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GEOPHYSICS, ASTRONOMY AND SPACE

No. 410

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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

GEOPHYSICS, ASTRONOMY AND SPACE

No. 410

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

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I. ASTRONOMY

News

SHKLOVSKIY DOUBTS EXISTENCE OF EXTRATERRESTRIAL LIFE

Moscow NEDELYA in Russian No 42, 17-23 Oct 77 p 17

[Article by I. Shklovskiy, "Where Are You, Brothers by Intelligence?"]

[Summary] The mastery of circumterrestrial space is a matter of time. There are no fundamental difficulties on this path. The extensive mastery of space will immeasurably increase the technical potential of mankind. The energy resources of our planet, for example, can increase a billionfold. Man is entering a completely new phase in his development, into a civilization of the second type. A fact of fundamental importance is that approximately a thousand years will be required for the transformation of circumsolar space...The conclusion can be drawn logically that no such type of civilization exists in our Galaxy. And since they arise from lower-level civilizations, their existence is problematical. This, to be sure, is unproven, but is a logical deduction. In my opinion, at the present time there is more basis for pessimism than for optimism in the quest for finding 'reasoning brothers in space.' This point of view contradicts usual concepts and the subconcious wish of mankind to not be alone in the universe. Therefore, most specialists concerned with extraterrestrial civilizations are less pessimistic. But the unlimited optimism characteristic for the 1950's-1960's in attempts to establish communication with extraterrestrial civilizations has now died away. A more cautious opinion prevails. Rather than the problems of communication with other planets, emphasis is now on the problem of the generation of life and its transformation into reasoning life. Plans have been advanced for creating gigantic radiotelescopes, including in circumterrestrial space, which would make possible the reliable detection of radio signals from distant worlds... For the time being it is evidently unreasonable to construct expensive telescopes specially for communication with extraterrestrial civilizations... Attempts at discovering brothers in space must not be a purpose in themselves but secondary in nature associated in general with the planned, careful investigation of the universe.
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II. METEOROLOGY

Abstracts of Scientific Articles

GEOMETRY OF CLEARING ZONE IN CLOUD IN PRESENCE OF WINDS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 236, No 6, 1977 pp 1338-1341

[Article by Yu. S. Sedunov and L. P. Semenov, Institute of Experimental Meteorology, "Geometry of Clearing Zone in Clouds in the Case of an Arbitrary Wind Field"]

[Abstract] In investigations carried out up to the present time for the clearing of cloud media it has been assumed that the wind velocity is constant in direction. Since wind velocity in clouds plays an important role in formation of the cleared zone, the authors have sought to clarify to what degree the configuration of the cleared zone is related to structure of the wind field. The problem is solved here on the assumption that the collimated radiation beam with a circular cross section d is incident on a droplet cloud medium occupying a layer with the thickness h and this beam is perpendicular to the surface of the medium. In addition, it is assumed that: 1) the x-axis of the coordinate system coincides with the direction of propagation of radiation and the origin of coordinates coincides with the lower boundary of the cloud medium; 2) the state of clearing is stationary; 3) the intensity of radiation at the input to the cloud medium is constant in the beam cross section; 4) the wind velocity modulus is dependent only on the x scale; 5) the microstructure of the cloud medium is vertically inhomogeneous. With this formulation of the problem the authors have devised an asymptotic method for finding the maximum altitude and configuration of the clearing zone and a number of special cases are considered.
[92]

EFFECT OF GEOMAGNETIC ACTIVITY ON OCEAN AND ATMOSPHERE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 236, No 6, 1977 pp 1342-1345

[Article by R. V. Smirnov, "Manifestation of Long-Term Cycles of Geomagnetic Activity in Activity of Ocean and Atmosphere"]

[Abstract] A study was made of the manifestations of long-term heliocyclicity in the activity of the ocean and atmosphere. For investigating the geophysical manifestations of the 80-year helio-geomagnetic cycle the author constructed integral-difference curves of surface water temperature (ϑ_w) and the level (h) for the regions of the Atlantic, Baltic and Black Seas, air temperature (ϑ_a) and pressure (P) for stations in Western Europe and the European USSR and also the frequency of recurrence of circulation forms according to the Girs classification. It was found that the manifestation of geomagnetic cyclicity in the activity of the North Atlantic is a real fact and the amplitude of the 11-year component of variability of the temperature regime of the North Atlantic in some places attains 70% of the amplitude of the annual variation. With respect to atmospheric circulation, an intensification of geomagnetic activity at first favors an increase in the frequency of recurrence of the easterly form E in the Atlantic-Eurasian sector and then with a decline, an increase in the meridional form C. Such a dependence of the frequency of recurrence of the forms E and C on the phase of the geomagnetic cycle not only can explain the principal characteristics of formation of $\Delta\vartheta_w$ in the North Atlantic, but also favors the discovery of some reasons for the appearance of droughts in the European USSR and Kazakhstan during individual years. The initial reaction of the atmosphere to this external agent evidently arises in the high latitudes and the ocean-continent boundary regions, where there are temperature contrasts and a considerable vertical wind shear and where the maximum reserves of potential and kinetic energy of jet streams are concentrated.
[92]

III. OCEANOGRAPHY

News

INITIAL TESTING OF BATHYSCAPH "SHEL'F-1" COMPLETED

Moscow PRAVDA in Russian 23 Nov 77 p 6

[Article by N. Bratchikov, "Marine 'Tractor'"]

[Text] The first tests of the "Shel'f" bathyscaph have been successfully completed. It was developed and designed by specialists of Far Eastern University.

A sea vehicle with a sufficient degree of autonomy, mobile, capable with a crew of two men to submerge to a depth of 500 meters, has been incorporated into the scientific research program of the problems laboratory for studying the shelf of Far Eastern seas. And now there have been control dives in these waters. For the time being the depths are small -- 20-25 m. But in the first stage of "populating the medium" the problem is a different one: under natural conditions to check the tactical-technical specifications of the instrument and carry out a series of experimental bottom studies.

The head of the Department of Nuclear Statistical Physics, Candidate of Physical and Mathematical Sciences V. Yudin, states: "We will go into the open ocean in spring in the 'Shel'f,' when the field work of our university geologists begins. Earlier they studied the shelf by means of aqualungists and now we will equip them with a laboratory."

Q: What can your bathyscaph do on the shelf?

A. In defining the work capabilities of the apparatus we jokingly have called it a "sea tractor." It is surprisingly adapted to "plowing" the blue deeps. The bathyscaph will help on experimental farms which are engaged in the cultivation of underwater gardens, in the search for kombu, scallops, mussels, and colonies of trepang. The vehicle is capable of performing the role of explorer of minerals on the shelf: ground samples will be taken in unlimited numbers and then selectively.

The bathyscaph is stable and operates reliably in the deeps. During movement it develops a speed greater than five kilometers per hour. The motors do not disturb the medium, its vegetation and animal world; this is particularly important for the cultivation of underwater gardens. It can remain under the waves for a rather prolonged time -- 36 hours.

Q: What are the advantages of the "Shel'f" in comparison with its "brothers?"

A: The instrument is relatively light. Its total weight is three tons. This will make possible its easy transport by ships or helicopters in any region of the ocean and the vehicle maneuvers easily in the water. In conformity to the ideas of our designers, all the electric motors, electronic apparatus, and thrust mechanisms are situated outside the solid capsule. This makes safe the prolonged presence of humans below the water. Three windows afford a panorama of the underwater world. In the capsule there is a television camera and films can be taken.

Great interest in the new underwater vehicle is being shown by scientists of the Pacific Ocean Scientific Research Institute of Fishing and Oceanography, a number of scientific subdivisions of the Far Eastern Center USSR Academy of Sciences, ship repair plants, constructors of sea ports, geologists...

[Note: A photograph shows the "Shel'f-1" bathyscaph in the test polygon of the Far Eastern University in Peter the Great Gulf.]
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Abstracts of Scientific Articles

EVOLUTION OF BAROCLINIC SYNOPTIC EDDIES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 236, No 5, 1977 pp 1105-1108

[Article by B. A. Nelepo, G. K. Korotayev and V. K. Kosnyrev, Marine Hydrophysical Institute, Ukrainian Academy of Sciences, "Evolution of Baroclinic Synoptic Eddies"]

[Abstract] In October-December 1976 specialists at the Marine Hydrophysical Institute, on voyages of the "Akademik Vernadskiy" and "Mikhail Lomonosov" carried out investigations of the synoptic variability of the ocean within the framework of the international POLIMODE program. It was established that the observed eddies had horizontal dimensions of 450-500 km. The amplitude of the vertical displacement of isotherms attained 250 meters. The maximum velocity of orbital motion in an eddy was 80 cm/sec at a depth of 200 m and on the average the velocity in the upper 1,000-m layer was about 60 cm/sec. A T-S analysis indicated that at the center of the eddy there are waters with properties different from the surrounding waters of the Sargasso Sea. The velocity of movement of the eddy, determined from the position of the maximum of the isotherms, during the entire period of observations was directed for the most part to the west. The velocity of movement remained approximately constant during the period of time from the beginning of October to the end of November and was 7 km per day. During the time from late November to the middle of December the velocity of movement of the eddy decreased considerably and was already 2-2.5 km per day. A model of an isolated synoptic eddy making it possible to explain some characteristics of its evolution, based on factual data, is proposed in this paper. The model formulated here explains some observed characteristics of evolution of synoptic eddy formations as a result of interaction between the baroclinic and barotropic components of the eddy field.

[81]

RESOLVABILITY OF PROBLEMS IN OCEAN DYNAMICS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 237, No 1, 1977 pp 52-55

[Article by A. A. Kordzadze, Computation Center, Siberian Division USSR Academy of Sciences, "Resolvability of Problems in Ocean Dynamics with Allowance for Wind Currents"]

[Abstract] In earlier studies by the author (DAN, Vol 232, No 2, 308, 1977) an investigation was made of stationary boundary-value problems of the dynamics of a baroclinic ocean in which turbulent friction forces are not taken into account. The resolvability theorem was demonstrated for these problems. As is easily confirmed, such a theorem is also correct in a case when the terms $\partial u/\partial t$, $\partial v/\partial t$ and the corresponding initial conditions at the time $t = 0$ are added to the left-hand side in the equations of motion and water density. The paper cited above demonstrates the theorem of resolvability of the stationary problem of dynamics of a baroclinic ocean with wind currents taken into account (presence of turbulent friction forces in the equations of motion). The theorem remains correct for a number of other boundary-value conditions and in the case of a nonstationary formulation of the problem.
[91]

IV. TERRESTRIAL GEOPHYSICS

News

MHD-GENERATOR USED IN EARTHQUAKE PREDICTION

Moscow IZVESTIYA in Russian 16 Nov 77 p 4

[Article by B. Konovalov, "By Rocket Into the Depths of the Earth"]

[Text] One of the paradoxes in modern science is that we know far more about immeasurably distant galaxies, stars, strange planets than about the deep layers of our own earth.

For the time being the deepest boreholes have penetrated into the earth's body for only 7-8 km. In other words, by the drilling method we have not even studied the skin of the "terrestrial orange," but only its uppermost layer.

There are seismic sounding methods. The remarkable Russian geophysicist B. Golitsyn compared earthquakes with lanterns which for an instant illuminate the deep layers of the planet. A study of the nature of propagation of oscillations generated by earthquakes will yield much valuable information concerning the earth's crust. But this research method is passive, observational. Earthquakes must be awaited. It is unknown when and where they will occur. Therefore geophysicists have begun to use explosive shots for reconnaissance. But seismic waves carry only information concerning the elastic, mechanical properties of matter. They would be entirely adequate for describing a billiard ball, but not the earth.

It is widely known, for example, that at an average depth of about 30 km seismic waves are seemingly incident on some kind of boundary of a new state of matter, experiencing considerable refraction and reflection. It is known as the Mohorovicic discontinuity. This boundary has been known to geophysicists for more than a half-century now, but it still remains unclear as to what this change in the properties of matter is associated.

The possibilities of seismic sounding have not been exhausted, but its pallettes are inadequate for sketching a reliable picture of the state of the earth's deep layers. It is necessary to have new "colors" -- new data.

Additional information is obtained by electromagnetic sounding methods. If the characteristics of arriving electromagnetic oscillations are measured at different distances from some generator of an electromagnetic field, it is possible to obtain data on the conductivity of the rocks which are encountered along the path. And conductivity is related to temperature and other highly important characteristics of the state of matter.

The Achilles heel of electromagnetic sounding is the signal generators. The use of natural earth currents is difficult because too many uncertainties arise. The artificial signals are attenuated very greatly with depth of penetration. They are also greatly affected by natural noise from the ionosphere and industrial objects. In order to become detectable against their background, the signal must be as strong as possible. But the creation of powerful generators in itself is a difficult business, this being particularly true of apparatus for operation under field conditions. Therefore, the methods of electromagnetic sounding until now have been used only for surface investigations of the earth's crust. Now the situation is changing due to the "intrusion" of physicists into the earth sciences field.

Several years ago scientists of the Atomic Energy Institute, Academician Ye. Velikhov, Yu. Volkov and B. D'yakonov, drew attention to the fact that the time for penetration of an electromagnetic field into the thickness of the earth's crust is only several seconds and for investigations of the crust it is possible to make use of powerful pulsed signals. What apparatus can produce them? At that time specialists at the Atomic Energy Institute imeni I. V. Kurchatov were working on magnetohydrodynamic generators which should operate in harness with nuclear reactors. The principle of MHD generators is that with the flow of plasma across a transverse magnetic field a current is generated in it. The idea was born that this machine should be made pulsed and that the earth should be used instead of a load.

The "joining" of the latest direction in power production and geophysics at first glance seemed fantastic, improbable. But as has happened more than once, a new breakthrough into the secrets of nature occurred at the juncture of the sciences; a new tool of knowledge was born.

An analysis indicated that if the flame of powder charges is used as a plasma generator and work is in short impulses without special cooling, it is possible to create quite compact generators. Now it was necessary to design and test a "hybrid" of a powder rocket with a magnet. It was necessary to have an unusual rocket whose flame should be a good conductor of electricity. Soviet chemists have dealt successfully with this problem. The magnet also had to be unusual -- light and powerful. It was decided to use copper coils. In them a discharge of capacitors was used in creating a small magnetic field which was intensified when the powder charge began to burn. The stream of plasma increased the magnetic field and in turn this intensified the current. And the process increased like an avalanche. When the current reached a definite intensity it was registered by electrodes sunk into the earth.

In 1973 a new apparatus created by Soviet scientists, in collaboration with a whole series of industrial organizations, for the first time left the laboratory walls. Field tests began in the Pamirs in the geophysical polygon of the Institute of Physics of the Earth USSR Academy of Sciences. Rocket apparatus became an ordinary part of a seismic observatory. The experiments carried out jointly with specialists of this institute indicated that the new tool of knowledge can be used for the prediction of earthquakes. The conductivity of rocks in the observed earthquake focus begins to change long before the event itself. And strong earthquakes can be predicted two or three or even more months in advance.

The computations of specialists show that 30-50 MHD apparatuses are adequate for covering all the seismically dangerous regions of our country with observations. The most expensive part of such a forecasting system will be the recording network of receivers, components for the transmission of information and its processing. But since the signals from the MHD apparatus are powerful, this network can be made very simple and completely automated, and in addition, the processing of data by means of an electronic computer can facilitate the work. Then, using this new method together with traditional methods, it will be possible to predict in advance the place and time of the future earthquake. And foreseeing the danger is rendering it far less harmful.

MHD apparatuses have equal importance as a tool for learning about the depths of the earth. During the past year in the Urals, in collaboration with the Geophysical Institute of the Ural Scientific Center USSR Academy of Sciences, a more powerful MHD apparatus was tested. The electromagnetic sounding signal generated a current of 40,000 amps flowing in a quadrangular loop with a length of each side of one kilometer! There are 40 tons of aluminum in this loop. The new emitter produced a signal hundreds of thousands of times more powerful than previously existing geophysical apparatuses for electromagnetic sounding. An ordinary automobile engine was used for starting up the MHD apparatus. The signal was stably registered at a distance up to 70 km along the earth's surface and penetrated to a depth greater than 40 km -- the entire thickness of the earth's crust in the Urals.

It was found that there is a decrease in resistivity by a factor of more than 100 at depths of 35-40 km, that is, below the Mohorovicic discontinuity, which in this place is situated at a depth of about 30 km. This result is fundamental. Now it is necessary to clarify whether this is a local phenomenon characteristic for the Urals or whether it is a general pattern.

By measuring conductivity in east-west and north-south directions, investigators discovered a difference. It was found that this is the influence of a deep fault which was not known earlier. Thus, a new method was found for the discovery of deep faults, many of which are in fact "channels" bringing ore-bearing melts from the earth's depths to the surface.

And in this year the physicists carried out a new unique experiment, simply astonishing to the imagination. Ye. Velikhov and Yu. Volkov proposed using the Barents Sea as part of the new "Khibiny" apparatus. A saline sea is a good conductor, enormous, inexpensive. Therefore, the physicists decided to place the MHD apparatus on an isthmus connecting the Sredniy and Rybachiy Peninsulas with the main body of the entire Kola Peninsula and to lower the electrodes into the sea. The current went through the sea water from one electrode to another, bending around the shoreline of the Sredniy and Rybachiy Peninsulas. In order to carry the powerful current from the MHD apparatus it was necessary to lay two cables with a total weight of 160 tons. But on the other hand, now the "loop" generating the sounding signal took in an area of about 5,000 square kilometers! If such an emitting loop was made from aluminum, 7,000 tons would be required.

In order to register signals from this unique emitter and process them, specialists organized a network of observation stations in collaboration with the Institute of Geology and the Polar Geophysical Institute of the Kola Affiliate USSR Academy of Sciences, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Scientific-Production Division "Geofizika" of the USSR Geology Ministry. And their efforts were rewarded. The signals passing through the earth's crust were reliably registered over an enormous area, with probing of virtually all the Kola Peninsula and a great part of Karelia. For geophysicists to be able to obtain the electric characteristics of depths over such enormous areas is the same as for physicians to have x-rays for examining patients. An electromagnetic signal, for example, seemingly "sticks" in ore-bearing bodies and they immediately become "visible."

Soviet scientists and engineers in actuality have already created a whole series of MHD apparatuses from light, compact apparatus which is easily carried on a truck to powerful apparatus capable of immediately investigating territories of hundreds of kilometers in radius and at great depths. Space vehicles enabled geologists to see our earth from above with a single glance and this gives them highly valuable information. Using MHD generators it will be possible to see the depths of the earth, predict their state and more reliably predict deposits.
[93]

Abstracts of Scientific Articles

FREQUENCIES OF CHARACTERISTIC OSCILLATIONS OF EARTH WITH OCEAN

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 9, 1977 pp 3-10

[Article by M. S. Molodenskiy, Institute of Physics of the Earth, "Frequencies of Characteristic Oscillations of the Earth with Ocean"]

[Abstract] On the basis of earlier derived ordinary equations for tides and characteristic oscillations of the earth, with allowance for Coriolis force, the author examines the problem of free or forced oscillations of the earth with the ocean. Tides in the ocean and the characteristic frequencies of its oscillations can be determined from those same equations which are used in describing fluctuations of the earth's fluid core, with the differences that volume compression of matter can be neglected; however, the boundary conditions are stipulated on a surface of extremely complex form. In the simplest case of an ocean of constant depth covering the entire earth a solution is obtained relating depth of the ocean to the frequencies of its free oscillations. A generalizing solution of this problem is set forth in Lamb's "Hydrodynamics" for the case of a rotating earth. The article gives a method for taking into account the elastic downwarping of the earth's surface and it is shown that with an accuracy of the cotidal charts to about 1% this effect can be neglected. For an ocean of variable depth, bounded by a shoreline of complex configuration, an equation is derived determining the amplitudes of the elementary waves making up the tide. From solution of this equation it is possible to obtain the effective depth of the ocean for oscillations determined by a spherical function with the stipulated exponents n and m.
[77]

CHANGES IN MECHANISM OF EARTHQUAKE FOCI

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 9, 1977 pp 29-37

[Article by Ye. I. Shirokova, Institute of Physics of the Earth; "Change in Focal Mechanism of Earthquakes and Their Relationship to 'Rejuvenated' Dislocations in the Middle and Near East"]

[Abstract] The paper gives the results of study of the focal mechanism of 62 earthquakes in the Middle and Near East which occurred during the period from 1964 through 1973. These are compared with the results of an investigation of the mechanism of earthquake foci for events occurring during 1953-1963. It is shown that during these periods of time considerably different mechanisms predominated at the foci. Most of the earthquake foci during the period 1963-1973 were characterized by a predominance of shearing and slipping movements along the planes cutting known dislocations and faults. At the foci of earthquakes occurring during the period 1953-1963 there was a predominance of upthrust-overthrust movements along planes parallel to tectonic lines.
[77]

METHODS FOR SOLVING INVERSE PROBLEM IN SEISMOMETRY

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 9, 1977 pp 38-55

[Article by A. Plesinger, Geophysical Institute, Czechoslovakian Academy of Sciences, "Methods for Solution of the Inverse Problem in Seismometry and the Limits of Their Practical Applicability"]

[Abstract] This paper concisely describes the principles of modern methods for reconstructing the true motion of the soil from standard seismograms and sets forth the merits and shortcomings of individual procedures. All the described methods in essence can also be used for reconstructing the input signals of other linear dynamic systems. On the basis of experience already acquired in the experimental processing of seismograms it can be said that good results from any of the cited methods can be expected in the processing of relatively short wave groups with a clear arrival. A careful choice of the beginning and end of the seismogram is decisive for the result of the reconstruction process. Prior to beginning the reconstruction procedure it is always necessary to exclude from the time series obtained by digital representation of the record both the constant component and the linear trend. It is also important to investigate the properties of the spectrum of this time series, corrected for the frequency characteristic of the seismograph, since this can give an answer to the question of whether it is really possible to reconstruct this signal, and in addition, gives a criterion for the selection of optimum stabilization.
[77]

VARIATIONS OF RADIOISOTOPIC PARAMETERS OF CRUSTAL FAULTS

Moscow IZVESTIYA AN SSSR, FIZIKA ZEMLI in Russian No 9, 1977 pp 56-64

[Article by P. I. Chalov, T. V. Tuzova and V. M. Alekhina, Institute of Physics and Mathematics Kirgiz Academy of Sciences, "Variations of Radioisotopic Parameters of Crustal Faults Over Long Time Intervals and Earthquake Prediction"]

[Abstract] As a result of investigations of temporal variations of radioisotopic and other parameters of waters in crustal faults within the limits of the Northern Tien Shan seismic zone the most important temporal changes have been established for the content of He and in part for Rn and Ra. These variations are unrelated to the peculiarities of formation of the studied waters of faults or their mixing with ground water because synchronous changes in all the parameters for one and the same source are not observed. The noted variations in the content of He and in part Rn can be attributed to temporal changes in the tectonic regime of the investigated seismic zone, as a result of which there can be a change in the permeability of the faults for the entry of deep gases, gas pressure, stressed state of rocks and their continuity. In a special case the concentration of stresses in individual sectors can lead to the appearance of earthquake foci, an example of which is the Kochkorskoye earthquake. The assumption that the temporal variations of the content of He in the waters of faults reflect the tectonic regime is confirmed by changes in this parameter for sources at great distances with different geological and hydrogeological conditions. In this paper it is shown for the first time that the earth's helium field, at least in tectonically active zones, changes significantly not only in space, but also in time, and that these changes can give valuable information for learning about the dynamics and regime of modern processes and the phenomena accompanying them. Since tectonic processes do not always lead to the formation of foci of sensed earthquakes, on the basis of the temporal variations of the He content in fault waters it is impossible to make an unambiguous prediction of these earthquakes within the limits of a seismic zone. Such a prediction in time is most probable when a slow increase in the He content ends (directly before an earthquake) with large brief variations of an impulse character which can be accompanied by variations of this same character for Rn. But the indicated variations, in contrast to long-period variations, are not observed for all, but only for individual sources of fault waters.
[77]

SOLUTION OF THREE-DIMENSIONAL INVERSE PROBLEM IN GRAVIMETRY

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 9, 1977 pp 65-77

[Article by P. I. Balk, Siberian Division Institute of Geochemistry, "On the Theory of the Trial-and-Error Method in Solution of the Three-Dimensional Inverse Problem in Gravimetry"]

[Abstract] In connection with the general problem of defining and describing new classes of possible solutions of the inverse problem in gravimetry the author introduces classes of three-dimensional field sources, unknown in gravimetric prospecting, having good approximation and computation

properties. Using the general concept of an approximation approach to solution of the inverse problem formulated by V. N. Strakhov, as the fundamental idea, within the framework of the introduced classes of field sources the author has constructed a model for the quantitative interpretation of gravity anomalies within the framework of the classical trial-and-error method.
[77]

AN APPROACH TO SOLUTION OF INVERSE PROBLEMS IN GRAVIMETRY

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 236, No 3, 1977 pp 571-574

[Article by V. N. Strakhov, Institute of Physics of the Earth, "An Approach to Solution of Inverse Problems in Gravimetry Based on the Theory of Equivalent Redistributions of Mass"]

[Abstract] The solution of two problems is of great importance for the theory of interpretation of potential fields (gravitational and magnetic anomalies): 1) problems of synthesis, within the framework of the trial-and-error concept, of approaches to solution of the inverse problem, based on the use of geologically meaningful and formal models of sources; 2) problems in synthesis of the concepts of trial-and-error and singularities. Here it is shown that in a class N (class of distributions of masses satisfying definite requirements) an equivalent singular distribution, by means of the method described in this paper, can be transformed into a physically and geologically meaningful volumetric distribution. Specifically, the author assumes that it is known a priori that field sources of the class N with a positive density fall within a finite singly connected volume V_0 with the boundary ∂V_0 which is assumed to be quite regular. Then, on the basis of the external field (on the basis of the stipulated potential $U(x)$) it is possible to make an unambiguous reconstruction of the equivalent simple layer on ∂V_0, and from it some equivalent volumetric distribution having the required smoothness. The possibility and methods for constructing such a distribution follow from the results of earlier studies (V. N. Strakhov, DAN, Vol 236, No 2, 1977; Vol 236, No 1, 1977; Vol 235, No 6, 1977.)
[64]

USE OF POINCARE METHOD IN SOLVING GRAVIMETRIC PROBLEMS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 236, No 1, 1977 pp 54-57

[Article by V. N. Strakhov, Institute of Physics of the Earth, "The Poincare Balayage Method and its Use in Solving Direct and Inverse Problems in Gravimetry"]

[Abstract] During recent years it has become increasingly clear that the Poincaré balayage method (that is, the construction of an equivalent (with respect to the external field) simple layer on a stipulated surface can serve as an important tool in solving direct and inverse problems in gravimetry, at least ore gravimetry. One of the basic ideas is to construct on the surface ∂V_0 a volume V_0 which is known to contain anomalous masses in a volume v equivalent (with respect to the external field) to a simple layer. Whereas in a general solution of the problem it is necessary to be able to construct an equivalent simple layer on a given surface, in the latter case it is necessary to be able to construct a simple layer on ∂V for stipulated (model) distributions of mass within V. In this paper the author proposes a fundamentally new approach based on an examination of the process of redistribution of masses with time. It is shown that there are processes of redistribution of mass within a region which do not change the external field. Within the light of results obtained earlier by the author (DAN, Vol 235, No 6, 1977) it is clear that effective numerical methods, such as the finite-differences method, can be used in solving the problem. [65]

PREDICTION OF ZONES OF PETROLEUM ACCUMULATION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 236, No 1, 1977 pp 172-175

[Article by V. I. Vityaz' and V. V. Bogatskiy, "Krasnoyarskneftegazrazvedka" Trust and Krasnoyarsk Division, Siberian Scientific Research Institute of Geology, Geophysics and Mineral Raw Material, "Telecosmic Information as a Possible Basis for Predicting Zones of Petroleum Accumulation (in the Example of Western Siberia)"]

[Abstract] An attempt was made to clarify the patterns of spatial distribution of petroleum and gas structures relative to disjunctive systems in the example of Western Siberia. The point of departure was a map of disjunctive dislocations for the West Siberian Platform and adjacent territories compiled on the basis of television photographs. The spatial-statistical method was used in investigating the distribution of the extent of disjunctive dislocations and a map of their density was compiled. These materials were compared both with data on disjunctive dislocations detected by other methods and with a map of prediction of petroleum and gas deposits and also with a map of the density of distribution of petroleum and gas deposits. The comparison revealed that the extent of the disjunctive dislocations detected on the TV photographs exceeds by a factor of 5-6 the extent of the dislocations detected by ground work -- by a geological survey and by geophysical methods. The distribution of the frequency of occurrence of dislocations in extent is close to exponential, but polymodal. The basic mode is for the maximum of dislocations (29%), corresponding to an extent of 50 km. For Western Siberia and adjacent regions there are three groups of

dislocations: 5-30, 30-230 and 230-1,130 km (local, regional and interregional). Small dislocations are identified by a ground survey, large dislocations from TV photographs and intermediate ones by either method. Among the findings was that submeridional zones of petroleum and gas accumulation are spatially distributed along the western margin of each of the submeridional zones of increased density of dislocations. Zones characterized primarily by gas accumulation coincide spatially with areas of a low density of dislocations. It is surmised that the areas of maximum density of dislocations, that is, more than 80 m/min^2 (on the map) have poor prospects for the detection of new commercially important zones of petroleum and gas accumulation. In areas where the density of local dislocations exceeds some optimum there is a low probability of detecting large gas deposits, although petroleum deposits can be found in such areas.
[65]

CONVECTIVE INSTABILITY OF INHOMOGENEOUS MODELS OF EARTH'S MANTLE

Moscow IZVESTIYA AN SSSR, FIZIKA ZEMLI in Russian No 9, 1977 pp 99-101

[Article by B. I. Virger and S. G. Shlesberg, Institute of Physics of the Earth, "Convective Instability of Multilayer Inhomogeneous Models of the Earth's Mantle"]

[Abstract] In an earlier paper (IZV. AN SSSR, FIZIKA ZEMLI, No 6, 1977) the authors solved the problem of the influence of inhomogeneity of viscosity on convective instability of the earth's mantle, modeled as a horizontal layer of incompressible fluid heated from below. The real dependence of viscosity on depth was approximated in the form of a piecewise-homogeneous function and this made it possible to break down the mantle into N homogeneous layers. The solution algorithm presented in the earlier study is shown, in this new paper, to be easily generalized for a case when all the physical parameters of the mantle are inhomogeneous in depth and have internal heat sources. A specific example of use of the algorithm is given for solution of such a problem.
[77]

GEOPHYSICAL INVESTIGATIONS IN KAZAKHSTAN

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR. SERIYA GEOLOGICHESKAYA in Russian No 5, 1977 pp 27-35

[Article by D. A. Al'mukhanbetov, A. N. Antonenko, I. P. Benevolenskiy and V. M. Pilifosov, Institute of Geological Sciences Academy of Sciences Kazakh SSR, "Geophysical Investigations in Kazakhstan"]

[Abstract] This article sets forth the principal results and a method for the geophysical investigations carried out by the Institute of Geological Sciences imeni K. I. Satpayev from the beginning of the 1950's to the present time. The authors give the basic results of geophysical work carried out by other geophysical organizations. The paper gives new, generalized data on the deep structure of the earth's crust in Kazakhstan, obtained on the basis of a complex geological-geophysical interpretation of materials from deep seismic sounding, the method of spatial seismic soundings with explosive shots, the method of earthquake exchange waves, gravimetry and magnetotelluric sounding. The problems involved in the methods of ore and petroleum geophysics are examined and directions for further geophysical investigations are mentioned.
[87]

CONFERENCE ON PROBLEM "EARTH'S TECTONOSPHERE"

Moscow SOVETSKAYA GEOLOGIYA in Russian No 9, 1977 pp 140-142

[Article by B. A. Borisov, Institute of Physics of the Earth, and Yu. P. Vidyapin, Scientific Council on Complex Investigation of the Earth's Crust, "Conference on Problem 'Earth's Tectonosphere'"]

[Abstract] A conference of the Scientific Council on Complex Investigations of the Earth's Crust and Upper Mantle on the problem "Earth's Tectonosphere" was held during the period 29 November-1 December 1976 at the Institute of Physics of the Earth. It was attended by about 250 specialists from 22 scientific institutions. The chairman of the Council, V. V. Belousov, Corresponding Member USSR Academy of Sciences, informed the conferees on the course of work on publication of the three-volume monograph TEKTONOSFERA ZEMLI (Earth's Tectonosphere), prepared by the scientific council. This monograph will incorporate the content of many of the reports presented at the conference. Twelve reports were presented, among them the following. V. A. Magnitskiy, in a report entitled "The Earth's Tectonosphere. Status of Problem, Hypotheses of Structure and Development, Prospects for Development of the Problem," discussed important methodological problems associated with the fact that the earth sciences have accumulated and continue to accumulate facts seemingly evidence in support of different competing hypotheses. In actuality, this indicates the imperfection of these concepts and also that a generalizing theory of the earth's development must be formulated which will explain all the facts. V. V. Belousov, in a report entitled "Fundamental Laws of the Geological Development of the Tectonosphere," spoke of a planetary system of zones of diastrophism having meridional, latitudinal or diagonal (NE, NW) strike. It has been established that it existed and developed regularly over the course of all geological history. This has been demonstrated in the example of the strike of folded systems arising in the Proterozoic and Early Phanerozoic. The moving forces

responsible for this regular development for the time being have not been investigated adequately, but the very fact of such development is unquestionable. One of the corollaries following from this fact is that it is impossible for large blocks in the earth's crust to move. A. B. Ronov and A. A. Yaroshevskiy gave a paper on "The Principal Laws of Evolution and Composition of Matter in the Tectonosphere." New data were presented forcing a change in our ideas concerning the composition of the earth's crust and its evolution. The report mentioned the heterogeneity of the crust in oceanic regions, on subcontinents and continents. The authors feel that the "basaltic" layer of the crust has a complex, but nonetheless in general a basic character. The origin of the enormous quantity of calcite in upper crustal rocks is a still unsolved problem. Available data on the chemical composition of the crust indicate its directed, not cyclic development. Other reports included: N. L. Dobrentsov -- "Metamorphism and its Relationship to Other Geological Processes"; B. G. Lutts -- "Mineralogical Nature of the Asthenospheric Layer Under Ancient Platforms"; M. Ye. Artem'yev -- "Density Inhomogeneities in the Mantle Under the System of Island Arcs and Marginal Seas"; D. M. Pecherskiy -- "Characteristics of Basaltic Magmatism of the Continents and Oceans According to Magnetic Data and a Model of the Magnetically Active Layer of the Ocean Crust"; N. A. Belyayevskiy, et al. -- "New Seismic Data on Structure of the Earth's Crust of the Continents and Oceans"; L. P. Vinnik -- "Seismic Investigations of the Mantle"; Ye. A. Lyubimova -- "Heat Flows from the Earth's Crust and Mantle"; M. P. Volarovich -- "Elastic, Electric and Deformational-Strength Properties of Rocks and Minerals in Cases of High Thermodynamic Parameters"; E. B. Nalivkina -- "Geological Results of the First Stage in Drilling of the Superdeep Kola Borehole."
[85]

REGISTRY OF POLARIZATION POTENTIALS IN BOREHOLE ASSOCIATED WITH EARTHQUAKES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 236, No 5, 1977 pp 1102-1104

[Article by I. A. Musayev, Geology Institute, Dagestan Affiliate USSR Academy of Sciences, "Registry of Intrinsic Polarization Potentials in Borehole Associated with Earthquake and the Nature of the Earth's Natural Electric Field"]

[Abstract] Continuous observations of intrinsic polarization potentials in a borehole in the epicentral zone were initiated immediately after the Dagestan earthquake of 1975. This was for the purpose of possible detection of changes in polarization correlated with seismic tremors. The basis for the mechanism of appearance of electric potentials in the earth's crust, correlating with mechanical stresses, is electrokinetic phenomena in capillary-porous systems, in rocks. The gradients of pressure and temperature existing in the earth's crust, causing the motion of underground

fluids through a capillary-porous medium, generate gradients of the electric fields and the concentration of dissolved substances. The nature of the natural electric field can be examined from the point of view of the thermodynamics of irreversible processes. There is shown to be a functional relationship between the electric field, heat flow and the field of concentration and their joint study can find extensive practical use in the search for deposits of petroleum, gas, water, etc. The assumption can be made that the reason for absence of an appreciable electric (and possibly magnetic) field on the planets is the absence of fluid, especially water, on these planets.
[81]

V. UPPER ATMOSPHERE AND SPACE RESEARCH

News

MODEL OF EARTH'S ATMOSPHERE DEVELOPED BY ESTONIAN SCIENTISTS

Moscow PRAVDA in Russian 16 Nov 77 p 1

[TASS Report: "A Model of the Atmosphere"]

[Text] Tallin. A mathematical model of the atmosphere of our planet has been formulated as a result of joint observations from space and from the earth's surface. The observations were made by the crew of the "Salyut-4" orbital scientific station and by Estonian scientist-astrophysicists, who have been awarded the prize of Soviet Estonia for this research.

For many years specialists of the Estonian Academy of Sciences' Institute of Astrophysics and Atmospheric Physics have studied the nature of noctilucent clouds -- one of the components of the upper atmosphere. They set forth the hypothesis that these clouds, which are situated at an altitude of 80-100 kilometers above the earth, are formed as a result of ice formation around cosmic dust. Studies by cosmonauts G. Grechko, A. Gubarev, P. Klimuk and V. Sevast'yanov on board the "Salyut-4" station have confirmed the astrophysicists' conjecture. Having compiled the data from ground and space observations, specialists defined the physical structure of noctilucent clouds and their optical properties. The results of the research will find extensive application in the national economy. [5]

AVDUYEVSKIY STRESSES PRACTICAL APPLICATION OF SPACE RESEARCH

Moscow NEDELYA in Russian No 42, 17-23 Oct 77 p 16

[Article by V. Avduyevskiy, "The Motto is Utilization"]

[Text] The 23d International Astronautical Congress was held under the motto "Use of Space Today and Tomorrow." Cosmonautics is characterized by advance from purely research flights into space to its ever-more intensive

utilization. Only twenty years ago the first artificial satellite took off and now hundreds of them are in space simultaneously. Now the meteorological service of any country is unthinkable without the use of space information. Now, in essence, a world weather service has been created and makes use of meteorological satellites. It will be developed and will be used not only for meteorological purposes, but also for investigation of natural resources. Information from the experimental satellite "Meteor-Nature," launched last summer, is regularly transmitted for the practical use of the Ministries of Geology, Agriculture, Fishing, the Academy of Sciences and other departments. There has also been a strengthening of development of methods for the remote sounding of the earth's surface in the interests of the national economy from aboard manned spaceships and "Salyut" orbital stations. In the immediate future they will emerge from the experimental stage and will become an everyday working tool.

The Soviet communication satellites "Molniya" have been used for ten years now for the transmission of television programs of Central Television to regions of Siberia, the Far East, Central Asia, the northern European part of the country and for telephonic and telegraphic communication with them. Scientists have begun experimental operation of geostationary satellites of the "Ekran" type which make it possible to receive transmissions on rather simple and inexpensive collectively used antennas and relay programs of Central Television to small villages. The "Ekran" communications satellite seemingly hovers over the Indian Ocean, revolving synchronously with the earth at an altitude of about 36,000 km. It ensures relaying over approximately half the territory of the Soviet Union. This type of satellite makes it possible far more rapidly and cheaply to give television service to regions with a low population than by means of radio relay lines and "Orbita" stations.

Space itself is now beginning to interest scientists not only as an object of investigations, but also as a special medium where it is possible to organize technological processes impossible under terrestrial conditions. In the future the absence of gravitation and a deep vacuum will make it possible to organize in orbit the economically advantageous production of a whole series of particularly pure materials for electronics, medicine and other branches.

The beginning of the third decade of the space era will be characterized not only by the turning to solution of practical problems, but also an intensification of attention to the economic aspects of the mastery of space, the aspiration to extract from each space vehicle the maximum advantage and to create it with minimum expenditures. During the first decades it was possible to carry out such prestige programs as the "Apollo" program, which cost the United States 25 billion dollars. At present it is difficult to visualize that any country would decide on an experiment of this sort. In my opinion, cheaper space systems will now be created which will be repairable and have an extremely long lifetime, etc.

Evidently, the rocket engines will also change. Now rockets carry both fuel and oxidizer, although they fly upward through the atmosphere, where there is plenty of oxygen. It is desirable to use it as an oxidizer for rocket fuel. This will give a substantial saving.

The conditions for putting space vehicles into orbit are becoming less rigorous and this will make possible to use for work on orbital stations not only cosmonauts, but also narrow specialists with high skills -- astronomers, biologists, geologists, etc. This is extremely important and can considerably intensify the development of such directions, for example, as exoatmospheric astronomy. Emergence into space has made it possible to observe the universe in pure form, without such interference as is introduced by the earth's atmosphere. Therefore, exoatmospheric astronomy has exceptionally great importance. Weightlessness conditions will make it possible to create large telescopes and radio telescopes in space which have very high characteristics. This would make it possible to proceed to a detailed investigation of the unbounded star ocean in which we live together with our planet.

We should understand thoroughly how our earth developed and what awaits it in the future. For two decades in the space era it was possible to make the first scanning of the Moon, Venus, Mars and Mercury and begin investigations of distant planets by space vehicles. This produced a real revolution in our concepts of the solar system and gave rise to the main question: why did ideal conditions appear on the earth for the origin of life? For the time being it is unclear why Venus became a red-hot planet, whereas Mars, on the other hand, is too cold and is almost without an atmosphere and moisture. It is unclear when this occurred. Therefore, in the third decade there will be a detailed investigation of planets of the earth group.

The giant planets -- Jupiter, Saturn and Uranus -- are of great interest for science. These are fundamentally different from ours. The technical difficulties for creating automatic probes for exploring the giant planets are extremely large but not insuperable. The joining of the efforts of specialists in different countries would make it possible to create them.

International cooperation in the mastery of space during the third decade will undoubtedly be intensified. The international division of labor, use of the strongest resources of the partners and involvement of the scientific and technical potential of the small countries will considerably increase the effectiveness of space research and will be advantageous to all. This is clearly indicated, for example, by the many years of experience on work under the "Interkosmos" program, combining the efforts of the socialist countries in the mastery of space.
[79]

Abstracts of Scientific Articles

INTERPRETATION OF MEASUREMENTS OF SCATTERED RADIATION IN VENUSIAN CLOUDS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 5, 1977 pp 768-775

[Article by Ye. A. Ustinov, "Inverse Problem in Multiple Scattering Theory and Interpretation of Measurements of Scattered Radiation in Venusian Clouds"]

[Abstract] A method has been developed for solving the inverse problem of multiple scattering, applicable for inversion of the results of direct measurements of the intensity of scattered radiation in optically thick inhomogeneous planetary atmospheres. The use of this method for the processing of the results of measurements in the Venusian atmosphere made it possible to obtain the characteristics of atmospheric scattering, determining the regime of radiation transfer, and to discriminate from them the characteristics of scattering of the cloud layers. The use of the results of surface polarimetry made it possible to determine the coefficient of extinction and concentration of aerosol particles in the upper cloud layer, which at an altitude of 60 km constitute $1.6 \cdot 10^{-5}$ cm^{-1} and $2.4 \cdot 10^{2}$ cm^{-3} respectively. Confirmation was obtained of the existence of a lower cloud layer with a base at 20 km. Comparison with the results of direct nephelometric measurements in the Venusian atmosphere below 50 km makes it possible to obtain estimates of the extinction coefficient and the anisotropy parameter of the scattering function for the lower cloud layer -- $(0.3\text{-}1) \cdot 10^{-6}$ cm^{-1} and 0.5-1.5 respectively.
[82]

PROFILE OF WATER VAPOR CONCENTRATION ON MARS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 5, 1977 pp 776-780

[Article by V. A. Krasnopol'skiy and V. A. Parshev, "Vertical Profile of the Water Vapor Concentration on Mars"]

[Abstract] For different values of the coefficient of turbulent diffusion K the authors have solved the problem of mixing of water vapor in the lower atmosphere of Mars under conditions when condensation and adsorption occur more than half of the day at the planetary surface. The water vapor distribution can be represented by two components: the first, characterizing uniform mixing in the atmosphere up to the condensation level, the second, characterizing the excess quantity of water in the surface region of the atmosphere. The results of observations agree well with computations when $K = 3 \cdot 10^6$ cm^2/sec. In the morning hours only 45% of all the water is in the gas phase and the remainder is condensed on the surface (or is adsorbed by the surface) and in two aerosol layers, one of which is situated in the immediate neighborhood of the surface, the second -- at an altitude of more than 20 km. In the afternoon hours almost all the considered quantities of water pass into the gas phase and the determined vertical distributions of concentrations agree with the effective temperature of water vapor 225°K. Only about half of all the atmospheric water is in the surface layer.
[82]

DIFFUSE AURORAL ZONE ANALYZED

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 5, 1977 pp 708-724

[Article by V. L. Khalipov, Yu. I. Gal'perin, Yu. V. Lisakov, Zh. Kran'ye, L. M. Nikolayenko, V. M. Sinitsyn and Zh.-A. Sovo, "Diffuse Auroral Zone. II. Formation and Dynamics of the Polar Edge of the Subauroral Ionospheric 'Dip' in the Evening Sector"]

[Abstract] A complex experiment was carried out for investigating the polar edge of the main ionospheric 'dip' making use of a meridional chain of ionospheric stations with the addition of antennas for slant sounding from two subauroral stations (Yakutsk, invariant latitude $\Lambda_0 = 55°8$ and Batagay, $\Lambda_0 = 62°1$) and simultaneous measurements of auroral particles of the diffuse zone of injection in a broad range of energies from the satellite "Oreol-2." It was established that there is a quantitative and spatial correspondence between the ionization jump at the polar edge of the dip and ionization of the F-layer by soft electrons with energies 0.2-2 keV by a diffuse zone of particles injected on the inner boundary of the plasma layer at the time of a substorm. The lifetime of the additional ionization after the isolated burst of a substorm is 1-3 hours; there is a decrease in the ionization level at the edge of the diffuse zone and within it, with slow displacement of the ionization boundary at the edge of the diffuse zone and within it. Under these conditions the slow displacement of the ionization boundary toward the equator is due to the diurnal rotation of the station under the almost fixed (in the coordinates Λ_0 - MLT) structure of the plasma layer and its projection onto the ionosphere. During prolonged intensive disturbances the boundary of ionization by soft

electrons drops down to the subauroral latitudes $\Lambda_0 \leqslant 60°$. When the slant backscattering station is situated near the center of the dip ($\Lambda_0 \sim 60°$) the discrimination of critical slant reflections from the "ionization wall" at the polar edge of the dip is considerably simplified and this makes it possible to carry out its virtually continuous registry.
[82]

SPECIAL CASE OF FLIGHT BETWEEN COPLANAR ELLIPTICAL ORBITS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 5, 1977 pp 668-676

[Article by R. F. Appazov and V. I. Ogarkov, "Investigation of Optimum Flight With an Angular Distance 180° Between Coplanar Elliptical Orbits"]

[Abstract] An analytical study was made of optimum flight with an angular distance of 180° between coplanar elliptical orbits. It is shown that the magnitudes of the impulses are found using final formulas and the determination of the points of imparting of the impulses essentially involves solution of one of two transcendental equations. The choice of the type of equation is dependent on the relative position of the orbits and each equation has four roots related to the extrema of the total impulse. The derived transcendental equations are reduced to algebraic equations of the eighth degree. The authors give a comparative evaluation of the considered and absolutely optimum two-impulse flight and it was established that they are close with respect to the points of imparting of the impulses and their magnitudes. Therefore, the solution of this problem can be used both independently and as an initial approximation in seeking an absolutely optimum flight.
[82]

STRONG INTERACTION BETWEEN MARTIAN SATELLITE AND SOLAR WIND

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 5, 1977 pp 741-746

[Article by A. V. Bogdanov, "Some Evidence of the Possibility of Strong Interaction Between the Martian Satellite Deimos and the Solar Wind"]

[Abstract] In this paper it is demonstrated that within the framework of models of interaction between the solar wind and Mars it is not possible to find a satisfactory explanation of the perturbations of the characteristics of plasma registered by the "Mars-5" station between 1918 and 2018 hours on 15 February 1974. The relative positioning of Deimos and the "Mars-5" at the time of the perturbation satisfies the condition of corpuscular shading of the "Mars-5" by Deimos. Therefore, as an explanation of this

phenomenon the author advances the hypothesis of a strong interaction between the Martian satellite Deimos and the solar wind. Some characteristics of plasma in the Martian magnetosphere at the time of the perturbation observed on 15 February 1974 also indicate its possible shading by the corpuscular shadow of Deimos. Two factors are examined as possible reasons for the formation of the corpuscular shadow: a) strong gas release from the surface of Deimos and formation of a cometary type gas envelope; b) existence of a remanent magnetic field with a strength of about 1 gauss at the surface of Deimos.
[82]

SPECIAL CASE OF ELLIPTICAL THREE-BODY PROBLEM

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 5, 1977 pp 646-657

[Article by V. G. Demin and M. V. Kurchanova, "Numerical Investigation of Periodic Orbits in the Restricted Simplified Averaged Elliptical Three-Body Problem"]

[Abstract] A study was made of the plane restricted elliptical three-body problem, averaged by the N. F. Reyn method (DOKL. AN SSSR, 19, 1938). The point transformations method was used in studying simple and double periodic orbits of the averaged problem for the earth-moon-satellite system. The paper is organized as follows: 1. Differential Equations of Motion of Plane Averaged Elliptical Three-Body Problem. 2. Differential Equations of Motion in Simplified Problem. 3. Fixed Point Method as a Means for Detecting Periodic Orbits. 4. Classes of Simple Periodic Orbits Generated by Libration Points. 5. Internal Classes of Simple Periodic Symmetrical Orbits. 6. External Classes of Simple Periodic Symmetric Orbits.
[82]

GYRODAMPING OF NUTATIONAL OSCILLATIONS OF SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 5, 1977 pp 677-682

[Article by S. A. Mirer, "Optimum Gyrodamping of Nutational Oscillations of Satellite Stabilized by Rotation"]

[Abstract] A study is made of a satellite stabilized by rotation. In such a system of orientation it is necessary to have a device capable of extinguishing the nutational oscillations of a satellite which arise due to errors in the rotational system and also under the influence of external perturbations (for example, collisions with micrometeorites). One gyroscope with two degrees of freedom can be used as the damper of nutational

oscillations. This gyroscope is connected to the satellite skin by means of a viscoelastic suspension. In the study emphasis is on determination of such values of parameters of the satellite and gyroscope which will ensure the most speedy possible attenuation of the characteristic oscillations of the system. Use of the results of a study by V. A. Sarychev and V. V. Sazonov (KOSMICH. ISSLED., 14, No 2, 198, 1976) will make it possible to carry out a full analytical solution of this problem.
[82]

VI. MISCELLANEOUS

News

RESEARCH VESSEL "BASHKIRIYA" BEGINS ANTARCTIC EXPEDITION

Moscow PRAVDA in Russian 9 Nov 77 p 6

[Article by V. Bardin, "Voyage to the Antarctic"]

[Text] The steamer "Bashkiriya" has departed from its wharf in the port of Odessa for the shores of distant Antarctica. This is already the third vessel of the 23d Soviet Antarctic expedition which has headed for south polar waters. Not long before this the diesel-electric "Kapitan Kondrat'yev" and the scientific research vessel "Professor Zubov" left the port of Leningrad. After the holidays the diesel-electric "Amguema" will sail southward and a month later, the expeditionary ship "Mikhail Somov." Last, but after the New Year, the passenger liner "Estoniya" will head for the shores of Antarctica.

The "Bashkiriya" carries the most numerous group of researchers, 290 men headed by the chief of the 23d Soviet Antarctic Expedition, the experienced polar specialist V. Serdyukov. For the captain of the "Bashkiriya," S. Rodin, the distant voyage to the south polar latitudes also will not be the first; during the past year he already went to Antarctica as a senior assistant.

Whereas it is the task of the passenger ships to carry the personnel of the expedition to the polar stations, the other ships must, in addition, carry out an extensive complex of investigations in the southern ocean. The voyages of the "Professor Zubov" and "Mikhail Somov" are particularly interesting in this respect. The first vessel will continue work under the international program "POLEKS-YuG" (POLEX). Scientists in different fields of specialization -- meteorologists, hydrologists, biologists, will carry out complex investigations of the Scotia Sea. This voyage is being directed by Candidate of Geographical Sciences N. Smirnov. Another vessel, the "Mikhail Somov," will carry out investigations in the Davis Sea near the barrier of the Shackleton Shelf Ice. Parallel with investigations from

aboard the ship, provision is made for carrying out through drilling of the shelf ice.

As soon as the new detachment of Soviet polar workers lands on the sixth continent, extensive summer field work will begin there. As in the past year, the most extensive complex of field work will be carried out in the neighborhood of the seasonal base Druzhnaya on the Filchner Shelf Ice and the Ronne Shelf Ice in the Shackleton and Pensacola Mountains. A large group of researchers will work there: cartographers, geophysicists and geologists. Most of this territory is covered by a glacial cover. Scientists are faced with a complex problem: glancing beneath the thick ice layer and obtaining some idea concerning its geological structure. The work at Druzhnaya is headed by the geophysicist V. Masolov.

In another region of Antarctica, to the south and southeast of Mirnyy, the paths of sledge-tractor trains of geophysicists and glaciologists will be run across the ice plateau. The investigations under the international glaciological program, which will be carried out on these treks, will enrich science with new information concerning the feeding, heat regime, and internal structure of the world's most majestic glacial formation.

In addition to purely scientific research, the new expedition will be faced with many economic concerns, especially with respect to the sound structure of polar settlements. This year work will continue on reconstruction of the quarters for Antarctic villages. A particularly great volume of construction work is to be done at Novolazarevskaya station. Six new buildings will be erected there on pile foundations. The reconstruction of Vostok station is ending. December of this year will mark the twentieth anniversary of the founding of this highly famed settlement at the cold pole of our planet.

Soviet scientists are carrying out work in Antarctica in close collaboration with foreign researchers. Representatives of a number of countries are participating on our expedition this time as well. A particularly large group, 12 men, is from the German Democratic Republic. Six of them will spend the winter at Novolazarevskaya. The joint efforts of polar specialists of many countries are directed to a noble task -- scientific mastery of the most severe region on our planet.
[80]

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