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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

GEOPHYSICS, ASTRONOMY AND SPACE

No. 391

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I. ASTRONOMY

News

SPECTROSCOPIC STUDIES IDENTIFY SOLAR IONS

Moscow IZVESTIYA in Russian 29 Dec 76 p 4

[Article by B. Konovalov, "Stripped Atoms"]

[Summary] Spectroscopy has become the principal means for investigating the universe. However, approximately 30% of the lines in the short-wave part of the solar spectrum obtained in the Soviet Union and abroad could not be identified. But each line in the spectrum is the "autograph" of some atom. Is it possible that among the atoms "populating" the sun a third are unknown to science? Or are these the "autographs" of ordinary atoms which are in some unusual state? It was found that the second hypothesis is the correct one. It is so hot on the sun that the atoms must be "stripped" -- lose their electrons. In spectroscopic laboratories studies have been made of highly ionized atoms which lose many electrons from their shells surrounding the nucleus. At the Spectroscopy Institute USSR Academy of Sciences, located at "Krasnaya Pakhra," specialists study the spectra of atoms which are "stripped" by electric sparks during a discharge in a vacuum chamber or by the rays of powerful lasers. And very many spectra obtained in space have lost their mysteriousness. For example, one of the mysterious solar unknowns encountered by the "Interkosmos" satellites was an atom of ordinary iron, but almost completely stripped; only two of 26 electrons remained. Specialists at the Spectroscopy Institute have prepared a special table of elements. Atoms in a normal state are arranged in a horizontal row; the stripped atoms are arranged in vertical rows. Some boxes in this table have already been filled; this means that the spectra of atoms in this state have been well studied. But the bottom of the table, where the most highly ionized atoms are situated, is an almost complete "white spot." The fact is that much still remains to be done in this field.
[196]

II. METEOROLOGY

News

NOTES ON FORECASTING WORK IN THE USSR

Moscow PRAVDA in Russian 30 Dec 76 p 6

[Article by V. Gubarev: "Winter Comes from the Equator"]

[Summary] The unusual weather of 1976 is giving rise to commentaries in the Soviet press. Although short-range forecasts for the last 1 1/2 months have been quite successful, long-range forecasts have not. After all, the latter require an analysis of the state of the atmosphere in the entire northern hemisphere. At the USSR Hydrometeorological Center the amount of processed data is vast. But it has to be backed up with valid theory and effective processing methods. Seasonal forecasts are a special interest for Novosibirsk scientists. At the Computation Center Siberian Department USSR Academy of Sciences a theory has been formulated which has not been accepted by all meteorologists but is characterized by simplicity and originality. The weather is associated with cloud cover over the planet. It governs the degree to which the oceans and land are heated. The severity or mildness of the winter, such as in the Moscow region, is related to very remote regions of the world ocean. Cloud cover over the ocean regulates the receipts of heat in its surface layers. Powerful currents carry sun-heated waters to the north. Cyclones are generated on the boundary with the cold arctic. These move eastward and the heat absorbed by the ocean is transported onto the continents. The entire process lasts approximately a half-year. This means that the nature of the present winter is dependent to a considerable degree on how much heat was received by the ocean during the past year. And the heat received by the continent during the past year counts for little; according to the theory of Novosibirsk scientists, this influences the weather, but not for more than two weeks. The atmosphere is too dynamic. But insufficiency of data hinders full application of the theory. This is particularly true of data for the world ocean, and such information is essential for long-range forecasting. During 1978-1980 global investigations of the atmosphere will begin with the participation of Soviet scientists.

Meteorologists cannot complain of lack of attention to their needs. Several years ago there was talk of a lack of special instruments, electronic computers and apparatus. Now there has been a thorough technical reoutfitting of the Hydrometeorological Service. Weathermen also have space vehicles which are put into circumterrestrial orbits and the latest computers. This has undoubtedly been beneficial. However, the public sometimes gets the impression that the scientific subdivisions of the Hydrometeorological Service are somewhat bogged down. It is not by chance that during recent years the specialists in related fields have tried to exert pressure on meteorologists and have urged them to give greater attention to the findings of other fields. Such it was, for example, in the case of study of solar-terrestrial relationships and their influence on climate. But in meteorology, unfortunately, there are specialists who, to say the least, look on with disapproval at the intrusion of outside scientists. But this problem is so important that there must be no division into "theirs" and "ours."
[192]

NEW MONOGRAPH ON SATELLITE METEOROLOGY

Moscow SPUTNIKOVAYA METEOROLOGIYA. OSNOVY KOSMICHESKIKH METODOV ISSLEDOVANIYA V METEOROLOGII in Russian; Leningrad, Gidrometeoizdat, 1975, 361+ pages

[Monograph by M. A. German, "Satellite Meteorology. Fundamentals of Space Methods for Meteorological Research"]

[Abstract] This book examines the fundamental concepts and laws of motion of an artificial earth satellite. It gives a brief description of the measuring-scanning apparatus and instrumentation aboard meteorological and other special satellites. The author defines the requirements imposed on the hydrometeorological information obtained from satellites and discusses methods for its primary processing. Particular attention is devoted to the use of satellite information in the weather service. There is a discussion of the problems involved in use of satellite measurement data in a numerical analysis of meteorological fields. The book is intended as a study manual for students at hydrometeorological institutes and universities and can be used by a wide range of scientific workers, professional meteorologists, oceanologists and hydrologists.

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Abstracts of Scientific Articles

ICE-FORMING ACTIVITY OF SILVER IODIDE AEROSOL

[Article by B. Z. Gorbunov, N. A. Kakutkina, K. P. Kutsenogiy and V. I. Makarov, Institute of Chemical Kinetics and Combustion (Siberian Division),
"Investigation of the Dependence of the Ice-Forming Activity of a Silver
Iodide Aerosol on Dispersivity"]

[Abstract] A study was made of the ice-forming activity of silver iodide
aerosols in dependence on its dispersivity at the temperatures of a super-
cooled fog -5, -10 and -20°C. The number of ice crystals per gram of re-
agent is very highly dependent on the mean size of the aerosol particles.
Analysis of data in the literature shows that this is the principal reason
for the great discrepancies in data on the ice-forming activity of silver
iodide obtained by different authors. At -10 and -5°C it was discovered
that the fraction of ice-forming particles is a nonmonotonic function of
the degree of dispersion of the reagent, probably caused by the dependence
of the structure of silver iodide on the size of the aerosol particles.
[204]

AIRCRAFT MEASUREMENTS OF ATMOSPHERIC TRANSPARENCY AND SCATTERING FUNCTION

[Article by A. K. Gorodetskiy, V. S. Katin and B. Z. Petrenko, Institute
of Atmospheric Physics, "Atmospheric Transparency and Scattering Function
According to Measurements in the Spectral Region 1.9-2.3 μm from an Air-
craft"]

[Abstract] On the basis of the results of measurements of atmospheric brightness in the region about 2.2μm at altitudes up to 5 km it was possible to obtain the scattering functions for scattering angles 6-100°. It is shown that it is possible to determine the scattering layers with an acceptable accuracy on the basis of measurements with a scattering angle 30°. It is shown that the region of angles 20-40° corresponds to the minimum dispersion of the brightness function. A determination of the vertical variation of the scattering function is possible on the basis of measurements of atmospheric brightness at a scattering angle of 30°. Under sea haze conditions in the case of high humidities at altitudes 1-2 km there is a decrease in the gradient of the scattering function with altitude in comparison with the altitude range 0.1-1 km. Comparison of the optical thicknesses of attenuation and scattering makes it possible to estimate the residual thickness of absorption, in the spectral region 2.25μm attaining 0.05. This residual absorption is caused, probably, by an aerosol; this is indicated by a decrease in the gradient of the scattering function at altitudes 1-1.5 km corresponding to the maximum increase in $\mathcal{T}_{res}$.
[204]

METHOD FOR IDENTIFYING HAIL AND SHOWER CLOUDS

[Article by M. V. Alaniya, A. I. Kartsivadze and E. I. Khelaya, Geophysical Institute Georgian Academy of Sciences, "Use of the Multidimensional Correlation Method for the Recognition of Hail and Shower Clouds"]

[Abstract] During recent years good results have been obtained in the recognition of shower and hail clouds by N. Sh. Bibilashvili, et al. (TRUDY VGI, No 22, 1973, p 90) in which polynomial separating functions were used for this purpose. However, as shown in the paper cited above, a simpler and equally effective solution can be obtained by use of multiple regression analysis. In this case the problem is reduced to the following: using a combination of the values from a known complex of predictors it is possible to determine the value of some function Y which best separates the hail and shower clouds from one another. The predictors used were seven parameters: maximum altitude of radar echoes, temperature at the level H_m, ratio of the thickness of the supercooled part of the radar echoes to the thickness of its "warm" part, altitude of the radar reflectivity maximum, temperature at the level $H_{\eta m}$, thickness of the supercooled part of the zone of increased reflectivity, and temperature at the level of the upper boundary. The problem is reduced to finding regression coefficients a_i of a stipulated system of equations. Using these coefficients it is easy to derive a diagnostic equation. When $\hat{Y} < 0.35$ only nonhail cases are noted, whereas when $\hat{Y} > 0.75$

only hail cases are observed. In the range of Y values from 0.35 to 0.75 convective precipitation of both types is observed. Hail cases are regarded as those when the falling of hail with a diameter greater than 0.5 cm is observed; nonhail cases are those when only shower precipitation falls.
[205]

DETERMINING EQUIVALENT ZONAL MODEL OF ATMOSPHERE

[Article by M. V. Kurganskiy, Institute of Atmospheric Physics, "Use of Adiabatic Motion Invariants for Determining an Equivalent Zonal Model of the Atmosphere"]

[Abstract] The concept of an equivalent zonal model of the atmosphere was first proposed by A. M. Obukhov in METEOROLOGIYA I GIDROLOGIYA, No 2, 1964. He introduced an adiabatically invariant characteristic of the atmosphere -- the mass density distribution $\mu(\theta, \Omega)$ for the adiabatic invariants: potential temperature θ and potential vorticity Ω. The equivalent zonal model of the atmosphere was determined as zonal circulation, which has the same function $\mu(\theta, \Omega)$ as the actual state of the atmosphere. Two assumptions must be made: 1) potential vorticity increases monotonically toward the pole at each isentropic level, 2) the earth's surface is one of the isentropic surfaces. In this paper, on the basis of a qualitative analysis of the properties of adiabatic motion, an attempt is made to substantiate the assumption of a monotonic nature of potential vorticity for equivalent zonal circulation, define an approach to the general case of a nonisentropic surface of the earth, and on the basis of a two-level model of the atmosphere, for specific actual cases, compute their equivalent zonal models.
[204]

LASER SOUNDING OF WIND VELOCITY

[Article by V. Ye. Zuyev, G. G. Matviyenko and I. V. Samokhvalov, Siberian Division, Institute of Atmospheric Optics, "Laser Sounding of Wind Velocity by the Correlation Method"]

[Abstract] The paper cited above describes a method for measuring the velocity and direction of the wind on the basis of correlation processing of laser pulses reflected by the atmosphere which are modulated due to large-scale aerosol inhomogeneities. The authors give a correlation analysis of the motion of randomly inhomogeneous media, followed by a study of the influence of fluctuations of total attenuation on correlation measurements of wind velocity. A theoretical analysis of the contribution of fluctuations of total attenuation to the reflected signal shows that in a slightly turbid atmosphere they can be neglected at ranges up to 5-15 km. Monostatic measurements of wind velocity in the horizontal plane are discussed in detail. The authors used a monostatic lidar with a radiation wavelength 0.53 μm, pulse power 0.02 J, pulse duration 10 nanoseconds, distance between optical axes of receiver and transmitter of optical system 200 mm. It is shown how time correlation analysis of lidar signals in horizontal sounding makes it possible to obtain additional wind velocity information. By combining time and space correlation analysis of horizontal sounding signals it is possible to obtain a method for determining the vector of mean wind velocity in only one direction. The results of comparison of optical and traditional measurements of wind velocity show that the mean square scatter of deviations of the wind velocity modulus in the investigated interval 1-8 m/sec from the readings of ordinary anemometers is about 0.5 m/sec; the discrepancy in wind velocity azimuth is 10-15°.
[204]

PHASE MEASUREMENTS OF ATMOSPHERIC TURBULENCE

[Article by V. P. Lukin, V. L. Mironov, V. V. Pokasov and V. M. Sazanovich, Siberian Division, Institute of Atmospheric Optics, "Phase Measurements of the Internal Scale of Atmospheric Turbulence"]

[Abstract] A study was made of the possibility of determining the internal scale of atmospheric turbulence by simultaneous measurement of fluctuations of the phase differences of optical radiation on two bases of different length. The measurements were made on a horizontal path 95 m long near Tomsk in July-October 1974. The author has already described the method and instrumentation (V. P. Lukin, et al., IZV. VUZov, RADIOFIZIKA, 16, No 11, pp 1726-1729, 1973; SBORNIK DOKLADOV X VSESOYUZNOY KONFERENTSII PO RASPROSTRANENIYU RADIOVOLN, "Nauka," Irkutsk, pp 377-381, 1972). Measurements were made with single-mode collimated beams with an effective radius 2 cm. Phase changes greater than 0.1 rad could be registered. The results of the measurements are shown in a figure: correspondence between meteorological and optical measurements of internal scale; the most probable value of the parameter is in the interval 6-8 mm.
[204]

REMOTE DETERMINATION OF ANOMALOUS HUMIDITY-TEMPERATURE DISTRIBUTIONS

[Article by A. S. Gurvich and A. T. Yershov, Institute of Atmospheric Physics, "Remote Determination of Anomalous Distributions of Atmospheric Temperature and Humidity"]

[Abstract] Many problems in remote sounding of the atmosphere can be reduced to a vector equation in the form: $f = K\varphi + \delta$. In this equation φ is an unknown vector with the dimensionality n x 1, representing the deviation of the sought-for atmospheric meteorological element from some a priori evaluation of this element. With respect to the φ vector it is assumed that its mathematical expectation is equal to zero: $M[\varphi] = \bar{\varphi} = 0$, that all possible records of this vector have a normal distribution and that the autocorrelation matrix of this distribution is known: $M[(\varphi\varphi*)] = B_{\varphi\varphi}$. The vector of f-dimensionality m x 1 is known from measurements, whose errors are stipulated by the vector δ of this same dimensionality. With respect to the errors it is assumed that $M[\delta] = 0$ and that the matrix $M[(\delta\delta*)] = H$ is known. The statistical regularization method is used in solving such equations applicable to problems in atmospheric physics. In many practical problems it is particularly important to determine unusual, anomalous cases of the sought-for vector φ. Investigation of this dependence was carried out using model computations employing an ordinary closed computation scheme in problems of reconstructing anomalous distributions of atmospheric humidity from satellite three-frequency measurements of its radiation near $\lambda = 1.35$ cm and the temperature profile from ground three-angle measurements at 53.4 GHz. The modeled measurement error for humidity was 1-1.5K, and for temperature — 0.5K.
[204]

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III. OCEANOGRAPHY

News

CONGRESS OF SOVIET OCEANOLOGISTS TO BE HELD

[Unsigned article, "First Congress of Soviet Oceanologists"]

[Abstract] In accordance with a decree of the State Committee of the USSR Council of Ministers on Science and Technology and the Presidium USSR Academy of Sciences, the First Congress of Soviet Oceanologists will be held in Moscow during the period 20-25 June 1977 at Moscow State University. At the congress there will be plenary sessions devoted to a discussion of the principal problems in modern oceanology and also symposia on many directions in the science of the oceans and seas will be held. The notice lists the planned directions and symposia and the proposed chairmen. These include: Physics of the Ocean (A. S. Monin); Turbulence, Internal Waves and Microstructure of the Ocean (R. V. Ozmidov); Micro- and Macroscale Interaction Between the Ocean and Atmosphere (S. A. Kitaygorodskiy); Ocean Optics (K. S. Shifrin); Ocean Acoustics (L. M. Brekhovskikh and I. B. Andreyeva); Satellite Oceanology (B. A. Nelepo); Geophysics, Geomorphology and Tectonics of Ocean (V. V. Fedynskiy). Symposia will also be organized on marine law, marine economics, contamination of the world ocean and instrument and apparatus to be used at sea.
[206]

SEMINAR ON GEOPHYSICAL HYDRODYNAMICS

[Article by Yu. Z. Miropol'skiy, "Seminar on Geophysical Hydrodynamics of the Oceanographic Commission USSR Academy of Sciences"]

[Abstract] A series of important papers was presented at several of the recent seminar sessions of the Oceanographic Commission devoted to problems in geophysical hydrodynamics. A report by K. D. Sabinin told of recent experiments carried out at the Acoustics Institute on internal waves in the ocean. These measurements revealed that short internal waves are usually propagated in the form of narrow, almost monochromatic wave packets. There is a correlation between internal waves and inertial oscillations. It can be postulated that short-period internal waves can be generated by a current with vertical velocity shear, which in turn is created by orbital movements in inertial waves. A. I. Leonov devoted his report to the derivation of the two-dimensional Korteweg-de Vries equation from the equations for a stratified fluid. The article is an examination of the three-dimensional equations for an ideal incompressible stratified fluid with a full dynamic and kinematic condition at the surface (for taking surface waves into account). K. V. Konyayev told about new methods for writing multidimensional (two- and three-dimensional) spectral functions for a random process with a restricted amount of experimental data on the process. As examples of application of these methods in oceanology the author gives the three-dimensional spectra of internal and surface waves, constructed on the basis of a small number of experimental points. Despite the limited amount of initial empirical information, such methods for processing data nevertheless make it possible to draw a series of interesting physical conclusions. K. Hasselmann (West Germany) pointed out in his report entitled "Methods in Nonlinear Dynamics in the Theory of Surface and Internal Gravitational Waves and in the Theory of Climate" that during recent years it has become clear that many random fields in geophysical hydrodynamics are not turbulent in the classical sense, but constitute slightly nonlinear weakly interacting systems of random waves in whose study it is possible to use the theory of perturbations, especially the method of two-scale time expansions. He told of studies made under his direction at the Hamburg Institute of Theoretical Meteorology on the use of methods of two-scale time expansions in the theory of surface and internal waves and also in the theory of climate. He noted that internal waves make the principal contribution to fluctuations of hydrophysical fields in the ocean. Accordingly, for describing a statistical set of internal waves the same approach can be used as for surface waves.
[206]

Abstracts of Scientific Articles

MOTION OF ANCHORED BUOY STATIONS AND EFFECT ON CURRENT REGISTRY

[Abstract of article by E. A. Rebayns; Leningrad, TROPEKS-74, Vol 2, Gidro-
meteoizdat, 1976, pp 196-204, "Characteristic Motions of Anchored Buoy Sta-
tions and Their Influence on Current Registry"]

[Text] On the 19th voyage of the "Akademik Kurchatov" specialists made a
series of observations of the motions of buoy stations (Soviet produced --
type GM-51 and American -- Series R) placed at the equator at depths of
about 3,700 m. Processing of the collected material revealed: 1) the
trajectories of motion of the buoys are complex; their envelope can be rep-
resented in the forms of ellipses whose semimajor axis in most cases is
oriented in the direction of the surface current and varies in the range
800-1,580 m (buoys of series R) and 1,500-2,100 m (buoys of the GM-51 type);
2) the spectra of oscillations of both buoys reveal a six-hour periodicity
of characteristic motions of the buoys; this periodicity is attributable to
the action of semidiurnal tides on the buoy stations, causing a strong half-
harmonic in the characteristic motions of the stations; 3) the rates of move-
ment of the buoys along the trajectories vary in the range 2-29 cm/sec; 4)
with a half-hour interval of averaging of current data the probable error
from the characteristic movements of the buoys in the upper layers can at-
tain 10 cm/sec (for the GM-51 buoy) and 7 cm/sec (for a buoy of series R);
this error decreases with an increase in depth and the averaging interval,
whereas in the case of daily averaging of data is virtually insignificant.
Bibliography of one item.
[162]

EFFECT OF SHIP MOTION ON METEOROLOGICAL MEASUREMENTS

[Text] On the basis of hourly values of the main meteorological elements
measured from the ship "Akademik Kurchatov" at the nominal point 00° lati-
tude, 23°30'W and the hourly coordinates of the ship, obtained on the basis
of a satellite navigation system, a study was made of the influence of the
distance of the ship from the nominal point on the mean values and disper-
sions of the measured meteorological elements. The article gives a compar-
ison of the total mass of data and a sample mass within the limits of a
circle with a radius $r = \sigma(\varphi, \lambda)$, where σ is the standard deviation for
the coordinates of the main mass of data. An evaluation of the means and
dispersions is made on the basis of Student's test and Fisher's test respec-
tively. It is shown that the mean values of water temperature, wind velo-
city modulus and overall cloud cover at the 0.05 level are significantly
different inside and outside a circle with a radius of 80 miles. Using a
similar method, a study was made for samples at drift and when the ship was
under way. The mean values for the wind and total cloud cover measured
while the ship was under way were significantly greater than at drift. It
is emphasized that it is desirable to have an accurate approach in the spa-
tial generalization of water temperature, wind velocity and cloud cover and
also there is a need for "randomization" of the change in regimes of move-
ments of the ship when working at a point for the purpose of avoiding spur-
ious effects. Bibliography of six items.
[162]

POLARIZATION OF LASER RADIATION REFLECTED BY WATER SURFACE

[Text] Measurements were made in a number of different sea areas from an
aircraft and also from the shore (near Feodosiya). The authors used a ruby
lidar emitting a plane-polarized wave with a wavelength 6943 A. On the ba-
sis of statistical processing of the results it is shown that with an in-
crease in waves the degree of polarization (P) of reflected radiation de-
creases. This parameter is also reduced with a decrease in the slope of

the incident ray. The collected data show that using the value P of reflected radiation it is possible to determine the wave parameter. With waves of class 5-6 P attains 50% of its initial value. During a calm P of reflected radiation approaches the P value of the radiated electromagnetic wave. The differences in the polarization of reflected signals for radiation from the water surface in the presence of ice and without it make possible a remote determination of the types of these surfaces.
[162]

DETERMINING DEPTH AND TEMPERATURE OF MIXING LAYER IN OCEAN

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 9, 1976
9V61

[Abstract of article by K. L. Yegorov; Leningrad, TRUDY LENINGR. GIDROMETEOR-OL. IN-TA, No 57, 1975, pp 17-27, "Determining the Depth and Temperature of the Homogeneous Mixing Layer in the Ocean"]

[Text] On the basis of an analysis of dimensionalities and an integral model of the boundary layer, the author derives expressions relating the depth of the friction layer in the ocean and the value of the coefficient of turbulent mixing and tangential stress at the surface, temperature drop in the layer and the Coriolis parameter. The dependences are correct for both the middle latitudes and the equatorial region. The article gives a comparison with experimental data. The derived expressions are considered jointly with a model of a temperature-homogeneous layer for determining two parameters: layer temperature T_0 and its depth h. The author also gives the results of computations of the temporal variation of the parameters T_0 and h in the example of model problems. Bibliography of 12 items.
[162]

TURBULENT DIFFUSION OF DYE PLUMES

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 9, 1976.
9V65

[Abstract of article by V. I. Zats and M. S. Nemirovskiy; Sevastopol',
ISSLED. TURBULENT. STRUKTURY OKEANA, 1975, pp 122-133, "Experimental Investigation of Turbulent Diffusion of Submerged and Surface Dye Plumes"]

[Text] An experimental study was made of the diffusion processes (D) in the sea using an artificially introduced stationary stream (plume) of dye for the purpose of evaluating the role of D in the self-purification of the sea from contamination. The determined dye concentrations made it

possible to study their dispersions σ_y^2 and σ_z^2, and from them -- the coefficients of horizontal and vertical diffusion and their dependence on the scale of the phenomenon for two regions of the Black Sea -- near Yalta and near Batumi. It is shown that for most of the experiments the variability of the dispersion σ_y^2 with increasing distance from contamination sources is given by a power function in the form $\sigma_y^2 \sim x$, where $1.0 < n < 2.0$, and the dependence of σ_y^2 on time is expressed by the same power function with the exponent $n = 1.1$-1.2. On the basis of data on dispersion it was possible to determine the D coefficients and their dependence on the scales of the processes. Similarly the authors have computed the coefficient of vertical diffusion. The collected experimental data agree with data from other authors.
Bibliography of 14 items.
[162]

STRUCTURE OF CURRENTS IN EQUATORIAL ZONE

[Abstract of article by V. A. Bubnov, V. D. Yegorikhin and K. V. Moroshkin; Leningrad, TROPEKS-74, Vol 2, Gidrometeoizdat, 1976, pp 81-89, "Structure of Currents in the Equatorial Zone of the Atlantic"]

[Text] This is an analysis of the results of current measurements by the scientific research ship "Akademik Kurchatov" on a meridional section along 23°00'W through the equatorial region during the time of the GATE expedition (June-September 1974). The overall structure of the currents in the upper 300-400-m layer on the average in the course of all three phases of the experiment remained similar and was characterized by a predominance of zonal transfer of waters. The discontinuity of the Southern Trades Current and the subsurface equatorial countercurrent (Lomonosov Current) was at a depth of 30-35 m. The core of this countercurrent with velocities 70-80 cm/sec was situated at an average depth of 75 m. The authors note a persistence of easterly transport of waters in the layer 200-1,000 m during the first and second phases of GATE, whereas observations in the third phase revealed at depths of 400-1,000 m a westerly intermediate equatorial current with velocities up to 30 cm/sec. These facts indicate a nonstationary nature of this current. Observations indicated substantial displacements of the axis of the Lomonosov Current relative to the equator with an amplitude of 1° in latitude. During the second and third phases of the observations this displacement has the form of a wave perturbation with a period of about 18 days; this corresponds to the period of inertial oscillations at the equator, computed using the A. S. Monin formula (1972).
Bibliography of six items.
[162]

WATER TEMPERATURE VARIABILITY IN EQUATORIAL ATLANTIC

[Abstract of article by V. A. Bubnov, L. I. Kazachkina, Z. N. Matveyeva and
D. I. Filippov; Leningrad, TROPEKS-74, Vol 2, Gidrometeoizdat, 1976, pp
62-70, "Variability of Water Temperature in the Equatorial Atlantic Ocean"]

[Text] An analysis is given for the synoptic variability of water tempera-
ture in the layer 0-1,000 m at a point 00°N, 23°30'W on the basis of observ-
ational data from the scientific research ship "Akademik Kurchatov" during
the GATE period (June-September 1974). On the basis of the results of stat-
istical evaluations the conclusion is drawn that processes of a synoptic
scale play a decisive role in the overall variability of the temperature
field. It is shown that changes in the heat reserve of the layer 0-60 m
in July-August are caused primarily by fluctuations of advection; heat ex-
change with the atmosphere plays a secondary role. In the thermocline layer
(45-125 m) it was possible to determine temperature fluctuations with a
periodicity close to eight days. A correlation was established between
these fluctuations and the change in the spatial position of the axis of
the Lomonosov Current. Below the thermocline the synoptic changes in temper-
ature for the most part are aperiodic. Bibliography of five items.
[162]

INFORMATION ANALYSIS OF OCEANOLOGICAL FIELDS

[Abstract of article by G. G. Chalenko; --, TRUDY DAL'NEVOST. N.-I. GIDRO-
METEOROL. IN-TA, No 54, 1976, pp 139-142, "Experience in Information Anal-
ysis of Oceanological Fields"]

[Text] The paper gives the results of an analysis of the information re-
lationships for a single-factor communication channel for a two-component
system. The author examines a case when the stipulated values were the
water temperature gradations or the intensity of heating (cooling) of the
sea surface for four mutually nonoverlapping regions of the Sea of Japan.
On the basis of the results of an information analysis it was possible to
determine the fields of extremal temperatures of the surface layer of the
sea; the author constructed significant isolines of temperature minima
(winter of 1973/1974) and temperature maxima (summer of 1968) of the sea
surface. It was possible to determine the main (frontal) discontinuity
and ascertain the directions of restructuring of the temperature field
under the influence of monsoonal circulation. It is shown that information

measures characterize the stability of processes with time, evaluate the relative closeness of the correlation between the phenomenon and the factor, determine the optimum parameters of the causative factor, draw significant isolines in the field of the element, its extrema and the main (frontal) line of the discontinuity, etc. It is noted that information analysis easily conforms to algorithmization. Bibliography of nine items. [162]

KINEMATICS OF EDDIES IN VELOCITY FIELD OF OCEAN CURRENTS

[Article by L. M. Fomin and A. D. Yampol'skiy, Institute of Oceanology; "Local Kinematics of Synoptic Eddy Disturbances in Velocity Field of Ocean Currents"]

[Abstract] The results of measurements in a hydrophysical polygon in the tropical Atlantic Ocean gave convincing evidence of the existence in the velocity field of ocean currents of large eddy disturbances with characteristic scales lying in the range of synoptic variability of the ocean. For example, there was an anticyclonic vortex with virtually elliptical stream lines and horizontal dimensions of 200 and 400 km; it moved to the west-southwest with a velocity of 4-6 km per day and the current velocity in the vortex attained 20-25 km/sec. Current observations in the polygon were made at 17 buoy stations situated along the sides of a rectangular cross covering an ocean area of $200 \times 200 \text{ km}^2$. For studying the kinematic structure of the synoptic component of motion in the neighborhood of the experimental polygon the authors first investigated the temporal variability of current velocity at all points in the polygon and then estimated the horizontal change in the initial phase of each defined harmonic. The measured velocity series were first subjected to low-frequency filtration for excluding the high-frequency fluctuations. The results of the analysis are illustrated in the example of the 300-m horizon, for which current data are most complete. It was found that the synoptic disturbances of the current velocity field in the ocean can be represented in the form of the sum of the eddy fields with a dense packing of eddy formations which in turn are approximated by the sum of plane waves of current velocity. The limited dimensions of the experimental polygon made it possible to estimate the wave parameters only locally. The described kinematic picture of an individual synoptic eddy formation is determined by the structure of elementary eddy fields, in this experiment having similar spatial but essentially different time scales. With other relationships of the parameters of the plane waves making up the velocity field of the synoptic component of motion, the form, lifetime, rate of movement and other characteristics of an individual eddy can be different from the values obtained in the 1970 hydrophysical polygon.
[201]

METHOD FOR COMPILATION OF BATHYMETRIC CHARTS

[Article by N. A. Marova and V. V. Zdorovenin, Institute of Oceanology, "Method for Routine Compilation of Bathymetric Charts"]

[Abstract] The article describes a method involving the use of an electronic computer for carrying out the main part of the preparatory work in the routine compilation of large-scale bathymetric charts of polygons. The basis of the method is a daily cycle for the registry and processing of data from an echo sounder survey. These data, registered in the course of Greenwich calendar days, are sent in the form of an individual mass to the shipboard computation center for processing together with the results of measurements by other methods of a geophysical survey. The depth data consist of readings with a standard interval of five minutes, all the extremal depths and the depths of important bottom irregularities. Depending on the complexity of relief the total number of depths per day can vary in the range of 300-800 readings. All the depths are punched on punch tape together with the times of their registry and are fed into an electronic computer for processing. At the present time the shipboard electronic computers of the Institute of Oceanology are carrying out three principal types of data processing for the purpose of routine compilation of bathymetric charts: introduction of corrections for the speed of sound into the measured depths; determination of the positions of isobaths along the run; construction of a bottom profile at the scale of the map to be compiled. The described method makes possible a decrease by a factor of 10 in the time required for compiling a map of bottom relief in a polygon in comparison with former methods and makes it possible to obtain at once a final variant of the map.
[206]

WEAKLY NONLINEAR INTERNAL WAVES IN DEEP OCEAN

[Article by S. P. Levikov, State Oceanographic Institute, "Unsteady Weakly Nonlinear Internal Waves in a Deep Ocean"]

[Abstract] An attempt has been made to derive and analyze an equation describing the dynamics of internal waves in density interlayers. It is hoped that such an equation will make it possible to investigate some characteristics of the wave destruction process. The author examines an ideal incompressible fluid. It is assumed that vertically it consists of three layers: middle, with a thickness 2D, having continuous stable stratification, and homogeneous upper and lower layers whose thicknesses are unlimited. With

movement through the boundary of the layers the density changes continuously. The nonstationary equation for a thin stratified layer of fluid of great depth is derived by the method of three-parameter expansion. The author analyzes the contribution of the nonlinear and dispersion terms of the equation. The possible application of the equation to the problem of destruction of internal waves is discussed. It is noted that after this paper was sent to press A. E. Gargett (DEEP SEA RES., 23, No 3, 1976) published a paper very similar in content.
[206]

TEMPORAL CHARACTERISTICS OF MARINE BIOLUMINESCENCE

[Article by V. D. Pozdynin, Institute of Oceanology, "Temporal Characteristics of Marine Bioluminescence"]

[Abstract] This paper is a discussion of the results of statistical processing of observations of bioluminescence at sea, carried out in a number of regions in the Mediterranean Sea and the Pacific Ocean. Observations were made at drift by the method of holding the instrument at a stipulated horizon. It is shown that the observed diversity in time intervals between bursts of luminescence in some cases can be described by an exponential distribution law, whereas in other cases -- by a distribution law describing the model of a branching Poisson process. Using this model it is possible to clarify the influence of movements of the instrument under the influence of rolling on the registered temporal characteristics of bioluminescence. The article gives several quantitative estimates of the parameters of the distribution laws obtained by the processing of the bioluminescence records.
[206]

DIFFUSION OF DYE PLUME IN SURFACE LAYER OF SEA

[Article by V. M. Zhurbas and R. M. Mamedov, Institute of Oceanology, "Experimental Investigation of Diffusion of a Stream of Passive Impurity in the Surface Layer of the Sea"]

[Abstract] On the basis of data from diffusion experiments in the surface layer of the Caspian Sea the authors computed the mean and fluctuation characteristics of the fields of concentration of streams of a passive

impurity in the range of scales 1-100 m. The experiment was carried out at the Marine Observatory of the Caspian Scientific Experimental Station of the Geography Institute Academy of Sciences Azerbaydzhan SSR located 25 km from Artem Island on the base of a former petroleum tower. The sea depth in this region is 37 m. A dye solution with a concentration of about 10^{-6} g·liter^{-1} with a constant discharge of the dye directly on the surface was used. A clearly visible dye plume was formed under the influence of the mean current. By means of repeated intersections of the plume by a ship towing the fluorimeter at a depth of about one meter it was possible to obtain profiles of the dye concentration in transverse horizontal sections of the plume. It was found that the distribution of the concentration in the sections of the plume was close to Gaussian. Using the empirical dependence of the relative dispersion of the width of the plume on diffusion time it was possible to estimate the energy flux in the eddies. The results of the computations of the fluctuation characteristics of the plume are compared with the semi-empirical model published by G. T. Csanady (GEOPHYS. AND ASTROPHYS. MONOGR., 3, 1973).
[206]

AUTOMATIC PROCESSING OF RECORDS OF BOTTOM SEISMOGRAPHS

[Article by Yu. P. Neprochnov, I. N. Yel'nikov, S. M. Zverev, A. A. Pokryshkin and G. N. Shchipletsov, Institute of Oceanology and Institute of Physics of the Earth, "Experience in Automatic Processing of Records of Bottom Seismographs During Deep Seismic Sounding in the Atlantic Ocean"]

[Abstract] Early in 1975, during the 20th voyage of the "Akademik Kurchatov," specialists of the Institute of Oceanology and the Institute of Physics of the Earth carried out deep seismic sounding in different tectonic structures of the floor of the Atlantic Ocean. The source of seismic waves was pneumatic high-power sound sources. Three types of sound sources designed by the All-Union Scientific Research Institute of Geophysics were employed: PI-1A with a total chamber volume of 28 liters (4 x 7 liters), PI-5 with chamber volume of 30 liters and PI-5 with a chamber volume of 60 liters. Most of the work was done with the second type. The pneumatic sound sources were towed with a ship speed of five knots at a depth of about 15 m; this ensures a maximum energy radiation in the frequency range 5-20 Hz. The triggering of the sound source was accomplished automatically from the signals of an on-board quartz chronometer at one-minute intervals. The interval between successive radiations along the profile was approximately 150 m. Magnetic recordings of bottom seismographs were processed

by obtaining a synchronous assembly of seismograms and travel time curves were obtained by the variable density method. The assembly of seismograms was accomplished by the method of automatic photographing of the records of bottom seismographs from the screen of a cathode ray oscillograph and their reproduction. The method used in producing the variable density travel time curves is described in detail.
[206]

LATEST MEDITERRANEAN VOYAGE OF "AKADEMIK S. VAVILOV"

[Article by Ya. P. Malovitskiy, Yu. D. Yevsyukov, N. K. Karpenko, N. G. Prokoptsev, M. F. Pilipchuk and V. S. Sokolov, "Twenty-First Mediterranean Voyage of the Scientific Research Vessel 'Akademik S. Vavilov'"]

[Abstract] The 21st voyage of the "Akademik S. Vavilov," which was the final voyage for this veteran of the Soviet oceanological fleet, was made during the period 8 July-29 August 1975 with participation of specialists of the Southern Division of the Institute of Oceanology in the central part of the Mediterranean and Aegean Seas. An expedition map is reproduced on the following page. The principal scientific objective of the expedition was the carrying out of complex geological-geophysical investigations, data from which will make it possible to understand the tectonic and magmatic processes of formation of a series of submarine rises on the bottom and also the lithological-geochemical processes of formation of the layer of unconsolidated sediments in depressions. These investigations were a continuation of the studies made on the 19th and 20th voyages of this ship, but on the 21st voyage more attention was devoted to study of bedrock on rises, steep slopes and scarps. The report gives some of the basic results of these investigations. The expedition was headed by Ya. P. Malovitskiy and the geological detachment was directed by N. G. Prokoptsev.
[206]

GEOLOGICAL EXPEDITION IN BALTIC SEA

[Article by Ye. M. Yemel'yanov, "Geological Expedition in the Baltic Sea Aboard the Research Ship 'Professor Dobrynin'"]

[Abstract] A joint expedition of scientists of the USSR and GDR took place during the period 30 May-30 June 1976. Its purpose was a study of the geological structure of the Arkona and Bornholm depressions and the regions

SUPPLEMENT TO ABSTRACT: LATEST MEDITERRANEAN VOYAGE OF "AKADEMIK S. VAVILOV" [206]
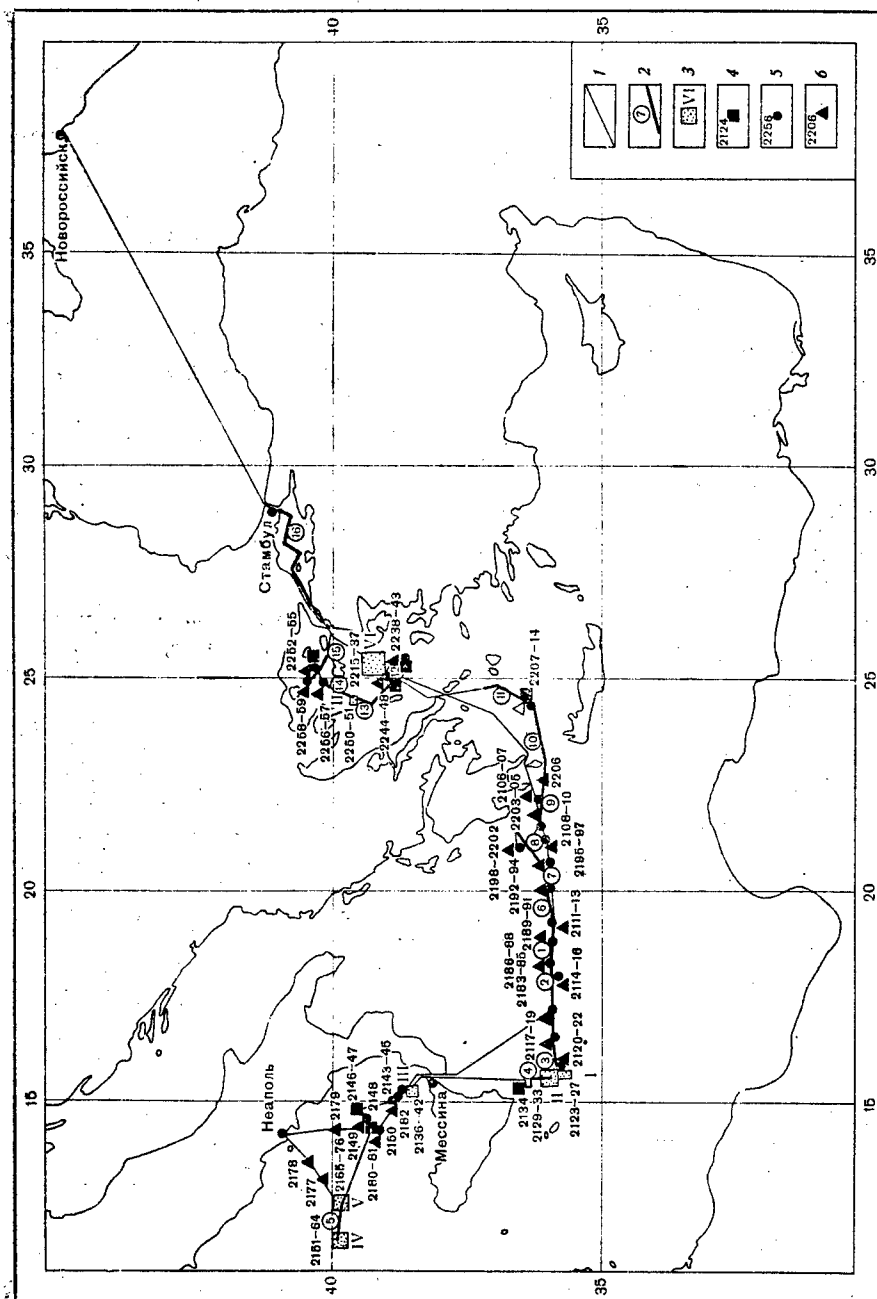
Map of track. 1) track of vessel without work; 2) magnetometric investigations jointly with bottom measurements; 3) polygons; 4) sampling of bedrock by dredging; 5) taking of bottom samples with corer; 6) same, with dredge

around Bornholm Island ("Thornquist line"). Expeditionary work was on the theme "Study of the Geological History and Processes of Recent Sedimentation in the World Ocean." Most of the specialists were from the Institute of Oceanology, assisted by one East German specialist. The work was done aboard the vessel "Professor Dobrynin." The basic method used was continuous seismic profiling using a "sparker." Other parts of the program included dredging, taking samples of bottom sediments with a dredge and corer, and collection of water suspensions by the filtration method. Echo soundings and seismic profiling were carried out (1,980 miles) and samples of sediments and suspended matter were taken (11 stations).
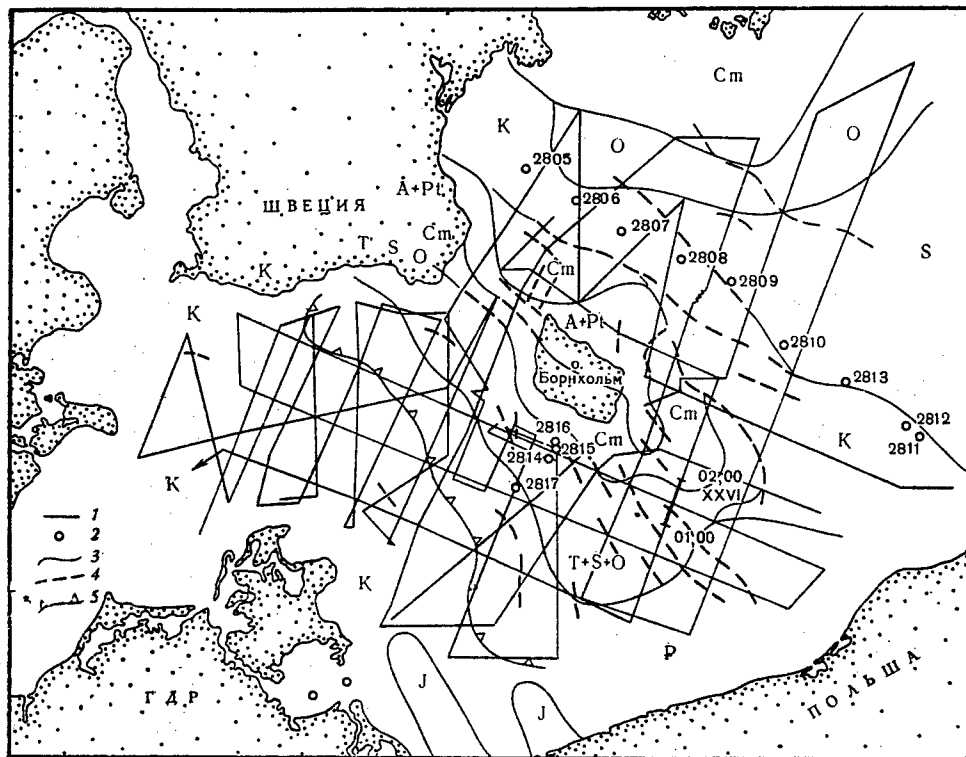
Map of work done by "Professor Dobrynin" in Baltic Sea. 1) track of vessel along which depth measurements and seismic profiling were carried out; 2) geological stations; 3) boundaries between geological systems; 4) tectonic dislocations in upper layer (200-300 m) of Pre-Quaternary sediments. Only dislocations detected on the expedition are plotted; 5) boundaries of depression in Upper Cretaceous layer of sediment probably filled with Paleogene deposits. Dip of layers to northwest. XXVI -- position of cross section shown and discussed in text.

The continuous seismic profiling method made it possible to study the structure of the upper part of the sedimentary stratum with a thickness up to 250 m. On the seismograms it was possible to discriminate rather clear reflecting boundaries by means of which it was possible to judge the structure and age of the basement of sedimentary rocks underlying the Quaternary sediments. Details are given concerning the Quaternary, Pre-Quaternary, Mesozoic and Cenozoic formations.
[206]

OCEANOGRAPHIC RESEARCH IN THE NORWEGIAN SEA

[Article by V. G. Kort and Ye. G. Morozov, "'Akademik Kurchatov' in Norwegian Sea"]

[Abstract] The 21st voyage of the scientific research ship "Akademik Kurchatov" took place in the summer of 1975 in the southern part of the Norwegian Sea. The principal objective of the expedition was a study of mesoscale spatial-temporal variability of the principal hydrophysical fields: currents, temperature, density. The region is an excellent polygon for studying interaction between the atmosphere and ocean, especially the reactions of the ocean to dynamic effects of the atmosphere. The article is accompanied by a sketch map of operations of the vessel. The scientific program included investigations of currents from the surface to a depth of 1,500 m using self-contained current meters at buoy stations, study of their variability at the tidal, inertial and synoptic scales, computations of the mean fields of temperature, salinity, content of oxygen, phosphates, alkalinity and other characteristics, collection of data on the vertical distribution of temperature and humidity from the ocean surface to 3,000 m above it, carrying out observations of the ionosphere and cosmic rays, study of bottom relief and collection of navigational-hydrographic information. The expedition was the first stage in preparations for the Soviet-American POLIMODE experiment to be carried out during 1977-1978. Fifteen oceanographic buoy stations operated in the hydrophysical polygon during the expedition (7 July-21 September 1975). The velocity and direction of the sea currents were measured at seven stations continuously for 66 days and at the eight remaining stations the currents were registered during time intervals from three to 20 days. Three hydrological surveys were made in the polygon at stations situated 30 miles apart. Primary processing of observational data was completed during the voyage. There was found to be an exceedingly strong dependence of total solar radiation on cloud cover. Using data from pilot balloons it was possible to discriminate types of thermodynamic structure of the lower layers of the atmosphere over the sea. Current data show that there is an eddylike cyclonic motion of waters, formed as a result of interaction between two powerful currents, and there is little dependence on the direct wind effect.

Optical investigations in the polygon region revealed a strongly expressed spatial and temporal variability of the characteristics of distribution of light in sea water. The ionosphere was sounded 9,000 times. The intensity of the meson and neutron components of cosmic rays was investigated. The research group consisted of more than 70 persons in a wide number of fields of specialization.
[42]

VOLCANIC EFFECT ON NORTH ATLANTIC SEDIMENTS

[Article by Ye. M. Yemel'yanov, N. G. Lozovaya and G. S. Kharin, Atlantic Division Institute of Oceanology, "Influence of Volcanism on the Formation of the Mineral Composition of Recent Sediments in the North Atlantic"]

[Abstract] On the basis of a study of the mineral composition of 250 samples it was found that the recent sediments of the North Atlantic (in the Iceland region) are formed under the influence of the volcanoes of Iceland, Jan Mayen, the Faeroes and Greenland. This influence is decisive at a distance as great as 100-300 km and rather significant at a distance as great as 1,200-1,500 km. A thorough study of the distribution of clastic material in the fraction 0.1-0.05 mm made it possible to compile four important maps (reproduced in the text): Fig. 1 -- Distribution of volcanic glass in the light coarse silt subfraction of the upper layer (0-5 cm); Fig. 2 -- Distribution of total content of pyroclastic material in heavy coarse silt subfraction of upper layer; Fig. 3 -- Distribution of clinopyroxene in heavy coarse silt subfraction in upper layer; Fig. 4 -- Distribution of hornblende in the heavy coarse silt subfraction of the upper layer. On this basis it was possible to compile a mineralogical regionalization map, reproduced in the text, showing terrigenous-volcanic mineralogical provinces of the fraction > 0.01 mm in the upper layer of sediments (0-5 cm). There are 12 provinces, of which four are "volcanic" (Iceland, Jan Mayen, Faeroes and Central Greenland).
[206]

BOTTOM RELIEF ON WHITE SEA SHELF

[Article by P. S. Chakhotin, Institute of Oceanology, "Periodic Forms of Bottom Relief on the White Sea Shelf"]

[Abstract] Sand waves are observed on the open shelf, in narrow straits and in the estuaries of rivers which are entered by a tidal wave, and also on the slopes of banks and ridges and between them. Well-developed sand waves are formed when there is an abundance of sand and in some interval of velocities when there is an elongated velocity ellipse of the tidal currents. No sand waves exist in regions where the current ellipse is close to a circle. A table in the text gives some characteristics of tidal sand waves in different regions. The article describes and analyzes three cases of periodicity of bottom relief in different regions of the White Sea. By comparison of echograms with known cases of sand waves, the author examines the possibility of identification of these profiles as tidal sand waves. It is shown that the northeastern part of the White Sea (Voronka) is the most promising region for carrying out extensive investigations of the morphology and dynamics of tidal sand waves and ridges. [206]

RESEARCH VOYAGE IN AUSTRALIA-NEW ZEALAND REGION

[Article by L. A. Ponomareva and N. G. Vinogradova, "Sixteenth Voyage of the Scientific Research Ship 'Dmitriy Mendeleyev'"]

[Abstract] The 16th expeditionary voyage of the "Dmitriy Mendeleyev" of the Institute of Oceanology was carried out during the period 5 December 1975 - 29 March 1976 in the Australia-New Zealand region. The expedition operated under a specialized biological program. The principal objectives of the expedition were: study of the composition and genesis of benthos and necton in the Australian-New Zealand region and adjacent regions of Subantarctica at different depths; clarification of the structure and functioning of plankton associations of subantarctic and antarctic waters; obtaining varied materials for investigating evolutionary and ecological biochemistry of different taxonomic groups. A special objective of the expedition was an investigation of the Macquarie complex. The expedition was broken down into seven biological detachments and auxiliary detachments ensuring the collection of hydrological, hydrochemical and geological data necessary for biological investigations (expedition chief L. A. Ponomareva). The benthos detachment took samples of bottom fauna collected at 62 trawling and 31 dredging stations. The total number of invertebrates taken was 15,000, belonging to not less than 300-400 species. Many of these are new for science. The abyssal fish detachment made extensive collections of fish in the Australian-New Zealand region. About 3,000 bottom fish belonging to 220-230 species and 80 families were taken. Specialists in the nectopelagic detachment found that tropical species of macroplankton penetrate into the regions to the south of Australia from the west through the Great Australian Bight and from the east along
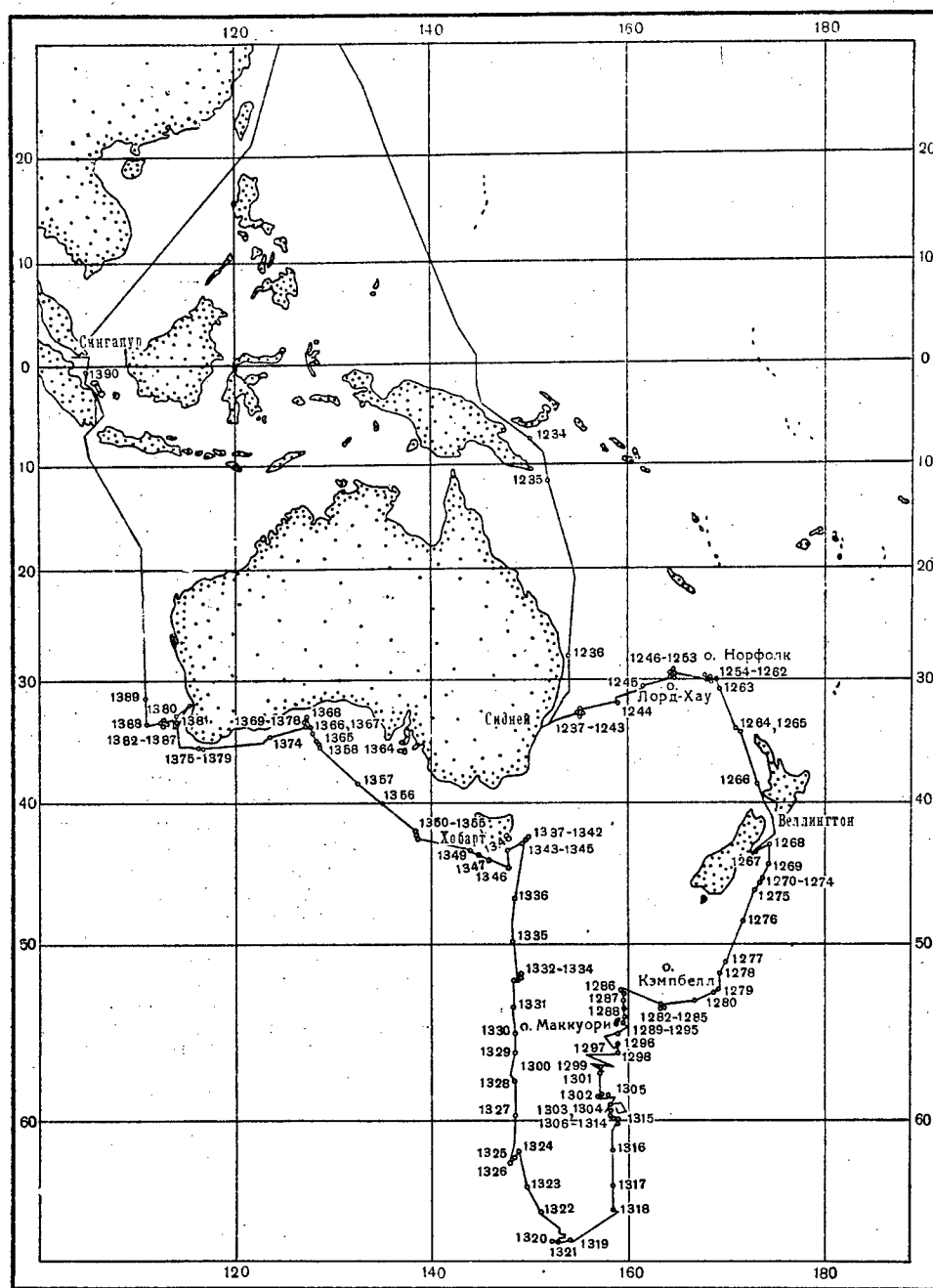
Sixteenth voyage of the "Dmitriy Mendeleyev"

eastern Australia. A small sector to the southwest of Tasmania is filled
with cold water and tropical fauna does not penetrate there. The plankton
detachment occupied 45 stations along two meridional profiles and at 32
of them, situated 30-120 miles apart, complex investigations were made
of mesozooplankton, microzooplankton, net and bathymetric phytoplankton
at very definite times of day. The primary production detachment carried
out investigations of primary production and chlorophyll on meridional
profiles through subtropical, subantarctic and antarctic waters. The first
data were obtained on the distribution of all forms of nitrogen in antarc-
tic waters. Data were obtained on the distribution of organic phosphorus
in the zone of the antarctic convergence. The geology and geomorphology de-
tachment made echo soundings over a distance of 18,272 miles. The meteor-
ological conditions were very difficult and observations were possible
only due to the presence of a satellite navigation system and antidrift
apparatus.
[206]

SYSTEM FOR DETERMINING OPTICAL CHARACTERISTICS OF WAVES

[Article by V. V. Polovinko, Moscow Institute of Geodetic, Aerial Mapping
and Cartographic Engineers, "Investigation of Some Optical Characteristics
of Wave-Covered Sea Surface"]

[Abstract] For investigating the temporal characteristics of sea waves it
is possible to use a method based on determination of the statistical char-
acteristics of the intensity of radiation of the wave-covered sea surface.
This article describes such a system for measuring the radiation from an
element of the sea surface with the coordinates x_0, y_0. This flux passes
through the air, an optical system and is incident on a photocell. The
photocurrent arising in the photocell is fed to an electronic apparatus
and is used for registering or processing the arriving information. A
function α (x_0, y_0, t) is fed to the input of a linear system; this is
a section of the spatial-temporal field of slopes $\alpha(x, y, t)$ of the wave-
covered sea surface. Expressions can be derived which make it possible to
obtain the spectrum for a section of the three-dimensional field of slopes
from the spectrum of the output process for the optical-electronic system.
Figure 3 in the text shows a measurement system which makes it possible
to register the radiation flux from the sea surface. This can be represented
in the form of a linear system with many inputs. The use of the method is
illustrated by field measurements made with such a system in the Caspian
Sea.
[185]

IV. TERRESTRIAL GEOPHYSICS

News

OPERATION OF HIGH-PRESSURE HYDRAULIC PRESS DESCRIBED

[Article by B. Konovalov, "Journey to the Center of the Earth"]

[Summary] Assembly work has been completed and successful tests have been carried out with a gigantic hydraulic press which creates a pressure of three million tons. In conducting a tour of the press building, section chief Ayk Akopovich Semergyan of the Institute of High-Pressure Physics, pointed out first the enormous concrete well which forms the lower part of the complex. It has a depth of 17 meters. Twelve thousand cubic meters of reinforced concrete were used for the walls and concrete "cushion" of the foundation for the press. The press itself weighs 5,000 tons. The giant piston is a 60-ton cylinder approximately the height of two men and it would take five men to embrace it. The motion of this polished giant creates a pressure of 3,000,000 atmospheres. Almost the same as in the earth's core! On our planet there are several presses of approximately the same power, they have been constructed for industrial purposes. But this giant is essentially a scientific instrument, built especially for scientists. The director of the Institute of High-Pressure Physics, Leonid Fedorovich Vereshchagin, noted that before the war he was working with a pressure of only 10,000 atmospheres. This press was created by engineers, designers and technicians of the Novo-Kramatorskoye Machine Building Plant. The press was constructed in parts and then assembled at the scientific center "Krasnaya Pakhra" near Moscow, where the institute is situated. The transport of the multiton parts from the Ukraine was highly complex, but they were moved in much the same way as when transporting the parts of the six-meter optical telescope. Investigations will make it possible to ascertain the behavior of different substances at the pressures prevailing at the center of the earth. Seismic waves show that dense matter is situated in the deep layers, but the nature of this matter is not known. The high-pressure studies will also help in revealing the nature of the interiors of other planets.
[197]

FUTURE SEISMIC PROBING OF THE EARTH

[Article by A. V. Nikolayev, "Seismic Probing of the Earth"]

[Abstract] One of the advanced methods in seismology is the use of complex
observation systems, seismic groups or antennas. Combined probing of the
earth with receiving and transmitting seismic antennas is highly promising.
Seismic antennas have not only directivity, but raise the level of the use-
ful signal above the background of microseismic noise. Seismic antennas are
capable of accumulating signals in time, but this requires artificial sources
which radiate seismic oscillations. Evidently only a mechanical vibrator can
satisfy all the requirements imposed on seismic sources. This article dis-
cusses how it is possible to use vibrators for probing the deep layers of
the mantle and core. The technical characteristics of such seismic wave
sources are analyzed. Two systems of this type are mentioned. The "Vibro-
seis" source emits a long quasiharmonic signal with a smoothly changing fre-
quency. The registered seismogram is transformed into a seismogram corres-
ponding to an ordinary pulsed form of source action. Further processing of
probing data is by the procedures usually employed in seismology and seis-
mic prospecting. Observations by the "Holograph" method make use of harmonic
sources of oscillations and seismic receiving antennas. The method is now
being developed. The basis of the idea is optical holography, involving use
of lasers. Methods are also being developed to monitor sources of interfer-
ence in seismic observations and to determine the contribution of these
sources in the field of microoscillations and this will mean that microseisms
will be transformed from interference into useful signals. Progress in the
monitoring and use of microseisms will mean a new stage in seismological
probing of the earth, an advance from the "seismology of vibrators" to the
"seismology of microseisms." In order to achieve this it will be necessary
to pass through the stage of active probing by means of receiving antennas
and vibroseismic radiating antennas and it is necessary to develop tech-
niques for the collection and processing of enormous volumes of digital in-
formation. But for the time being seismology is by and large still the
"seismology of earthquakes."
[42]

Abstracts of Scientific Articles

GEODYNAMIC SYSTEM OF ARCTIC OCEAN

[Article by Yu. Ye. Pogrebitskiy, Northern Marine Geology Trust, "Geodynamic System of the Arctic Ocean and its Structural Evolution"]

[Abstract] On the basis of a tie-in of geological-geophysical investigations of the Arctic Ocean, the precontinents and adjacent regions of the land it was possible to define a group of tectonic structures, interrelated in their development, reflecting the evolution of the global geodynamic system of a central type. The geological processes in the Arctic are determined by the development of this system beginning with the Permian. The oceanic morphostructures are only elements in the group of tectonic structures in the arctic geodynamic system; they developed as a result of regular structural-mineralogical transformations of the earth's crust on the border between the Cretaceous and the Paleogene. The author determined the limits of the Arctic geodynamic system, its tectonic expression in the ocean and on the land and the principal development stages. Its relationship to other geodynamic systems of the earth is noted. The article gives a genetic model of geodynamic systems, the basis for which is gravitational segmentation of the earth. A concept is proposed refuting the tectonic nature of platforms; it indicates that there is a need for a new approach to clarification of tectonic processes, taking into account the contribution of systematic investigations of the world ocean and the land to geology.
[203]

GEOMAGNETIC FIELD OF UKRAINE

[Article by B. L. Gurevich, A. B. Kogan, M. G. Raspopova (Ukrainian Scientific Research Institute of the Gas Industry and Yu. N. Khitarov (Scientific Research Institute of Geological Prospecting), "New Results of Analysis of Geomagnetic Field in Ukraine"]

[Abstract] A study was made of the geomagnetic field of the territory of the Ukraine and its geological interpretation is given. The authors analyze the magnetic field by the directed summation method with simultaneous frequency filtering. The theoretical and methodological principles of this method are outlined. It is demonstrated that expansion of the magnetic field into components by means of simultaneous frequency filtering makes it possible to obtain qualitatively new geological information in the study of the structure of the Precambrian basement both in the regions of its considerable dipping beneath the deposits of the sedimentary cover and in sectors of multiple tectonic activation and reworking of the ancient base by subsequent recent movements.
[203]

HELIUM AND RADON ANOMALIES AS EARTHQUAKE INDICATORS

[Article by P. I. Chalov, T. V. Tuzova and V. M. Alekhina, Institute of Physics and Mathematics Kirgiz Academy of Sciences, "Sporadic Nature of Anomalies in Helium and Radon Content in Some Water Sources in Faults of the Northern Tien Shan Seismic Zone in the Period Preceding the Kochkorskoye Earthquake of 1974"]

[Abstract] The article describes brief variations of the radioisotopic parameters of waters in faults in the Northern Tien Shan seismic zone in June-July 1974. These waters in deep crustal faults are of interest in predicting earthquakes on the basis of changes in the radioisotopic and other parameters of ground water. But for solving such a problem it is necessary to know the scales of the temporal variations of the radioisotopic parameters of these waters in the absence of significant seismic phenomena. The measurements were made in the summers of 1973 and 1974 at hot springs and in boreholes at Alamedin and Dzhety-Oguz. The period of observations in 1974 at Dzhety-Oguz directly preceded the Kochkorskoye earthquake of 2 July 1974, whose epicenter was situated about 245 km from these sources, whereas there were not even weak earthquakes in the immediate neighborhood. The site of the Dzhety-Oguz sources therefore cannot be related to the region of preparation of the Kochkorskoye earthquake. It is concluded that the observed helium and radon anomalies reflected activation of tectonic processes in the Northern Tien Shan seismic zone or the Terskeyskiy fault. The radon anomalies ended sooner than the helium anomalies, indicating the receipt of He and Rn from quite great depths. The Rn breaks down during movement with waters to the earth's surface and its anomalies disappear sooner than the helium anomalies. Temporal changes in the content of He and Rn, with a great frequency and amplitude, against a background of a general increase in these parameters, in some sources of waters of deep faults of

tectonically active zones can serve as a signal of activation of tectonic processes, as a result of which earthquake foci can be formed within the limits of a seismic zone or large fault.
[200]

TECTONIC STRUCTURE OF WESTERN BERING SEA

[Article by S. I. Andreyev, N. N. Rzhevskiy, V. N. Shimarayev and N. V. Ustinov, "Tectonic Structure of the Western Bering Sea According to Geophysical Data"]

[Abstract] As a result of an analysis of aeromagnetic, gravimetric and seismic materials for the shelf and abyssal part of the western Bering Sea between Capes Barykov and Olyutorskiy it was possible to ascertain the continuation of structures known on the land and it was possible to detect a series of new tectonic elements. Figure 1 in the text is a tectonic regionalization map of the western part of the Bering Sea. The interpretation was based on geological data for the adjacent territory of the Koryaksko-Kamchatkan folded region, consisting of two folded systems. All the newly collected data and its interpretation confirm the hypothesis expressed repeatedly earlier that there was an ancient "Beringiya" complex. It is now possible to trace its limits. This indicates a young age of the Aleutian deep trench and its formation as a result of basification of the Bering complex, probably in the Late Neogene. It appears that deep destruction of the earth's crust of a continental type led to a restructuring of relief morphostructures, as a result of which an abyssal depression was formed in its place.
[201]

MAGNETIC ANOMALIES AROUND SHIKOTAN ISLAND

[Article by Ye. V. Kochergin and M. L. Krasnyy, Sakhalin Multidiscipline Scientific Research Institute, "Geological Nature of Magnetic Anomalies of the Sea Surrounding Shikotan Island"]

[Abstract] During recent years specialists at the Sakhalin Multidiscipline Scientific Research Institute have obtained new data on the distribution of the geomagnetic field in the neighborhood of Shikotan Island which made it possible to compile the first intermediate-scale map of isodynamic lines ΔT and on its basis make a study of the geological nature of the magnetic

anomalies (Figure 1 in the text). Analysis reveals that the anomalous magnetic field here has an exceptionally complex nature. This is attributable to the fact that the structure of the Tertiary deposits consists of several complexes nonconformingly lying on one another and having a different structural plan of the rocks making them up. The faults defined on the basis of the anomalous magnetic field indicate a predominance of two directions of the strikes -- submeridional and northeasterly. However, the latter are better expressed in the magnetic field, evidence of their magma-controlling nature. In addition, the rocks of the Kurile complex are represented by a broad series of magma formations, among which basic and ultrabasic varieties with a high magnetization play a considerable role.
[201]

METHOD FOR ESTIMATING PROBABILITY OF OCCURRENCE OF STRONG EARTHQUAKES

[Article by V. K. Kuchay and V. S. Ponomarev, Geology Institute Tadzhik Academy of Sciences and Institute of Physics of the Earth, "Evaluation of the Probability of Occurrence of Strong Earthquakes Using a Combination of Geophysical and Geological Criteria"]

[Abstract] By investigations in the Garm Geophysical Polygon of the Institute of Physics of the Earth it was established that the epicentral zones of strong earthquakes are selective relative to the peculiarities of the geological and seismological fields. This conclusion was drawn as a result of use of simple representations of the theory of probabilities and mathematical statistics. The paper describes in detail the method of stochastic evaluations of the development of strong earthquakes and the results of use of this approach in the Garm polygon. The necessary formulas are derived and used in computing the probabilities and reccurrence of strong earthquakes. Figure 1 is a map of stochastic prediction of strong earthquakes based on geological criteria; Fig. 2 is a map of stochastic prediction of strong earthquakes based on seismological criteria; Fig. 3 is a map of stochastic prediction of strong earthquakes using a combination of geological and seismological criteria. The maps prepared in these three ways are compared and evaluated.
[118]

THERMOELASTIC STRESSES CAUSED BY CHANGE IN CRUSTAL HEAT REGIME

[Article by M. A. Aleksidze, G. Ye. Gugunava and K. V. Pertaya, Geophysical Institute and Computation Center Georgian Academy of Sciences, "Computation of Thermoelastic Stresses Caused by Change in Crustal Heat Regime for One Physical Model"]

[Abstract] The article is an examination of one of the possible mechanisms of earthquakes excited by thermoelastic stresses in the region of a high-temperature intrusion. The authors derive a system of equations which makes it possible to compute thermoelastic stresses in the medium surrounding an intrusion of a parallelpiped configuration (intrusion along a deep fault). One of the mechanisms capable of causing earthquakes in a number of regions of the Caucasus is related to residual manifestations of Tertiary and Quaternary volcanism. Specifically, there are thermoelastic stresses arising in the field surrounding the heated magma wedging into the crust: when the thermoelastic stresses exceed the breaking point of the rocks, their destruction begins, manifested in the form of earthquakes. The article gives a mathematical description of this mechanism.
[205]

USE OF BOREHOLE GEOPHYSICS IN EARTHQUAKE PREDICTION

[Article by Ye. V. Karus, O. L. Kuznetsov and I. A. Rezanov, All-Union Scientific Research Institute of Nuclear Geology and Geophysics, "Possibilities of Borehole Geophysics in Predicting Earthquakes"]

[Abstract] Theoretical and experimental investigations carried out during recent years in the USSR and other countries show the great possibilities of development and introduction of an effective combination of geophysical investigations (wide-band acoustical logging, highly sensitive thermometry, radioactive logging) in deep and superdeep boreholes for the purpose of detecting the precursors of earthquakes and also the routine and long-range prediction of earthquakes. The criteria used in defining the imminence of earthquakes are defined and there is a discussion of the means used in determining the direction and coordinates of a postulated earthquake focus. A method for such geophysical observations is proposed. When making such investigations it is necessary to have a specialized network of observation stations and also a geophysical service ensuring periodic measurements and processing of the results. The first regions where polygons could be established for the short-range prediction of a destructive earthquake are the cities of Ashkhabad, Dushanbe and Alma-Ata. In each of these places it is desirable to drill initially two or three boreholes with a depth of 5-7 km, one at the center of the city and the others to the north and south in such a way as to obtain a deep geophysical profile across the strike of the seismic zone. As a comparison, a similar complex of observations must be carried out in observation boreholes situated in a region with quiet tectonics (for example, Turan platform, Dnepr-Donets depression, and elsewhere).
[202]

CORRECTION FOR DYNAMIC SHEAR MODULUS FOR EARTH'S NATURAL FREQUENCIES

[Article by S. Ts. Akopyan, V. N. Zharkov and V. M. Lyubimov, Institute of Physics of the Earth, "Correction for the Dynamic Shear Modulus for the Earth's Natural Frequencies"]

[Abstract] Investigations of the natural oscillations of the earth have made it possible to determine the distribution of the dissipative function $Q_\mu(l)$ in the earth's interior (l is depth). Sample $Q_\mu(l)$ distributions which agree satisfactorily with the experimental data are summarized in Table 1. With a change from purely elastic models of the earth to inelastic models the static shear modulus is replaced by the dynamic modulus $\mu_{dy}(\omega)$, dependent on the frequency ω. Prior to the study made by S. Ts. Akopyan, et al. (DAN, 223, No 1, 1975) this well-known circumstance was not analyzed and it was assumed that the frequency dependence of the dynamic shear modulus is too weak in order to lead to the observed effects. In this paper, together with a quantitative examination of this problem, the authors have now computed corrections for the dynamic shear modulus for the entire frequency spectrum of the earth's natural oscillations. It is shown that allowance for the frequency dependence leads to an appreciable decrease in the shear modulus (about 3-5%) in zones in the earth with reduced Q_μ values. Failure to take this into account invalidates many detailed constructions of models of the earth. In such investigations a correction of the dynamic modulus must be introduced into the natural frequencies instead of "reading" corrections (base line corrections) for the travel time of longitudinal and transverse waves.
[165]

REFLECTED WAVE TIME FIELDS AND TRAVEL TIME CURVE PARAMETERS

[Article by S. V. Gol'din and V. S. Chernyak, Institute of Geology and Geophysics Siberian Department USSR Academy of Sciences, "Effective Parameters of Travel Time Curves and Time Fields of Reflected Waves in Inhomogeneous Media"]

[Abstract] In this paper expressions are derived for the effective parameters of RW and RTW travel time curves and time fields. These are discussed through the characteristics of the medium for a model of a vertically inhomogeneous layer with an arbitrary velocity function v = v(z) and a curvilinear reflecting boundary. The derived formulas can be used in approximating travel time curves and time fields in complex media and also in solving a number of inverse problems.
[112]

RECOGNITION METHODS FOR EVALUATING PARAMETERS OF GEOPHYSICAL OBJECTS

[Article by Yu. I. Zhezhel', F. M. Gol'tsman and N. F. Zhezhel', Leningrad
State University, "Application of Recognition Methods for Interval Evalu-
ation of the Parameters of Geophysical Objects"]

[Abstract] A method is proposed for the joint interval evaluation of a set
of parameters characterizing the geological medium by means of a two-alter-
native recognition of the registered fields. The decision rule is based on
computer modeling of representative sets of fields by means of use of well-
known theoretical dependences of the field on the parameters of the objects.
The paper gives a detailed examination of examples of interval evaluation
in problems of magnetometry in the presence of noise. A method is develop-
ed for selecting the optimum nonuniform observation schemes and the prin-
cipal combinations of secondary criteria, making it possible to investig-
ate the comparative significance of both primary and secondary criteria
and to reduce considerably the number of criteria necessary for recognition.
[165]

V. UPPER ATMOSPHERE AND SPACE RESEARCH

Abstracts of Scientific Articles

NUMERICAL METHOD OF IONOSPHERIC PREDICTION

[Abstract of preprint by Ye. V. Lavrova; Moscow, CHISLENNYY METOD IONOSFER-
NOGO PROGNOZIROVANIYA, Institute of Terrestrial Magnetism, Ionosphere and
Radio Wave Propagation, Preprint No 10(153), 1976, 23 pages]

[Text] In this preprint the author examines the variability of the daytime
and nighttime deviations of the critical frequencies of the F2 region from
the median values ($\delta f_0 F2$) from day to day on the basis of ionospheric
data for Moscow station for a year of the maximum (1968) and the minimum
(1964) of solar activity. A study was made of the distribution of $\delta f_0 F2$
values characteristic for different states of the ionosphere and the mag-
netic field on the preceding day. The author proposes a numerical method
for predicting the mean daytime and nighttime $\delta f_0 F2$. Equations are deriv-
ed for computing $\delta f_0 F2$ for different initial conditions. The method makes
it possible to compute the state of the ionosphere with a mean square error
not exceeding $\pm 15\%$. This method can be used for computing $\delta f_0 F2$ on an el-
ectronic computer.
[162]

QUASITRAPPED ELECTRONS IN INNER MAGNETOSPHERE

[Abstract of article by Ya. Kolar and S. Fisher; Moscow, IZV. AN SSSR, SER.
FIZ., 40, No 3, 1976, pp 558-560, "Amplitude Distribution of Pulsations of
Quasitrapped Electrons in the Inner Magnetosphere"]

[Text] The "Interkosmos-5" artificial earth satellite was used in making
measurements of fluxes of electrons (>40 keV) and protons (>1 MeV) along
and across the geomagnetic lines of force. Frequently there were rapid
changes in the intensity of the perpendicular fluxes with characteristic
periods from several seconds to tens or hundreds of seconds. Particular at-
tention is devoted to cases of pulsations of quasitrapped and trapped elec-
trons occurring in a quiet geomagnetic field and occupying extensive re-
gions of the inner magnetosphere (tens of degrees in longitude) in the
course of several hours or even days. The mechanism of these pulsations
for the time being has not been clarified. For understanding the processes
causing pulsations of these fluxes a study was made of the amplitude dis-
tribution of pulsations registered for different activity levels. It is pos-
tulated that the pulsations are caused by the interaction of low-frequency
electromagnetic and trapped particles.
[162]

INSTRUMENTATION ON "INTERKOSMOS-KOPERNIK 500" SATELLITE

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 9, 1976
9A55K

[Abstract of preprint by V. I. Aksenov, S. Aleshkevich, G. Velnovskiy, B.
Vikerskiy, S. Gorgolevskiy, G. P. Komrakov, Z. Kravchik, A. P. Modestov,
I. V. Popkov, L. Yu. Sokolov, V. A. Timofeyev and Ya. Khanash; Moscow,
NAUCHNAYA APPARATURA SPUTNIKA "INTERKOSMOS-KOPERNIK 500" DLYA ISSLEDOVAN-
IYA SPORADICHESKOGO RADIOIZLUCHENIYA SOLNTSA I PARAMETROV IONOSFERY ZEMLI
(Scientific Instrumentation on the "Interkosmos-Kopernik 500" Satellite
for Investigating Sporadic Solar Radio Emission and Parameters of the
Earth's Ionosphere), Institute of Radio Engineering and Electronics, Pre-
print No 4(210), 1976, 24 pages]

[Text] This preprint describes a radiospectrograph for the frequency range
0.45-6.0 MHz, low- and high-frequency impedance probes, by means of which
the "Interkosmos-Kopernik 500" satellite was able to carry out investiga-
tions of sporadic solar radio emission and the parameters of the earth's
ionosphere. As an example, the publication gives an example of the dynamic
spectra of type-III solar radio bursts and passive plasma resonances in
the ionosphere, registered using a radiospectrograph, and also the results
of measurements of the parameters of ionospheric plasma (characteristics
of the ion screen around a cylindrical antenna, electron concentration and
its inhomogeneities) using low- and high-frequency probes.
[162]

EFFECT OF VERTICAL DRIFTS ON F-REGION ELECTRON CONCENTRATION

[Article by A. G. Khantadze, R. G. Gachechiladze and B. Ya. Chekhoshvili, Geophysical Institute Georgian Academy of Sciences, "Effect of Vertical Drifts on the Electron Concentration in the Ionospheric F Region"]

[Abstract] This paper gives the results of numerical integration (on an electronic computer) of the continuity equation for electrons, taking into account vertical drift, which is not dependent on altitude and time. Computations show that the diurnal variation of the altitude of the electron concentration maximum for latitudes $\varphi = 60°$ and $30°$ at drift velocities is ±0.5 m/sec. After sunrise the altitude of the maximum begins to decrease, and attaining a minimum value, remains constant for two to four hours; with an increase in latitude h_{max} is situated at a greater altitude. Then there is a rise in the altitude of the maximum, which during the night remains almost constant. At this time there is a decrease in the altitude of h_{max} and there are diurnal fluctuations with an increase in latitude. After sunrise the electron concentration increases at all altitudes; the rate of its change decreases with an increase in altitude. In addition, the time of onset of N_{max} lags with an increase in drift velocity and altitude. The influence of vertical drift is strongly reflected only at great altitudes · (300-400 km), whereas at low altitudes (250 km) its influence can be neglected.
[205]

INFRARED RADIATION OF VENUSIAN CLOUDS

[Article by L. V. Ksanfomaliti, Ye. V. Dedova, L. F. Obukhova, N. V. Temnaya and G. F. Fillipov, "Infrared Radiation of Venusian Clouds"]

[Abstract] The two identical radiometers carried aboard the "Venera-9" and "Venera-10" for measuring the IR radiation of Venusian clouds have an angular resolution of about 70°K and a working range of wavelengths of 8-13 and 18-28 μm. Rejection of the interval 13-18 μm prevents distortions of the results due to radiation of the higher layers of the atmosphere in the CO_2 band at 15 μm. The wavelength of the radiation maximum of Venus falls in the middle of the radiometer range. The thermal radiation of Venus is formed in the upper layer of the planetary cloud cover. The measured brightness in the indicated range is used in determining the brightness temperature of the emitting layer. The radiation balance of the planet is dependent on this temperature. Among the experimental objectives were: study of the

effect of "darkening toward the limb," investigation of local inhomogeneities and their relationship to phenomena observed at other wavelengths and study of longitude and latitude effects. The article is accompanied by a series of graphs of the brightness temperature of Venus in the IR range as determined by the instrumentation on the two space vehicles. A diagram shows the distribution of the constant component of the brightness of thermal radiation of Venus for the surface of the cloud layer in the latitude region ±35°. It is shown that the "nighttime" regime probably occupies more than 180° in longitude. The thermal radiation of Venus is therefore asymmetric. The temperature of the daytime zone in the latitude region ±35° is 233-234°K; for the nighttime zone in these same latitudes it is 244°K. The stable difference observed between the daytime and nighttime temperatures has an obvious relationship to interception of part of the solar radiation by the cloud layer. The probable reason for the decrease in daytime temperatures is the appearance of powerful convective fluxes in the daytime zone which transport part of the emitting matter into the zone above the clouds at an altitude of 3-4 km. The mechanism described in this article makes possible an independent estimate of the concentration of water vapor (at the altitude of the emitting layer) on the basis of its pressure.
[141]

UV PHOTOMETRY OF VENUS

[Article by L. V. Ksanfomaliti, Ye. V. Dedova, V. G. Zolotukhin, G. N. Krasovskiy and V. M. Filimonova, "Ultraviolet Photometry. Scattering Layer Above the Absorbing Clouds"]

[Abstract] Photometric measurements were carried out using three instruments carried aboard spacecraft. The most important of these was a photometer with the following parameters: wavelength at the transmission maximum of the interference filter 3520 A ("Venera-9") and 3450 A ("Venera-10"). The object of the photometric measurements was the upper level of clouds in the cloud cover of Venus, whose boundary is situated at altitudes 64-67 km, and the atmospheric layers situated somewhat above this. The pressure at these altitudes is 15-100 mbar and density is $4-20 \cdot 10^{-5}$ g/cm^3. The aerosol of the cloud layer consists of spherical particles with a mean diameter of about 2μm, evidently consisting of concentrated sulfuric acid. On the basis of the collected data it was possible to construct a model of the cloud cover of Venus. Directly over the upper boundary of the main clouds there is a scattering layer with a thickness of 8-9 km. The layer has $\tau_0 = 0.6-0.9$ and a coefficient of volume scattering $\sigma \sim 3.7 \cdot 10^{-6}$ cm^{-1}. It consists of finely disperse particles, has a patchy structure and scatters UV rays without appreciable absorption. However, the main cloud layer greatly absorbs these rays. Dark bands are formed in places where one can see the lower layer through the reduced optical thickness of the upper layer. It is confirmed that the scattering layer is situated above the absorbing layer.
[141]

OPTICAL MODEL OF CLOUD LAYER OF VENUS

[Article by N. A. Parfent'yev, "Preliminary Optical Model of the Cloud Layer of Venus Based on Spectrophotometric Data Collected by Descent Modules and Orbital Vehicles"]

[Abstract] An extensive complex of studies of the cloud layer of Venus was made using the "Venera-9" and "Venera-10." The descent modules carried a wide-band photometer, narrow-band photometer and nephelometer and the orbital vehicles carried an IR-spectrometer, IR radiometer and photopolarimeter. All the experiments gave new information on the characteristics of the cloud layer and have now been used as the basis for a unified model of the cloud layer. The model presented here combines the results of two optical experiments, one carried out with the descent modules and the other with the orbital stations. The two groups of data made it possible to construct a vertical profile of the cloud layer. A direct comparison can be made because the scattering cross section for a spherical particle is virtually identical for the two wavelengths employed (0.8 and $2 \mu m$). A figure show the vertical profile of σ, n and τ (mean volume scattering coefficient, particle concentration and optical thickness) in the Venusian cloud layer satisfying the data from both experiments. Measurements with the narrow-band photometer show σ fluctuations evidently associated with the "patchy" structure of clouds.
[168]

INTERRELATIONSHIP OF AURORAS, SOLAR FLARES AND GEOMAGNETIC PULSATIONS

[Article by V. M. Davydov, Institute of Space Physics Research and Aeronomy, Yakutsk Affiliate Siberian Department USSR Academy of Sciences, "Manifestation of Auroras and Chromospheric Flares in Geomagnetic Pulsations"]

[Abstract] The effect of the sun and solar radiation on the earth's magnetosphere causes a number of global effects in the lower ionosphere, leading to a change in the concentration of charged particles. The effect of the sun on Pi2, Pif and some other geomagnetic variations has a specific nature and requires allowance for the influence of parametric changes in ionization and integral conductivity of the lower ionosphere. Accordingly, this paper examines the parametric influence exerted on the propagation of long-period geomagnetic pulsations by changes in the total conductivity of the lower nonstationary ionosphere associated with auroras and chromospheric flares. An analytical solution is given and theoretical magnetograms are computed.

The qualitative correspondence between the experimental and theoretical magnetograms makes it possible to postulate that in addition to the assumed mechanism of formation of Pi2 from a single impulse by the magnetospheric resonator there can be another. The essence of this mechanism is as follows. A relatively limited train is formed from the initial hydromagnetic pulsation as a result of the dependence of integral conductivity of the lower ionosphere on time. In the case of auroras a distinguishing characteristic of this mechanism is a marked intensification of the primary hydromagnetic pulsation. Thus, two mechanisms operate simultaneously: a) parametric and b) magnetospheric resonator.
[144]

NEW VECTOR AIRBORNE MAGNETOMETER DESCRIBED

[Article by N. V. Alekseyev, Ye. A. Bugrov, V. I. Pochtarev, A. Ya. Rotshteyn, M. A. Sergeyev, Yu. G. Turbin, S. V. Farmakovskiy, A. D. Cherednichek and V. I. Yushchenko, Leningrad Division Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation and Leningrad Institute of Precise Mechanics and Optics, "Vector Airborne Magnetometer Apparatus"]

[Abstract] The article describes apparatus for vector airborne magnetometer investigations created for study of the spatial structure of the earth's magnetic field and secular variations. The theory of such investigations is discussed, followed by a discussion of the problems involved in selecting the technical specifications of different components. The entire apparatus is designed in the form of four units. There is a rigid frame to which are attached a number of quantum sensors placed within ring systems and astrosights. This assembly is placed in the tail part of the aircraft. The magnetometric recording apparatus is designed in the form of a support in which digital voltmeters are placed and also a device for the readout of magnetometer data. Mounted on this same support is an automatic recorder for the analog registry of T. Another support holds a coding device for navigational data and instrumentation for guiding the astrosights. The same support holds two punchers on rubber shock absorbers. The fourth unit is a system for coding and readout of information. The output is supplied a d-c current from the aircraft system (27 V); required power is 3KW. Total weight, including the frame is 750 kg. The most suitable types of aircraft for carrying this apparatus are the IL-18 or AN-12. It is noted that a similar outfit is being developed in the United States to be carried aboard a nonmagnetic aircraft (H. P. Stockard, IAGA BULLETIN, Paris, No 28, 1971).
[144]

SATELLITE MEASUREMENTS OF NITRIC OXIDE IR EMISSION

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 9, 1976
9A56K

[Abstract of preprint by M. N. Markov, G. M. Grechko, A. A. Gubarev, Yu. S.
Ivanov and V. S. Petrov, "Infrared Emission of Nitric Oxide by the Upper
Atmosphere According to 'Salyut-4' Measurements" (INFRAKRASNOYE IZLUCHEN-
IYE OKISI AZOTA VERKHNEY ATMOSFERY PO IZMERENIYAM SALYUTA-4); Moscow, Phys-
ics Institute USSR Academy of Sciences, Preprint No 8, 1976, 18 pages]

[Text] The measurements were made on 27 January 1975 from aboard the "Sal-
yut-4" orbital station using a telescope-spectrometer. The angle of view
of the instrument is about 10^{-5} sr, spectral range is 1-8μ, resolution
up to 0.2μ. The radiation detector is a photoresistor made of germanium,
alloyed with gold, cooled to -50°K. The instrument response in the range
2.5-5.5μ is up to $3\cdot10^{-7}$ W$\cdot$cm$^{-2}\cdot$sr with a time constant of about 0.1 sec.
The investigated region of the atmosphere was situated over regions of the
earth with the coordinates 38-45°N and 45-60°E. The measured volume density
of NO radiation is equal to approximately $1.5\cdot10^{-6}$ erg$\cdot$cm$^{-3}\cdot$sec^{-1} and the
vertical flux of NO in the layer 60-70 km is 10 erg$\cdot$cm$^{-2}\cdot$sec^{-1}. Taking into
account the approximate estimates of the length and thickness of the radiat-
ing layers, the authors assume that the vertical flux of NO falls in the
limits 5-10 erg$\cdot$cm$^{-2}\cdot$sec^{-1}. Bibliography of 12 items.
[162]

THERMAL RADIATION IN ATMOSPHERE BENEATH CLOUDS ON VENUS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 12, No 12, 1976 pp 1277-1285

[Article by N. I. Moskalenko, "Spectral Structure and Spatial Distribution
of Thermal Radiation in the Atmosphere Beneath the Venusian Clouds"]

[Abstract] Computations of the fields of descending and ascending radiation
in the layer of the Venusian atmosphere beneath the clouds were carried out
for a carbon dioxide atmosphere with small admixtures of water vapor, HCl,
CO, HF and NH_3, the concentrations of which were selected in accordance
with data from the "Venera-4," "Venera-5" and "Venera-6" and data from as-
tronomical observations. The lower boundary of the cloud cover was assumed
to be 32 and 40 km. The article gives a thorough analysis of the intensit-
ies and fluxes of descending and ascending radiation in this part of the
atmosphere. Allowance is made for continuous absorption by the wings of the
spectral lines of CO_2 and absorption induced by pressure. The selective ab-
sorption of radiation by H_2O, CO_2, CO, HCl and HF vapors was computed us-
ing the two-parameter equivalent mass method with allowance for the influ-
ence of temperature on the spectral transmission function.
[204]

TESTING OF A HEAT PIPE UNDER SPACE CONDITIONS

[Article by L. L. Vasil'yev, V. V. Gil', N. A. Zharikov, V. Ye. Zelenin, O. M. Syvorotka and Ye. I. Uvarov, Institute of Heat and Mass Exchange, Minsk, "Tests of a Heat Pipe in Space"]

[Abstract] An experiment was carried out for checking the performance of heat pipes under weightlessness conditions for developing heat pipes for heat-regulating systems aboard spacecraft. Since the purpose was design improvement for "Interkosmos" satellites, there were definite restrictions on the energy and size and weight characteristics of the pipes. The working range of temperatures was -5 - +50°C; the heat flow transmitted by the heat pipes for their stipulated lengths and temperature difference in the segments of heating and cooling was P = 10 W. The heat pipes were fabricated from pipe 12 x 1 with a length of 730 mm and the material was the aluminum alloy AMg-3-M. The heat carrier used was freon-11 freed from solid inclusions (12.5 cm^3, volume given for a fluid at a temperature of 20°C). The tests were carried out in a pressure chamber with a capacity of 2 m^3. Ground data were compared with telemetric data on functioning of the heat pipe system aboard the "Interkosmos-11" during the period 17 May 1974-1 October 1974. The comparative data confirmed performance of the heat pipe system under space conditions; there was no deterioration in performance during 4.5 months of operation.
[207]

BALLISTICS AND NAVIGATION DATA FOR "VENERA" STATIONS

[Article by S. K. Abramovich, G. D. Ageyeva, E. L. Akim, Z. P. Vlasova, N. M. Ivanov, R. K. Kazakova, M. A. Kazanskiy, V. I. Lyaskovskaya, I. M. Morskoy, A. K. Platonov, V. S. Polyakov, V. A. Stepan'yants, K. G. Sukhanov, V. F. Tikhonov and V. N. Kheyfets, "Ballistics and Navigation in Control of Flight of the Automatic Interplanetary Stations 'Venera-9' and 'Venera-10'"]

[Abstract] A rather detailed description of ballistic and navigational aspects of "Venera-9" and "Venera-10" flight control is given. During the flight two motion corrections were made. These corrections ensured optimum conditions for operations near the planet. The most important of these conditions were: entry of the descent module into the Venusian atmosphere at an angle -20 - -23° to the local horizon; landing of the descent module on the illuminated side of Venus in a region bounded by 285 and 295° in

longitude and 15 and 35° in latitude. For selecting the final approach parameters specialists carried out mathematical modeling of flight of the automatic stations, taking into account all maneuvers made and their accuracy characteristics, and also predicted some set of parameters critical from the point of view of solution of the flight mission. A special programming complex made possible routine selection of the control parameters for the stage of braking at the destination. Details are given on how the orbital vehicles were put into the orbits of satellites around Venus. Under the influence of perturbing forces the satellite orbits are evolving. The evolution of these orbital parameters is discussed. Actual and computed orbital evolutions coincide well. This indicates correctness of current concepts concerning the nature of the Venusian gravitational field. The results of trajectory measurements are now being processed and generalized for the purpose of obtaining reliable numerical characteristics of the gravitational field.
[141]

OPTIMUM CONDITIONS FOR DETERMINING ORBITAL ELEMENTS

[Article by G. A. Ustinov, "A Priori Evaluation of Accuracy and Optimum Conditions for Determining Orbital Elements"]

[Abstract] The article cited above examines the conditions for determining the elements of a Keplerian orbit in dependence on the type and distribution of measurements. The author gives an analysis of the longitudinal, lateral and radial components of the error in satellite position both in the measured segment and in the prediction of its motion. It is noted that the high correlation of the longitudinal and radial components leads to an increase in prediction errors which cannot be eliminated. The formulas derived in this paper make it possible to give a qualitative evaluation of prediction errors and estimate their values approximately.
[185]

USEFUL EQUATIONS IN SPACE PHOTOGRAMMETRY

[Article by M. S. Urmayev, Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers, "Some Equations in Space Photogrammetry"]

[Abstract] The presence of topographic and star cameras aboard a space-craft for the synchronous photographing of the star sky and the planetary surface and also a radioaltimeter with registry of the point of the re-flected pulse makes it possible to solve problems regardless of whether there is a spacecraft tracking system on the surface of the planet. How-ever, it is also necessary to ensure the necessary conditions for the space survey -- approximate tracking of the center of mass by the optical axis of the topographic camera, constant overlap of photographs along the or-bital trajectory, minimum rotation of the spacecraft about the vertical axis, and a number of others. With these considerations taken into account, the author cites the fundamental equations for application of the orbital method in space surveys. The article gives a linearized form of the fun-damental equation. A method is proposed for determining the operator for orienting a star photograph. Also discussed is the possibility of use of the overlap of photographs along the orbital trajectory for differential refinement of the orbit and the coordinates of stations on the planetary surface.
[185]

COSMIC X-RADIATION STUDIED FROM ABOARD "SALYUT-4"

[Article by S. I. Babichenko, D. A. Goganov, G. M. Grechko, A. A. Gubarev, Ye. V. Dereguzov, I. P. Karpinskiy, P. I. Klimuk, N. I. Komyak, V. G. Kurt, B. S. Lozinskiy, V. V. Matveyev, Ye. I. Moskalenko, A. G. Nikolayev, V. I. Sevast'yanov, V. A. Sklyankin, L. G. Titarchuk, Ye. K. Sheffer and A. V. Shifrin, "Some Results of Investigation of Cosmic X-Radiation from Aboard the 'Salyut-4' Orbital Station"]

[Abstract] The "Filin" X-ray telescope, carried aboard the "Salyut-4," was designed for a study of the intensity and spectral composition of radia-tion from discrete cosmic sources in the energy region from 0.2 to 10 keV. Four or more pages of this paper are devoted to a detailed description of the instrumentation. A block diagram of the X-ray telescope-spectrometer accompanies the text and serves as the basis for description of the ap-paratus and its functioning. Basically, there were four detectors of X-radiation, two star photometers, solar and lunar sensors, a measurement unit, power source and gas flow system. Operation of each is discussed. Information is given on ground calibration and in-flight control of the instrumentation. The article describes investigations of X-radiation from some galactic sources during different station flight regimes. Valuable new detailed data are presented on the sources Sco X-1, Her X-1, Cyg X-1, Cir X-1 and A 0620-00.
[168]

AERODYNAMICS AND DYNAMICS OF "VENERA" DESCENT MODULES

[Article by V. P. Karyagin, R. S. Kremnev, K. M. Pichkadze, A. I. Sklovsk-aya and V. A. Yaroshevskiy, "Investigation of the Aerodynamics and Dynamics of the 'Venera-9' and 'Venera-10' Descent Modules During Motion in the Atmosphere"]

[Abstract] The final segment of the descent trajectory for the "Venera-9" and "Venera-10" spacecraft included the uncontrolled descent of the descent modules after release of the parachute system prior to contact with the surface. At the initial moment the descent module had a velocity of about 7 m/sec; after release of the parachute system for approximately 10 seconds it was propelled to an equilibrium velocity and then it descended with this velocity, slowly changing in dependence on altitude. The motion of the module about the center of mass in the initial segment of the final stage in the trajectory is dependent to a high degree on the perturbations which the module acquires in the process of parachute system release. If these perturbations do not result in overturning of the module, the motion about the center of mass acquires an almost steady character with possible rotation about the longitudinal axis and autooscillations in angle of attack and gliding. The principal requirements which are imposed on the final stage of the trajectory are the following: it is necessary to prevent a possible overturning of the descent module after parachute system release; the velocity at the time of impact with the surface must not exceed 8 m/sec in order to avoid descent module destruction; at the time of surface impact the longitudinal angular velocity must not exceed 120°/sec and the amplitude of oscillations in spatial angle of attack must not exceed about 15° in order to avoid overturning of the descent module after impact with the Venusian surface. This article gives a thorough analysis of the formulation of these requirements and the ways used in solving the problems involved in landing the descent modules on the Venusian surface. [168]

ELIMINATING INTERFERENCE FROM SPACE PHOTOGRAPHS

[Article by L. N. Kapranov, Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers, "Method for Eliminating Pulsed Interference on Photographs"]

[Abstract] Different kinds of interference appear on space photographs taken of distant planets. Pulsed interference is one type of such interference. The extent and nature of distribution of this interference over the field of the photograph are completely random. This interference makes difficult both visual perception of the photograph and automatic processing of a photograph for the purpose of obtaining useful information. Digital computers can be used in eliminating such interference but the processing time is long, the apparatus used is complex and the cost is high. Analog methods are without these shortcomings and therefore a search was made to find a solution in this direction. It is shown that by making use of the specific characteristics of the pulsed interference it is possible to construct electric circuits for eliminating this interference. The article describes the development and testing of electric circuits making use of a delay line making it possible to eliminate this interference. Block diagrams and a circuit diagram in the text serve as a basis for the textual description of such a system, its individual components and operating principle. [185]

CERENKOV RADIATION OF INTERNAL GRAVITATIONAL WAVES

[Article by V. P. Goncharov, V. A. Krasil'nikov and V. I. Pavlov, Moscow State University, "Cerenkov Radiation of Internal Gravitational Waves"]

[Abstract] In this paper, within the framework of the Hamiltonian formalism method (V. P. Goncharov, et al, IZV. AN SSSR, FAO, 12, No 11, 1976), the authors examine the problem of the radiation of internal gravitational waves by a high-frequency sound packet propagating vertically upward in a stratified medium. It is postulated that the medium allows use of a model of an isothermal atmosphere. This is convenient in a theoretical investigation of wave movements and is entirely sound when the entire medium or a part of it can be considered quasi-isothermal and the gravitational field in which the medium is situated is uniform. In this case the height of the uniform atmosphere can be considered not dependent on coordinates. A physical situation corresponding to such a model can be observed in many problems in geo- and astrophysics. Such a medium is the chromosphere of the sun or a star of the corresponding spectral class. Formulas are derived which make it possible to ascertain the energy emitted by a sound packet in a unit time into a solid angle element. A specific case is considered as an illustration. Numerical estimates are given for a case when the solar chromosphere is the considered medium. Acoustical waves generated in the convective layer beneath the photosphere propagate through this medium. The method makes it possible to use the method for obtaining quantitative estimates of the effect and examine the peculiarities of wave interactions in stratified media. [204]

LUNAR SPECTROMETRIC INVESTIGATIONS

[Article by G. Ye. Kocharov and V. I. Chesnokov, "RIFMA-M Spectrometer on the Moon"]

[Abstract] The "Lunokhod-2" lunar vehicle [a photograph of which accompanies the text] was used in exploring the transition zone between the moon's continental and mare areas. The objective was to ascertain the characteristics of this zone on the basis of spectrometric studies of the iron content in the lunar ground by measurements with the RIFMA-M spectrometer, a modernized version of the RIFMA instrument carried by the first "Lunokhod." A map accompanying the text shows the exact route taken by the vehicle on the lunar surface; it shows points where measurements were made and the chemical composition (Fe, Ca, K, Si, Al) at these stops. The change in chemical composition in the transition zone was gradual. It was found that whereas the typical iron concentration in the mare region was 10-12%, with approach to the continent it decreased smoothly to 4%. Such a low iron content is characteristic for terrestrial rocks of the anorthosite type, evidently occurring widely in lunar continents. The observed distribution is evidently attributable to the movement of lunar matter from continental highlands onto the lowland plains. Under the influence of meteorite impacts and hard solar radiation the lunar rocks are slowly broken down and pulverized. If the particles of lunar ground are brought into movement, they can roll downslope under the influence of gravity, blurring the originally distinct line separating the mare and continent and smoothing relief details. Particles of continental matter poor in iron are gradually mixed with the pulverized mare rocks rich in iron. The greater the distance from the continent, the lesser is the "dilution" by continental matter and the greater is the iron content in the lunar ground. Such investigations of the migration of lunar matter by measurement of ground characteristics in the transition zones can be an effective method for learning about the mechanism of formation of present-day lunar relief.
[42]

VI. MISCELLANEOUS

News

"BASKIRIYA" AND "MIKHAIL SOMOV" RENDEZVOUS IN ANTARCTICA

Moscow PRAVDA in Russian 8 Dec 76 p 6

[Article by V. Bardin: "Meeting Among the Icebergs"]

[Text] The first ships of the 22d Soviet Antarctic Expedition have now neared the shore of the sixth continent and entered the zone of drifting icebergs. At 61 degrees South Latitude, 500 miles from Molodezhnaya station, there was a meeting between the motor ship "Bashkiriya" and the scientific expeditionary ship "Mikhail Somov," which bears the name of the famed polar scientist who led the first Soviet expedition to the Antarctic.

The diesel-electric vessel [the "Mikhail Somov"] is only in its second year of service and has come to replace the legendary "Ob'", which hardly any earlier Antarctic expedition could manage without. The ship was brought to the ice continent by polar captain M. Mikhaylov. The holds of the ship are filled with cargo for the winter stations. Even on the deck there is hardly an empty spot. Containers, "IL-14" airplane parts, and all-terrain vehicles are crowded closely together. Three huge bright red vehicles stand out. These are the new "Khar'kovchanki" -- high-powered snow vehicles intended for trips to the central regions of the south polar mainland. The vehicles will be delivered to "Mirnyy" observatory and used for expeditions to the region of the cold pole and "Vostok" station.

Ninety-seven members of the expedition were transferred by sloop from the "Baskiriya" to the "Mikhail Somov." They will be working at Molodezhnaya station and will carry out operations for unloading the ship. The approaches to the station are blocked for several dozen kilometers by continuous shore ice. It is difficult even for an icebreaker to overcome it at the beginning of the summer. For this reason, the delivery of people and supplies to Molodezhnaya will be accomplished basically by aircraft. Busy days now lie ahead for the pilots who were bored during the long ocean passage.

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Soon the long-awaited meeting of the members of the two expeditions will take place on the shores of the Antarctic.

Within a few days the diesel-electric "Kapitan Gotskiy" is scheduled to arrive at Cape Norvegia and the next group of polar scientists, personnel for the seasonal base "Druzhnaya," will leave the hospitality of the "Bashkiriya." [4]

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