

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8G248

[Article by I. V. Maksimov and I. A. Drygina; Leningrad, PROBLEMY ARKTIKI I ANTARKTIKI, No 47, Gidrometeoizdat, 1976, pp 68-73, "Long-Period Tidal Variations of Gravity and Their Importance for the Earth's Ocean and Atmosphere"]

[Text] Using materials on gravity anomalies in the earth's northern hemisphere, the authors have computed the deformational, static anomalies of heights of the level surface of the ocean under the condition that the ocean covers the entire earth. The pattern of distribution of deformational levels of the ocean coincided geographically with the centers of low and high pressure over the oceans. The paper gives a generalization of materials on long-period tidal variations of gravity published by Soviet and foreign authors. The article gives an analysis of the reasons for the changes in gravity anomaly values. The hypothesis is formulated that gravity variations can serve as the reason for complex rhythmic accentuation of the centers of action in the ocean and atmosphere. Bibliography of five items.

[109]

## GEOBLOCKS AND TECTONICS OF PLATFORMS

Kiev GEOFIZICHESKIY SBORNIK in Russian No 70, 1976, pp 56-63

[Article by L. I. Krasnyy, All-Union Scientific Research Geological Institute, "Geoblocks and Tectonics of Platforms"]

[Abstract] The problem of the block division of the earth's tectonosphere is considered in this article. The concepts of geoblocks and movable lithospheric platforms are compared. It is stated that only one part of the "new global tectonics" (the presence of platforms) is proven by geological and geophysical data. The other part (spreading), based on data on the sharply asymmetric structure of the Pacific Ocean, is unacceptable. It is determined that S. I. Subbotin's model of rotation and advance movements of blocks is close to the natural pattern of distribution of geoblocks in the Australian-New Zealand sector of the Pacific Ocean mobile zone. The materials on the basis of which these conclusions were drawn are reflected in Table 1 (Comparative Characteristics of Geoblocks in the Australian-New Zealand Transition Zone), Table 2 (Comparative Characteristics of Geoblocks of Different Types) and Fig. 2 (map of geoblocks of the transition zone).

[110]

## DEEP FAULTS IN ARMENIAN SSR

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR, NAUKI O ZEMLE in Russian Vol XXIX, No 3, 1976, pp 54-62

[Article by S. N. Nazaretyan and S. S. Kazaryan, Institute of Geophysics and Engineering Seismology Armenian Academy of Sciences, "Experience in Classifying Deep Faults in the Territory of the Armenian SSR Detected Using Geophysical Data"]

[Abstract] After analyzing the regional and local peculiarities of gravimagnetic and geothermal fields, seismicity, physical properties of rocks and geological nature of the principal geophysical anomalies, the authors defined the following principal geophysical criteria for discriminating deep faults in the republic: 1) linear zones of great horizontal gravity gradients traced for hundreds of kilometers (as shown in Fig. 1); 2) a sharp difference in the structure of the anomalous gravity field along the two sides of the line; 3) clear boundaries of magnetic zones and sub-zones, along both sides of which there are different backgrounds and morphology of the fields, difference in forms, intensity and extents of the anomalies; 4) impairment in structure of the anomalous magnetic field; 5) sharp change in intensity of the  $\Delta T_a$  field; 6) sharp change in the sign of the anomalous magnetic field; 7) sharp jump in the depth of

magnetically active masses; 8) a chain of intensive positive local anomalies; 9) zones of epicenters of strong and weak earthquakes; 10) linearly elongated zones of strong and destructive earthquakes; 11) boundaries of geothermal zones with different heat flows; 12) presence of locally anomalous sectors of the geothermal gradient; 13) chains of thermal springs. Since with respect to geological and geophysical importance they are not of equal significance, the matter of their classification arises. The article describes an attempt to classify the discriminated deep faults on the basis of strike, structural position and with the use of an electronic computer.

[76]

#### PARAMETERS OF SEISMIC REGIME IN ARMENIA

Yerevan IZVESTIYA AN ARMYANSKOY SSR, NAUKI O ZEMLE in Russian Vol XXIX, No 4, 1976, pp 71-81

[Article by N. K. Karapetyan, Institute of Geophysics and Engineering Seismology Armenian Academy of Sciences, "Parameters of Seismic Regime of Armenia"]

[Abstract] In a study of the seismic regime of Armenia the author used data on strong earthquakes during the entire historical period. Computations of the energy class  $K$  in possible cases directly from the seismograms for Armenian earthquakes were carried out using the maximum amplitudes of the body waves using the T. G. Rautian nomogram. A scale which was prepared made it possible to reduce all earthquakes on the Armenian Plateau to one and the same energy classes, regardless of what method is used for determining the energy class. For the purpose of obtaining the first three parameters of the seismic regime  $A$ ,  $\gamma$ , and  $K_{\max}$ , graphs of the frequency of recurrence of tremors were constructed for the investigated area in the form of graphs of the dependence of earthquake recurrence on earthquake energy. Comparison of graphs of the frequency of recurrence constructed for the period of observations up to 1968 and through 1968 (that is, before and after the Zangezurskoye earthquake) reveals that the slope of the frequency-of-recurrence curves remains virtually constant. The graph of the frequency of recurrence constructed for a long period of time and for high energy classes also makes it possible to judge the maximum possible earthquake in a particular region.

[78]

#### EQUATIONS FOR ELASTIC SPHEROIDAL DEFORMATIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 11, 1976, pp 7-12

[Article by S. M. Molodenskiy, Institute of Physics of the Earth, "Green's Functions for Equations of Elastic Spheroidal Deformations of Earth"]

[Abstract] The Green's function for the equations of elastic spheroidal deformations of the earth is expressed through the regular solutions of the corresponding homogeneous system. The author has found a system of variables in which the self-conjugate nature of the problem is manifested in a symmetry of the coefficients of the differential equations. Also examined are elastic deformations of the earth caused by a -shape source of displacements. Displacements and changes in potential at the earth's surface are expressed through stresses at the depth of the source entering into the regular solutions of the homogeneous system. It was possible to derive a simple expression for change in the Love number with a variation of the model of the earth's structure not containing elements of the inverted matrix of the fundamental solutions.

[133]

#### DYNAMICS OF FLUIDS IN SEISMICALLY ACTIVE REGIONS

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8G151

[Article by D. G. Osika, A. B. Megayev and O. A. Saidov; Moscow, DEGAZATSIYA ZEMLI I GEOTEKTONIKA, Izd-vo "Nauka," 1976, pp 42-45, "Dynamics of Fluids in Seismically Active Regions"]

[Text] In the study of strong earthquakes (EQ) in the Northern Caucasus and Kirgizia it was established that sharp fluctuations in the yield of petroleum, gas and water in boreholes and in mineral springs not only accompany EQ but also precede them. Ten to thirty days before an EQ there is a marked increase in the yields of fluids as a result of an increase in stratum pressures in collectors of the sedimentary cover as a result of an increase in the total stressing of the earth's crust. One to three days before an EQ the discharges decrease due to a marked increase in the scales of tectonic fissuring and migration of great masses of fluids from overstressed collectors and in the underlying and overlying rocks and probably in fault zones where the foci of EQ are formed. Hydrodynamic effects are observed not only at the epicenters, but also far beyond their limits. Their scales are approximately proportional to the EQ magnitude. Fluctuations of the discharges of fluids are accompanied by profound changes in the chemical composition of the ground water and gases. The decrease in the concentration of hypergenic hydrogen sulfide, biogenous and atmospheric nitrogen up to their complete disappearance in the gaseous associations of the sedimentary cover coincides with an intensification of the processes of fissure formation directly before an EQ. The Anapskoye EQ of 1966 and the Dag-estanskoye EQ of 1970 were preceded by a marked increase in the content of

chlorine and the total alkalinity in the waters of the sedimentary cover. Here there was a change in the isotopic composition of carbon in methane and carbon dioxide as a result of the dilution of the gases in the sedimentary cover by "juvenile" carbon dioxide and methane. The Anapskoye and Tashkentskoye EQ (1966) were preceded by an increase in the radon content in the waters. Before the Dagestanskoye EQ of 1974-1975 there was an increase in the concentration of hydrocarbons in the gases and in the waters an increase in the concentration of chlorine, calcium, magnesium and total mineralization. It was possible to establish a direct dependence between the gas hydrogeochemical anomalies and the intensity of EQ and also an inverse dependence of the intensity of the anomaly on the distance of the epicenters to the observation point. The gas hydrogeochemical anomalies are observed in periods of aftershocks of strong earthquakes.

[109]

## V. UPPER ATMOSPHERE AND SPACE RESEARCH

### News

DATA ON VENUS DERIVED FROM "VENERA-9" AND "VENERA-10"

Moscow PRAVDA in Russian 10 Nov 76 p 3

[Article by V. Moroz: "Venus Narrates"]

[Text] Mercury, Venus, Earth and Mars are in many respects similar to one another; they are close in size, mean density and probably in structure of their deep layers. However, with respect to the nature of the atmosphere the different members of this family differ very greatly. For example, let us compare the Earth and Venus. The diameter of Venus is only 5% less than ours; their mean density is virtually identical. The quantity of heat received from the sun is virtually identical. Although Venus is closer to the sun, it reflects considerably more solar radiation than does the earth. But despite this Venus was found to have a thicker atmosphere and is by no means the same in composition.

Evidently, even small differences in initial conditions can lead the evolution of planetary atmospheres along different routes. And if we wish to understand the laws of development of the atmosphere and climate on the earth, we must make a detailed study of other planets. Venus is of special interest in this respect.

The new generation of automatic interplanetary stations makes possible a more detailed study of Venus. Basic information on the characteristics of the atmosphere -- temperature, pressure and wind velocity -- was already obtained on earlier flights. But recent measurements on the "Venera-9" and "Venera-10" yielded interesting additional data.

Near the surface itself the temperature and pressure were very close to the former results. At the landing places the temperature was about 460° Celsius and the pressure was about 90 atmospheres. Such an agreement of the results must be expected due to the enormous mass and thermal inertia of the atmosphere. We note that Venus rotates about its axis very slowly (the

solar days here are equal to approximately 120 terrestrial days). Nevertheless, the diurnal changes in temperature are manifested only at a great altitude. Near the surface the heat virtually does not drop off at nighttime.

Until recently we knew very little about the Venusian clouds: of what they consist, what the particle concentration is, and how transparent the clouds are for solar radiation.

When the experiment was prepared for photographing the surface it was not known whether it was light or dark during the daytime on Venus and whether natural illumination would suffice for the telephotometer. An experiment for measuring illumination in the deep layers of the Venusian atmosphere was carried out aboard the "Venera-8" in 1972 and it revealed that some fraction of sunlight nevertheless reaches the surface, but what this illumination might be was unknown.

The "Venera-9" and "Venera-10" were used in carrying out two experiments for measuring the intensity of sunlight scattered in the atmosphere. The illumination at the Venusian surface, according to data from the wide-band photometer, was about 10,000 lux. Such conditions on the earth correspond to the middle latitudes at midday when the sky is covered by continuous clouds. The light was adequate to a survey. The great illumination of the surface gives basis for assuming that the "greenhouse" effect hypothesis was completely confirmed.

During the descent of the vehicle in the atmosphere the illumination, according to data from the narrow-band photometer, varied greatly. This was caused by passage through individual cloud concentrations, whose dimensions are from several hundred meters to kilometers. The lower boundary of the cloud cover is not registered very precisely; according to the totality of different data, it is situated at an altitude of about 35 km.

It is interesting that all this thickness of clouds attenuates radiation by only a factor of 2.5-3. Analysis of this fact led to the conclusion that the Venusian clouds are more similar to a thin fog than to terrestrial clouds, such as cumulus clouds.

Data on particles in the cloud layer were obtained using a nephelometer -- an instrument with an artificial light source which sends a narrow light beam into the atmosphere.

The cloud layer has been investigated in detail by instrumentation carried aboard artificial Venusian satellites. It was found that the altitude of the upper cloud boundary during the daytime is approximately 68-70 km. This means that the scientific instrumentation of the descent modules was activated only several kilometers below the upper boundary of the cloud layer.

Infrared radiometry, photometry, polarimetry and spectroscopy of the Venusian cloud layer were carried out earlier by means of ground telescopes. The use of the same method on artificial Venusian satellites appreciably expanded its possibilities. The spatial resolution (related to the planetary surface) during ground observations is usually about 1,000 km, whereas during observations from "Venera-9" and "Venera-10" it was 20-50 km.

In the study of the chemical composition of the Venusian atmosphere it is of special interest to analyze the content of water vapor. The measurements made with photometers supplied with filters for the absorption bands of water vapor and carbon dioxide revealed that at altitudes from 40 to 20 km the water vapor content is about 0.1%. The photometer ceased measurements at an altitude of 35 km, but there is basis for assuming that such a concentration persists down to the surface. The partial pressure of water vapor at its boundary is about 0.1 atmosphere. If the earth's oceans were transformed into vapor, the pressure would exceed 300 atmospheres. Thus, there is 3,000 times less water on Venus than on our planet. Such a strong difference is one of the mysteries which still must be solved by scientists. The shortage of water on Venus was probably caused by the appearance of an enormous quantity of carbon dioxide in the atmosphere. If there were once oceans on Venus, they would dissolve the carbon dioxide and bind it in calcareous rocks, like on the earth.

Another mystery is the composition of the cloud layer. An interesting hypothesis has been proposed by the American scientists Young and Sill. They feel that the clouds (or at least their upper layer) consist of droplets of a concentrated solution of sulfuric acid. The optical properties of the clouds measured from ground observations and the instruments aboard artificial Venusian satellites agree well with this hypothesis. However, it seems probable that at different altitudes the cloud particles can have a different chemical nature.

A number of exceedingly interesting results were obtained on the upper layers of the planetary atmosphere: specialists discovered the spectral emission lines of the night airglow of Venus, the temperature of the upper atmosphere was determined and variations of ionospheric layers were studied.

Using artificial satellites the reason for the nighttime glow of the planet is clarified. Highly sensitive, high-speed spectrometers registered a clear group of emission bands, regularly observed, visible on the entire nighttime side and intensifying at the nighttime limb of the planet. The spectrum of night sky emission consists of bands forming a proper sequence and evidently belonging to molecular oxygen. We note that the spectrum of the nighttime glow of Venus obtained in this experiment is completely dissimilar to the spectrum of glow of the earth's nighttime sky. This system of bands arises only in a mixture of small quantities of oxygen and carbon dioxide.

Why is it that Venus is similar to the earth in mass, dimensions and quantity of heat obtained by the sun and at the same time differs so sharply in composition and structure of the atmosphere and in physical conditions at the surface? On Venus the greenhouse effect was intensified in the initial stages of its geological evolution: an increase in temperature led to the additional release of carbon dioxide and water vapor into the atmosphere, which in turn led to a temperature increase. The process continued until all the volatile compounds had passed into the atmosphere. On the earth this did not occur due to the far greater quantity of water, which led to the formation of a hydrosphere. Probably, the initial water content on Venus was far less than on the earth and this was the reason for such a sharp difference in the atmospheres of the two adjacent planets.

A study and understanding of the processes transpiring on Venus means a better understanding of our earth. This is the principal direction in investigation of the planets by means of space vehicles.  
[114]

#### TASS ANNOUNCES LAUNCHING OF "KOSMOS-867"

Moscow PRAVDA in Russian 25 Nov 76 p 3

[TASS Report: "'Kosmos-867'"]

[Abstract] The artificial earth satellite "Kosmos-867" was launched in the Soviet Union on 23 November 1976. The satellite was inserted into an orbit with the following parameters:

- initial period, 91 minutes;
- apogee, 418 kilometers;
- perigee, 258 kilometers;
- orbital inclination, 62.8 degrees.

#### TASS REPORTS "SALYUT-5" STATION COMPLETES FIVE MONTHS IN ORBIT

Moscow PRAVDA in Russian 23 Nov 76 p 2

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

[Text] Flight Control Center, 22 November. The "Salyut-5" scientific station, which was inserted into near-earth orbit on 22 June 1976, is continuing its flight. By 1300 hours Moscow time on 22 November the station had completed 2,455 revolutions around the earth.

The station has been in controlled flight mode with constant orientation on the earth for five months.

In accordance with the program of operations for the station in automatic flight mode, photography of the earth's surface has been conducted and scientific experiments have been performed using the IR telescope-spectrometer. The IR radiation of the earth and the moon has been studied.

Technical experiments and tests of the station's on-board systems in various operating modes are continuing.

The on-board systems, equipment and scientific apparatus of the station are functioning normally.

Parameters of the microclimate in the station's compartments are: temperature -- 23°C, pressure -- 830 mm Hg.

The information being received from the station is being processed.  
[4]

#### TASS ANNOUNCES LAUNCHING OF "PROGNOZ-5" SATELLITE

Moscow PRAVDA in Russian 26 Nov 76 p 3

[TASS Report: "'Prognoz-5'"]

[Text] In accordance with the program for space research, at 0659 hours Moscow time on 25 November 1976 the "Prognoz-5" automatic station was launched in the Soviet Union. "Prognoz-5" is intended to continue the researches begun in 1972 by the "Prognoz" automatic observatory.

As was the case with the four previous stations of this type, "Prognoz-5" will perform research on the corpuscular and electromagnetic radiations of the sun and on solar plasma streams. In addition, it will study the magnetic fields in near-earth space in order to determine the effect of solar activity on the interplanetary medium and the earth's magnetosphere. To perform these studies the satellite carries scientific apparatus created in the Soviet Union, the Czechoslovak Socialist Republic and France as part of a program for international cooperation in the field of space research. The weight of the station is 930 kilograms.

The "Prognoz-5" station was inserted into a high elliptical orbit with the following parameters:

- apogee, 199,000 kilometers;
- perigee, 510 kilometers;
- period of revolution, 95 hours 13 minutes;
- orbital inclination, 65 degrees.

The station was moved into its planned trajectory from an intermediate orbit as an artificial earth satellite.

In addition to the scientific apparatus the satellite has a radio transmitter operating on a frequency of 928.4 MHz, a radio system for precise measurement of orbital elements and a radiotelemetry system for transmitting to earth data on the operation of the instruments and scientific apparatus.

According to telemetry information, the on-board systems and scientific apparatus of the station are operating normally. The coordination-computation center and institutes of the USSR Academy of Sciences are processing the incoming information. [4]

#### TASS ANNOUNCES LAUNCHING OF "KOSMOS-868"

Moscow PRAVDA in Russian 27 Nov 76 p 3

[TASS Report: "'Kosmos-868'"]

[Abstract] The artificial earth satellite "Kosmos-868" was launched in the Soviet Union on 26 November 1976. The satellite was inserted into an orbit with the following parameters:

- initial period, 93.3 minutes;
- apogee, 457 kilometers;
- perigee, 438 kilometers;
- orbital inclination, 65 degrees.

#### TASS ANNOUNCES PLANS TO CONDUCT ROCKET LAUNCHES IN THE PACIFIC

Moscow IZVESTIYA in Russian 27 Nov 76 p 3

["TASS Announcement"]

[Text] During the period from 30 November through 30 December 1976 the Soviet Union will conduct launches of booster rockets into a region of the Pacific Ocean bounded by a circle with a radius of 50 nautical miles with its center at the coordinates 23 degrees 25 minutes North Latitude and 171 degrees 26 minutes East Longitude.

TASS has been authorized to announce that for purposes of safety the government of the Soviet Union requests the governments of other countries using the sea and air lanes in the Pacific Ocean to instruct appropriate agencies so that ships and airplanes will not enter this region or the air

space above it daily from 0800 to 1600 LT. [4]

#### TASS ANNOUNCES LAUNCHING OF "KOSMOS-869"

Moscow PRAVDA in Russian 1 December 1976 p 2

[Abstract] The artificial earth satellite "Kosmos-869" was launched in the Soviet Union on 29 November 1976. The satellite was inserted into an orbit with the following parameters:

- initial period, 89.3 minutes;
- apogee, 307 kilometers;
- perigee, 202 kilometers;
- orbital inclination, 51.8 degrees.

#### MISSION OF "PROGNOZ-5" SATELLITE DISCUSSED

Moscow PRAVDA in Russian 26 Nov 76 p 6

[Article by A. Galejev: "To Meet the Polar Aurora"]

[Text] An aurora is one of the most unique phenomena in nature. It is, after all, as mysterious as it is beautiful. The aurora has now already been studied for several centuries. Its origin is very closely related to processes on the sun and in the interplanetary medium. However, a significant advance in an understanding of the mechanisms of the action of solar electromagnetic and corpuscular radiations on the earth's upper atmosphere was possible only with the appearance of earth satellites by means of which it was possible to measure and monitor the state of the interplanetary plasma and magnetic field unperturbed by the earth. Such experiments are now being carried out aboard Soviet satellites of the "Prognoz" series.

A matter of special interest is study of the times of increased solar activity when its effect on the state of the circumterrestrial medium can have serious effects. During the time of what was probably the most intensive series of flares in our century, in August 1972, specialists carried out complex measurements on the satellites "Prognoz" and "Prognoz-2." Solar activity then led to a complete cessation of radio communication in high-latitude regions, interference in telephonic and telegraphic lines, geomagnetic storms, auroras and other phenomena.

Particles and electromagnetic radiation carry to the earth information on the "operation" of the sun. But it is necessary to discriminate from it precisely those data which relate to the sun itself, eliminate the effects of distortion of their spectra as a result of interaction with the

solar corona and interplanetary medium. Accordingly, it is necessary to study the peculiarities of generation of particles with different charge and isotope compositions. Instrumentation created by Soviet and Czechoslovakian scientists was carried aboard the "Prognoz-5" station for solving these problems.

The study of the dynamics and composition of the solar "wind" -- the stream of plasma continuously escaping from the sun -- was already initiated aboard the "Prognoz" and "Prognoz-2" stations. In collaboration with French colleagues, these studies are being continued on the new station.

Interplanetary plasma and magnetic fields, their parameters and configuration, exert a considerable influence on the state of the earth's magnetosphere. Study aboard the station of the entire diversity of plasma forms and electromagnetic radiation will help in an understanding of important problems in magnetospheric physics. This is of great importance. Quite recently it was discovered that the earth is a powerful source of directed radioemission in the kilometer range of wavelengths, similar to the light radiation of a number of pulsars. Thus, the earth is a singular "model" of distant worlds.

The "Prognoz-5" station is also helping in a routine evaluation of radiation conditions, a knowledge of which is important for space flights.

It is no accident that the problem of solar-terrestrial relationships is being solved aboard the "Prognoz-5" station through the efforts of scientists of the USSR, CzSSR and France. The global study of these physical processes requires the coordinated efforts of different countries. An international plan for investigation of the magnetosphere began to be executed in 1976. The launching of the "Prognoz-5" satellite is one of the most interesting experiments under this program, having enormous significance for modern science.

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#### DEVELOPMENT OF SOVIET COMMUNICATION SATELLITES DISCUSSED

Moscow PRAVDA in Russian 1 December 76 p 3

[Article by M. Fedorov and G. Markelov: "Space Telebridge is Operating"]

[Text] The principal directions in development of the national economy of the Tenth Five-Year Plan provide for the broader use of artificial earth satellites, especially for ensuring television broadcasting to different regions in Western and Eastern Siberia and for telephonic-telegraphic communication with remote regions of the country.

It is well known that by the use of artificial earth satellites it is possible in the cheapest way possible to carry out reliable radio communication and teletransmissions over great distances and over great areas. As early as 1965, under the direction of Academician S. P. Korolev, the "Molniya-1" relay satellite was created. In 1967 the "Orbita" network of ground stations began to operate in the USSR. This made it possible to transmit the programs of Central Television via satellites of the "Molniya-1" series to many regions of the country, including to the Far North, to Siberia, Central Asia, and to the Far East. Solution of such a problem using radio-relay or cable lines would require enormous expenditures of capital.

The "Molniya-2" and then the "Molniya-3" satellites began to operate in 1971-1974. These have a greater carrying capacity than the "Molniya-1" and operate in a new frequency range. In addition to use in the "Orbita" system, these satellites constituted the basis for the international communications system "Intersputnik." Testing of the new "Raduga" Soviet communications satellite began in 1975. Revolving in a circular orbit at an altitude of 36,000 km in the equatorial plane with an angular velocity equal to the velocity of the earth's rotation, this satellite is constantly in a fixed position relative to a terrestrial observer. In other words, a geostationary satellite can be compared with a relay station at an altitude of 36,000 km. In such a case land stations can have fixed antennas, which considerably reduces the cost of their construction.

The creation of complex space communication systems is possible as a result of the efforts of specialists in many fields of science and technology, especially due to the successes attained in the USSR in the field of cosmonautics. Relay satellites have today become the principal means for radio communication and television.

The "Ekran" television broadcasting satellite is a representative of the new generation of relay satellites. It was put into orbit on 26 October. During its development it was necessary to solve complex scientific and technical problems.

During the Tenth Five-Year Plan plans call for television broadcasting to reach virtually all the population of our country. Taking into account the enormous extent of the territory, today the only technically feasible way to solve this problem is the transmission of TV programs to simple and cheap receiving stations which it is economically feasible to set up in small cities and populated places. It is obvious that in this case it is mandatory to use geostationary relay satellites.

Soviet specialists have carried out a considerable volume of investigations for determining the optimum relationship between the "load" in the radio line, which the relay satellite must take upon itself, and the complexity of the equipment of ground receiving stations for the purpose of making them as cheap as possible.

The "Ekran" television broadcasting satellite was created taking into account the optimization which has been introduced. It ensures the transmission of color or black-and-white Central Television programs in the network of ground collective-use antennas. The receiving apparatus in this case is a relatively simple converter.

On the day of celebration of the 59th anniversary of the Great October Revolution, by means of the "Ekran" satellite it was possible to carry out the first teletransmissions from Moscow for the residents of Yakutiya, Krasnoyarskiy Kray, Tuvinskaya ASSR and other regions.

How does this satellite operate? It carries a receiver-transmitter which receives a signal emitted by a ground station in the Moscow region, amplifies and transmits it to the collective-use receivers located in the zone of radiovisibility of the satellite in the Siberian and Far North regions. The reception of the programs on the satellite is at a frequency of 6,000 and transmission at frequencies of 702-726 MHz by the FM method.

The signals of the powerful transmitter are amplified by the on-board antenna, which is a phased lattice with an area of 12 square meters. The high characteristics of the antenna make it possible to increase the energy of the radio line and exclude the possibility of radiointerference by stations operating in the used frequency range.

As the energy generator the satellite uses a solar cell with a power as great as 2 KW.

The use of a narrow-directional on-board transmitting antenna and the need for increasing the effectiveness of the solar cells require constant precise orientation on the earth of the antennas rigidly coupled to the skin of the satellite and the orientation of the panels of solar cells on the sun. This task is performed by the triaxial orientation and stabilization system.

The holding of the satellite at a stipulated point in a geostationary orbit and also the possibility of its movement along the equator in longitude are ensured by a correction system designed on the basis of liquid-fuel rocket microengines. The control of the satellite from the earth is accomplished by means of a radio command.

The necessary heat regime on board is maintained by a combination of passive and active heat-regulating methods.

The "Ekran" satellite is launched by means of a multistage carrier-rocket into a nearly stationary orbit. It is called nearly stationary because the period of revolution of the satellite in it differs somewhat from 24 hours so as to ensure the possibility of satellite "drift" from

the point of launching in the direction of the point of its "parking" -- 99 degrees East Longitude. At the point of "parking" the period of revolution is reduced to 24 hours by means of the on-board correcting apparatus.

After separation of the satellite from the carrier-rocket it is prepared for work; in the course of the "drift" there was control activation of the on-board apparatus. After carrying out the correction the satellite was ready for television broadcasting sessions.

In creating the "Ekran" the developers made use of the latest advances in a number of fields of science and engineering. This made it possible to achieve high characteristics of the on-board systems of the satellite with rigid requirements on their size and weight.

The creation of the "Ekran" satellite is a new step on the way to the practical use of the advances in cosmonautics.

Abstracts of Scientific Articles

INTERRELATIONSHIP OF E AND F IONOSPHERIC REGIONS

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8A242

[Abstract of article by Klos Zbigniew; Warsaw, MATER. I PR. INST. GEOFIZ. PAN, No 83, 1975, 100 pages, "Electrodynamic Relationship Between the E and F Regions of the Ionosphere in Relationship to the Equatorial F Scattering"]

[Text] The paper gives an analysis of the effectiveness of the electrodynamic relationship between the E and F layers of the ionosphere arising due to small-scale electric fields under conditions of instability in crossed fields  $E_0 \times B_0$ . The article describes the morphological characteristics of small-scale ionospheric inhomogeneities. The author discusses the applicability of a quasihydrodynamic model of three-component plasma to the dynamics of small-scale inhomogeneities. Within the framework of such a model the author obtains the tensors of diffusion and mobility for an arbitrary degree of ionization. In the approximation of geometrical optics, from linear equations it was possible to obtain a dispersion equation making it possible to determine the characteristics of the disturbances. In the approximation of random phases the article gives the derivation and analyzes the equations of slightly turbulent and slightly inhomogeneous plasma. On the basis of these equations a qualitative analysis is made of the influence of nonlinearity on the propagation of the energy of such events under explosive instability conditions. On the basis of a model of the equatorial ionosphere the author gives analytical formulas with an illustration by numerical computations.

[109]

SIGNAL PROPAGATION BETWEEN MOSCOW AND MOLODEZHNYAYA

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8A250

[Abstract of article by S. F. Golyan, T. S. Kerblay and Ye. M. Kovalevskaya; Moscow, Ionosfern. Raszpredeleniye Korotk. Radiovoln, 1975, pp 20-28, "Trajectory of Forward and Back Signals on the Moscow-Molodezhnaya Path"]

[Text] Anomalous phenomena in the distribution of short radio waves on the path Moscow-Antarctica (high fields and the propagation of frequencies above the MUF during the sunrise and sunset periods during the equinoctial months, reception of back signals) are explained drawing upon computations of the trajectories. The computations were made using the Ye. M. Kovalevskaya program. The conclusion is drawn that the horizontal inhomogeneity of the ionosphere along the path exerts a considerable influence on the type of trajectory. When there are horizontal gradients of electron concentration, negative near the point of transmission and positive in the reception region, trajectories appear without intermediate reflections by the earth, being energetically more advantageous and ensuring the propagation of radio waves with frequencies exceeding the MUF level. Bibliography of nine items. [109]

#### HORIZONTAL INHOMOGENEITY OF REGULAR E LAYER

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8A252

[Abstract of article by Ye. M. Kovalevskaya; Moscow, IONOSFERN. RASPROSTRANENIYE KOROTK. RADIOVOLN, 1975, pp 42-57, "Effects of Horizontal Inhomogeneity of the Regular E Layer and the Interlayer Region in the Trajectory Characteristics of Radio Waves"]

[Text] On the basis of hourly  $f_0E$  data from vertical sounding stations the author has investigated the statistical patterns of the  $f_0E$  gradient. Local gradients were replaced by time gradients. It was found that the horizontal gradients of the regular E layer are maximum in the morning and in the evening hours. The value of the monthly median  $f_0E$  gradient is  $\sim 0.04-0.05 \cdot 10^2$  MHz/km, which is 10 times less than the  $f_0E_2$  gradient. Nevertheless, during the propagation of radio waves in the range of vertical radiation angles somewhat above the limit at which reflection from the E layer is still observed, there is a considerable refraction in the E region and in the interlayer region. In these cases, due to the considerable contribution of the horizontal inhomogeneity of the E layer to the total gradient of the refractive index there can be a change in the angles of incidence in the vertical plane to  $2^\circ$  and in the horizontal plane to  $1^\circ$ . Sometimes there can be a change in the direction of signal arrival caused by different signs of the integral gradient of electron density of the E and F2 regions. Bibliography of five items. [109]

## IONOSPHERIC SOUNDING AT TWO FREQUENCIES CLOSE TO $f_0F_2$

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8A65

[Abstract of article by G. T. Nestorov and M. M. Cohen; Sofia, DOKL. BOLG. AN, 28, No 12, 1975, pp 1613-1616, "Quasivertical Sounding of the Ionosphere at Two Frequencies Close to  $f_0F_2$ "]

[Text] A study was made of the duration of reflections of signals in the case of quasivertical incidence of a wave on the ionosphere on two paths: Monte Carlo-Roburent (75 km, 6.035 MHz, R) and Stolnik-Sofia (25 km, 7.670 MHz, S). At Sofia and at Monte Capellino (near the indicated paths) specialists made use of vertical sounding ionosondes. The observations were made during the period from 20 June through 20 September 1974 at the time of low solar activity ( $R = 34$ ). The nature of signal reflections from  $E_S$  and F2 differed clearly; the frequency of manifestation of the  $E_S$  layer with  $f_0E_S > 7$  MHz is considerably higher at Sofia than at Monte Capellino. The variability of signal reflections on both paths ( $\tau_R$  and  $\tau_S$ ) is similar, evidence of a similarity of the signal reflection mechanisms at both frequencies, despite the considerable distance between the reflection points ( $\sim 1,300$  km). During periods of geomagnetic disturbances  $\tau_R$  and  $\tau_S$  decrease, evidence of the influence of negative magnetic-ionospheric disturbances in the F2 layer. An examination of the correlation between  $\tau_{R,S}$  and  $f_0F_2$  indicated that both frequencies were reflected from the F2 region even when their values were greater than  $f_0F_2$ . This is attributable to a decrease in the equivalent reflection frequency in comparison with the theoretical frequency in the refraction process. Bibliography of seven items.

[109]

## RELATIONSHIP BETWEEN MAGNETOSPHERE AND IONOSPHERE

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8A42K

[Abstract of preprint by G. A. Vnuchkov, L. L. Van'yan and A. S. Debabov; Moscow, ELEKTROMAGNITNAYA SVYAZ' MAGNITOSFERY S IONOSFEROY, Space Research Institute USSR Academy of Sciences, Preprint 225, 1975, 27 pages]

[Text] On the basis of an analysis of transverse magnetic disturbances (TMD) the conclusion is drawn that TMD are caused by the inflow (outflow) of longitudinal currents into the morning (evening) high latitudes of both hemispheres. The authors propose a model of high-latitude conjugate ionospheres having a latitudinally zonal structure and a potential difference of  $\sim 50-75$  kV between the morning and evening boundaries of the polar cap. It is shown that in the ionosphere there can be current systems of

two types: weak constant currents of the DP-2 type and stronger sporadic currents caused by an increase in conductivity of the disturbed auroral ionosphere.

[109]

#### GEOSTATIONARY VARIANT OF INCOHERENT RESPONSE METHOD

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 8, 1976, 8A43K

[Abstract of preprint by I. V. Kovalevskiy and G. V. Kuznetsova; Moscow, GEOSTATSIONARNYY VARIANT METODA NEKOGERENTNOGO OTVETA -- SREDSTVO IZUCHENIYA DINAMIKI MAGNITOSFERNYKH PLAZMENNYKH RAZRYVOV V PERIOD BUR', Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation USSR Academy of Sciences, Preprint No 3(146), 1976, 20 pages]

[Text] It is shown that by use of the incoherent response method in a geostationary variant, the basis for which was the idea of conversion of a signal sent from the interrogated (geostationary) satellite and received at the earth (response station), making it possible to change the sign of the frequency shift and the phase lag, it is possible to carry out investigations of the dynamics of the plasmopause, plasma tails of the plasmosphere, the boundaries of these plasma layers and the transitional region of the geomagnetosphere. By making on-board measurements (on the geostationary satellite) to determine the difference between the phase shift ( $\Delta\phi$ ) of the interrogation and response signals, the rate ( $\Delta f$ ) and duration of its increase, it is possible to obtain information on the position, velocity of motion of magnetospheric plasma discontinuities and on the jump in the concentration. Bibliography of 38 items.

[109]

## VI. MISCELLANEOUS

### News

#### START OF TWENTY-SECOND SOVIET ANTARCTIC EXPEDITION

Moscow PRAVDA in Russian 9 Nov 76 p 6

[Article by V. Bardin: "To the Ice Continent"]

[Text] As already reported in PRAVDA, the 21st Soviet Antarctic Expedition is completing its cycle of work on the sixth continent. Soon replacements will reach the winterers. Some of the ships have already gone to sea. Our special correspondent is aboard one of them. Today we report his first communication.

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The ships of the 22d Soviet Antarctic Expedition, one after the other, are departing from their berths for the distant shores of the southern ice continent. The diesel-electric steamers "Mikhail Somov" and "Penzhina" were the first to depart in late October from Leningrad. The "Kapitan Gotskiy" followed immediately after them.

The passenger liner "Bashkiriya" departed for Antarctica from Odessa after the diesel-electric ships, which had departed from the Baltic. It carried the largest group of polar workers.

The scientific research vessel "Professor Zubov" should depart for Antarctic waters in the second half of November. It is to continue work under the international program "Polar Experiment - South." This time the principal region of operations of the ships of science is the ocean waters to the south of Australia. The departure of the last of the ships -- the passenger liner "Estoniya," is planned for the second half of January.

The courses taken by the ships into the south polar latitudes are different. From the Baltic the route there lies through the Atlantic, from the Black Sea, through the Suez Canal and through the Indian Ocean. But all the ships must rendezvous along the shores of the ice continent, to which will

be delivered the participants of the wintering and seasonal expeditions -- a total of about 500 men and thousands of tons of different kinds of freight: scientific equipment, different kinds of gear, transport vehicles. With respect to the scale and complexity of the work, breadth of the formulated tasks and their scientific significance, this is unquestionably one of the largest expeditions of our time. Foreign scientists are also participating in it.

The new Soviet expedition is carrying out a replacement of the winterers at six south polar stations: Molodezhnaya, Mirnyy, Vostok, Bellinsgauzen, Novolazarevskaya, Leningradskaya. It is also planned that complex field investigations be carried out. For the summer season plans call for scientific treks along inaccessible intracontinental regions, complex cartographic and geological-geophysical investigations in the zone of the gigantic Filchner and Ronne shelf ice, where during the past year the seasonal station Druzhnaya was established. The expedition will be made up of specialists of different scientific institutes of our country, institutes of the USSR Academy of Sciences, USSR Hydrometeorological Service. The routine direction of all the work is the task of the Arctic and Antarctic Institute.

Scientists, seamen, airmen, builders, drivers, physicians, radiomen and cooks -- this is by no means a complete list of the occupations of those who are to work in Antarctica. Many of them more than once have been on the sixth continent. For example, the chief of the seasonal expedition Candidate of Geographical Sciences N. I. Tyabin and the chief of the wintering expedition Candidate of Geographical Sciences L. I. Dubrovin are experienced polar researchers. The same can be said of the directors of the individual groups of winterers. But most of the personnel are young people.

The 22d Soviet Antarctic Expedition has begun. There are major difficulties on its path. Even in our day the Antarctic continent is continuing to remain the most severe region of the planet.  
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