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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS  
 GEOPHYSICS, ASTRONOMY AND SPACE

No. 406

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

### Abstracts of Scientific Articles

#### UV OBSERVATIONS OF SOLAR FLARE HEATING

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 3, No 7, 1977 pp 315-318

[Article by S. I. Syrovatskiy and O. P. Shmeleva, Physics Institute and Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "Impulsive Solar Flare Heating Determined from UV Observations"]

[Abstract] Theoretical computations of heating of the chromosphere at the time of solar flares for two regimes: impulsive (constant concentration) and prolonged (constant pressure), carried out earlier by the authors (Syrovatskiy and Shmeleva, SOLAR TERRESTRIAL RELATIONS, Proc. Conf. in Calgary, Alberta, Canada, p 243, 1972; Shmeleva and Syrovatskiy, SOLAR PHYS., 33, p 341, 1973) are compared with data from ultraviolet observations of flares. It was found that the dependence of the emission measure for an "average" subflare on temperature in the region  $T > 10^5 K$  agrees with a model of impulsive heating. The purpose of this communication was to draw attention to the possibility of determining the dynamic state of flare plasma from ultraviolet observations and to encourage such observations and their analysis.

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#### SOLUTION OF THREE-BODY PROBLEM EXPLICITLY DEPENDENT ON TIME

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 3, No 7, 1977 pp 330-332

[Article by T. A. Tolmacheva, Moscow Automobile Highway Institute, "Use of an Electronic Computer in Solving the Three-Body Problem Explicitly Dependent on Time"]

[Abstract] A solution of the plane circular restricted three-body problem in a numerical-analytical form is described. The solution is based on methods proposed by T. A. Tolmacheva (PIS'MA V AZh, 1, No 5, 34, 1975) and by Yu. A.

Ryabov and T. A. Tolmacheva, PIS'MA V AZh, 1, No 11, 42, 1975) in which it was shown that a solution can be obtained which is expressed through longitude  $\theta$  and that thus it is possible to obtain the sought-for orbital elements as implicit functions of time. But here it is now shown that it is possible to derive an explicit dependence of longitude on time. The problem is solved by simple iterations on an electronic computer. Five iterations were required for finding a solution with the required accuracy.  
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## II. OCEANOGRAPHY

### News

#### REPORT ON "PAYSIS" EXPEDITION ON LAKE BAYKAL

Moscow IZVESTIYA in Russian 18 Aug 77 p 6

[Article by A. Malinov and M. Rostarchuk, "Assault on the Bottom of Lake Baykal"]

[Text] When the hydronauts, with a smile on their weary faces, still showing traces of stress and strain, one after another began to climb from the hatch of the submarine, they were greeted by the loud pops of opening of bottles of champagne. A record has been set: for the first time man has visited the bottom of Baykal at a depth of 1,410 meters.

We remind the reader that already for more than a month a complex expedition has been working on Lake Baykal. It involves several scientific institutes of the Siberian Division and the Institute of Oceanology of the USSR Academy of Sciences. The objective of this expedition is as follows: scientists are attempting to find clues to the origin, present-day development and future of the Baykal fault using the most modern instruments. According to the latest points of view, the Baykal fault in the earth's crust may be similar to the gigantic fissures which extend along the floor of the ocean. These so-called rift zones are frequently boundary regions, the contacts between enormous lithospheric plates into which the earth's upper layer is evidently divided. There are seven or eight such plates. It is postulated that they move relative to one another and the rift zones are the zones of movement.

Some of these world rift zones have seemingly grown old and frozen, and have died out, others are growing, developing, while still others are still being generated. Quite extensive scientific data have been collected concerning the oceanic rifts.

This makes it possible to look differently at the Baykal fault which cuts across the "ancient cradle" of the Asian continent. The hypothesis can be formulated quite paradoxically: if Baykal is actually a young, developing

rift zone, a crust of an oceanic type is forming on its bottom and with time (geological time, of course, that is, after tens of millions of years) will be a part of the world ocean.

Therefore, the conclusion can be drawn that if scientists can find new facts casting light on the history of formation and development of the deepest lake on our planet, a major contribution will be made to the modern theory of the structure of the earth. And if it is recalled that some of the deposits of Siberian petroleum discovered not so long ago were associated with "dead" faults filled with sedimentary rocks, one can understand the intensive and definite practical interest in the origin of Baykal.

A white steamer churns through the waters of Lake Baykal. The scientific research ship of the Limnological Institute Siberian Department USSR Academy of Sciences, the "Vereshchagin," has made runs and tracks over the extensive 600-km lake surface -- first parallel, then intersecting, running first from north to south and then from west to east. When a "white torpedo" was lowered from aboard the "Vereshchagin," it seemed that the ship was being pursued by a white shark which is unknown in the local waters. But in the housing of the shark was a very fine, if not one of the finest magnetometers, an instrument for measuring the magnetic field created by bottom rocks. The researchers hunted for the wild "animal" -- a magnetic anomaly characteristic of rift zones. Here we have a red barrel which has been lowered over the side of the ship. It is called a "pneumogun." Shooting, that is, generating a powerful pulse of acoustic waves, it makes it possible to sound a stratum of bottom sediments, to see how these layers lie.

Listvenichnoye village. This is the base of the expedition. At one of the T-shaped wooden piers there is a barge which carries two underwater vehicles.

Today there are guests in the "hall," as they facetiously call one of the rooms in the local boarding school. People have come from Moscow to become familiarized with the first results of the expedition. These include the Director of the Institute of Oceanology, Corresponding Member USSR Academy of Sciences A. S. Monin. Diagrams, maps, graphs and rolls of tape from echo sounding instruments are on the walls, on the table, in piles on cots, mostly on drafting paper. Speakers took turns: the geophysicist Anatoliy Shreyder used eloquent gesticulations, then came the geomorphologist Natal'ya Marova and the geologist Georgiy Valyashko.

So what is new on Baykal as far as the geophysicists are concerned? For the first time they have obtained reliable data on the thickness of the new compacted sedimentary rocks accumulating in the 2-20 million years of existence of the lake: they attain two kilometers. For the first time it was possible to obtain the picture of the latest dynamic changes in sedimentary rocks. A linear magnetic anomaly was discovered extending parallel to the edge of the Baykal fault.

The epithet "for the first time" could be used more than once. But we will not go into the details of the question but we will point out that in the opinion of the members of the expedition there is basis to say on a preliminary basis that: the Baykal fault, evidently, is experiencing the very initial stage of development, the "preprocess" of its formation as a rift.

After the first submergence everyone awaited the floating up of the "Paysis" with special impatience. Our helicopter hovered over the postulated location of the boat. Now we see the red conning tower and finally the "Paysis" gently rocks on the surface of Lake Baykal.

This record descent was preceded by training descents in the Black Sea and working dives to 800 m here in Lake Baykal.

There were three persons in the submarine in the first dive: the crew commander, deputy chief of the expedition A. Podrazhanskiy, second pilot of the underwater craft A. Sagalevich, both Candidates of Science, and the observer N. Rezenkov -- a professional diver of the Limnological Institute.

Receiving the "OK," the "Paysis-11" began its descent. Communication was stable and everything went in accordance with the plan. At a depth of a kilometer the commander reported: "We have stopped. We have checked the system. All is normal. We are continuing the descent."

Somewhat later Podrazhanskiy handed the controls over to Sagalevich. Suddenly Aleksandr felt how cold water was pouring on him somewhere from above.

"Quiet, it seems that we are leaking," he said aloud, and looking upward, actually saw how a stream of water poured from the instrument panel. The phrase from Aleksandr was like a command for Sagalevich. He more automatically than thoughtfully activated the pump for evacuating water from the ballast tank...

For a second there was silence, listening to the operation of the pump. Then they began to take the instrument panel apart -- it was important to find out where the leak was from. And as soon as it was found that the gasket for one of the cables was leaking, he reported "We have a leak aboard, we are going up."

Later Aleksandr stated: "For purely psychological reasons we first of all wanted to determine the quantity of water entering. The only thing which could be used for measuring was a Pepsi Cola bottle; we had to drink it down first. It was found that the bottle fills up in two minutes. The distance to the surface grew smaller. As we rose we became calmer. Even in the worst case we did not take on so much water that it would exceed our buoyancy reserve."

The gasket was repaired and the crew again descended into the waters of Lake Baykal.

We sit in the pilot house of the barge which carries the "Paysis" submarines and look at a videorecord made during the 17 submergences of these underwater vehicles. We, together with the submarine crew, are again making a striking journey to the bottom of Baykal. Here is a completely even sector covered by a gray-yellow silt; the depth here is more than a kilometer. Slowly, leaving a ribbed trail behind it, swims a planarian and crayfish race from place to place, made restless by the approach of the "Paysis."

From place to place the bottom was pitted by holes and burrows whose origin could not even be explained by the local biologist from the Limnological Institute. The transparent viviparous fish known as the golomyanka, which lives only in Baykal, also is surrounded with a great many mysteries: first it hovers with its head down, then it dives into the silt and burrows in it like a mole and then again shoots upward.

The expedition is continuing its work.

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### III. TERRESTRIAL GEOPHYSICS

#### News

#### INTERVIEW ON SUPERDEEP BOREHOLES

Moscow PRAVDA in Russian 9 Aug 77 p 6

[Article by V. Molchanov, "Window to the Depths"]

[Text] PRAVDA carried a report indicating that near the Azerbaydzhan city of Saatly specialists have begun to drill a borehole which will penetrate 15 kilometers into the depths of our planet. The same experiment is being carried out on the Kola Peninsula. A PRAVDA correspondent turned to Doctor of Technical Sciences, USSR Geology Minister Yevgeniy Aleksandrovich Kozlovskiy with a request to tell of the purposes of drilling the giant boreholes.

Koslovskiy: I would like to note that the Saatly and Kola boreholes are not the only superdeep boreholes in our country. They are being drilled in the Ukraine, in the Caspian region, and in the northern Caucasus. Geologists are expanding the search for and exploration of petroleum and gas deposits hidden by a stratum of rocks more than 6,000 m from the surface. In the case of the Saatly and Kola holes there are also tasks of a different nature. From these boreholes we should raise to the surface and carefully study matter from still inaccessible deep layers.

Interviewer: But there are geophysical methods, checked by practical work, for sounding the earth and they have assisted in sketching a "portrait" of the planet...

Koslovskiy: To be sure, geophysics has been of inestimable service in learning the structure of the earth's crust and in discovering underground treasures. On the other hand, in the interpretation of the collected data there is an inevitable element of subjectivism. It is one thing, for example, to study the moon by means of a telescope and another thing to take ground from its surface and investigate it in the laboratory. And although samples of "lunar rock" have already been obtained, we still do not know the appearance of the earth's matter lying below eight kilometers from its surface.

Direct penetration into the depths of the planet will make it possible to establish the correspondence between geophysical data and the actual structure of the earth's crust. These results will also be extended to other structures. And then geologists and geophysicists will have in their hands a tool making it possible to reduce expenditures on expensive drilling. The path to deep matter is being opened to researchers. The cross section of the earth's crust is being transformed from a more or less precise hypothesis into reality.

Interviewer: How do you explain why it is precisely on the Kola Peninsula, in the neighborhood of Saatly, that a site was selected for superdeep drilling?

Kozlovskiy: The earth's crust on the continent, roughly speaking, consists of three principal layers: upper -- sedimentary, then a more ancient layer -- the granite layer, and still deeper -- a basalt layer. Beyond it comes the mantle. The Kola borehole is being drilled in a rare place where the boundary of the granite and basalt parts approaches particularly close to the surface. "Basalt" means "boiled." Precisely in such a layer, as if in a bubbling cauldron of magma, the ore matter was "cooked." Seeing rocks from the depths where they were generated by nature has been an ancient dream of geologists.

In the Saatly region the thickness of the sedimentary cover has an unusual thickness. There is basis for assuming that the granite layer here is absent and the borehole, penetrating through the sedimentary rocks, will immediately enter the basalt layer.

Interviewer: Whereas the Saatly borehole has just been started, the Kola superdeep hole has already penetrated more than 7,900 m. What results have been obtained?

Kozlovskiy: Specialists carefully analyze every meter of the borehole and each core of matter which is raised to the surface from the depths of the Baltic crystalline shield. The deeper the borehole penetrates, the more secrets will be opened up before the prospectors of the deeps.

We are seeing more clearly the problem of the temperature regime with an increase in depth, the peculiarities of the physical and chemical properties of rocks subjected to great pressures. At a depth greater than four and a half kilometers, where the rocks are very dense, specialists unexpectedly discovered porous fissured strata. This means that the formation of ore concentrations is possible at such levels.

The horizons regarded as "dead" in actuality are filled with singular life and movement. Hydrothermal processes are actively transpiring here. It was found that at great depths there are hydrocarbonate waters containing much chlorine. This means that the hypothesis of the impermeability of rocks

at such depths requires reexamination. The collected data are important for improving the theory of ore formation.

Activity is also manifested by various gases present in the rocks. They strive to move in the direction of the fissures and continuously enrich the hot mineralized solutions moving through these capillaries. It has been established that there is an increase in the content of helium with depth. It is interesting that the gases dissolved in the water differ essentially from the gases which saturate the solid matter of the deeps. These facts will make it possible to broaden our concepts as to how gas exchange occurs in the rock - atmosphere system.

Instruments have shown that at a depth of seven kilometers the temperature exceeds 110 degrees. Specialists expect that at a depth of 10 km the thermometer will register 200-220 degrees.

By the end of the present five-year plan the Kola borehole will have reached 10 1/2 km. Plans call for obtaining a complete cross section of the earth's crust formed at an early stage in the planet's life.

Interviewer: In his novel, Jules Verne told attractively about his travels to the center of the earth. To be sure, the creation of such an apparatus is a fantastic idea. But after all, a "journey" to a distance of 15 km is a complex matter. Can you tell us briefly about the techniques for drilling such holes?

Kozlovskiy: The service has been supplied with the latest achievements in Soviet engineering thought. The "Uralmash BU-15 000" apparatus was constructed for drilling to a depth as great as 15 km. Light-alloy pipes have been fabricated. Ordinary steel pipes are not suited for this purpose: the drilling column would be too heavy. Superpowerful electric motors have been created. The height of the drilling tower attains 64 meters.

Specialists of the Ministries of the Petroleum and Aviation Industries, the Ministries of the Heavy, Petroleum and Chemical Machine Building Industries and others are working on the development and solution of technical problems involved in drilling and servicing a superdeep borehole.

Interviewer: In the technical literature it is reported that the drilling will be done by the "open shaft" method. What does this mean?

Kozlovskiy: In ordinary drilling the borehole walls, in order that they not collapse, are protected by steel, so-called casings of an appropriate diameter. The drilling tool passes freely within them, as does geophysical instrumentation. In this case the borehole walls are covered in such a way that they can no longer be studied. But from an open shaft it is possible to obtain additional geological material at any time. In addition, this method makes it possible to count on further deepening. After all, the casings rapidly wear out. Then, as we say, the borehole "is put out of action." Drilling has reached its limit.

The "open shaft" technology is extremely complex. True, the drilling of the Kola borehole was facilitated by the fact that the rocks here are very hard.

After the Kola and Saatly holes, other giant boreholes will appear on the geological map of the country. They will open a "window" to the mysterious depths. However strange it may seem, we now know more about what occurs in space at altitudes of thousands of kilometers than in the depths of our planet.

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## Abstracts of Scientific Articles

### INCREASING EFFECTIVENESS OF DEEP GEOLOGICAL MAPPING

Moscow SOVETSKAYA GEOLOGIYA in Russian No 6, 1977 pp 8-19

[Article by P. A. Litvin, M. B. Rybakov and M. L. Sakhnovskiy, All-Union Geological Institute, "Prospects for Increasing the Effectiveness of Deep Geological Mapping"]

[Abstract] The article briefly discusses the status of deep geological mapping, one of the new types of regional study of the territory of the USSR. The authors describe variants of deep geological mapping in different regions of the USSR. Also presented are the specific characteristics of deep geological mapping and the differences in geological maps of the basement from maps of open regions. The paper discusses the problems involved in the rational combination of methods and the optimum organization of deep mapping. It is proposed that specialists carry out prediction of deposits and ore fields on the basis of modeling and the extensive use of image recognition algorithms. Specific examples are cited of the prediction of copper mineralization, the choice of a rational combination of exploration methods in the course of deep geological mapping and evaluations of the expected results. Also examined are the problems involved in the economic effectiveness of deep geological mapping and the prospects for this type of work.

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### STUDY OF CRUSTAL STRUCTURE USING GRAVIMETRIC DATA

Moscow SOVETSKAYA GEOLOGIYA in Russian No 6, 1977 pp 122-127

[Article by Kh. I. Yusupkhodzhayev and P. Kh. Khasanov, Institute of Geology and Geophysics Academy of Sciences Uzbek SSR, "Study of Structure of the Earth's Crust Along the Profile Arys'-Tashkent-Osh-Zorkul' on the Basis of Gravimetric Data"]

[Abstract] The deep structure of the Pamir - Tien Shan region along the profile Arys'-Tashkent-Osh (Uzgen)-Karakul'-Zorkul' was studied on the basis of gravimetric data with the use of an automated interpretation system

proposed by Ye. G. Bulakh. As a result it was possible to construct a density section of the earth's crust which within the limits of the profile has considerable vertical and horizontal density inhomogeneities. The Tien Shan and the Pamir in general are characterized by a reduced density of the upper mantle. The most overdense rocks are associated with the segment of the profile Lake Karakul'-Kyzylart Pass. It was possible to discriminate blocks differing in structure and the relationship of the thicknesses of layers of the earth's crust. It has been established that the principal factors determining the behavior of the regional gravity field are relief of the Mohorovicic discontinuity and in part, the "basalt" layer.

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#### NEW CONCEPTS CONCERNING CRUSTAL STRUCTURE

Moscow BYULLETEN' MOSKOVSKOGO OBSHCHESTVA ISPITATELEY PRIRODY, OTDEL GEOLOGICHESKIY in Russian No 4, 1977 pp 73-77

[Article by N. K. Bulin, "Some New Concepts Concerning Crustal Structure (According to Seismic Data)"]

[Abstract] On the basis of an analysis of seismic and detailed seismological data the author has postulated that within the limits of the continents the basic divisibility of the consolidated crust is not determined by the Conrad discontinuity, but by the A horizon, situated in the upper or middle part of the granite-metamorphic layer; in most regions of Eurasia the lower part of the crust has an almost constant thickness ( $30 \pm 2$  km). As a formulation of the problem the author advances the hypothesis that in the open ocean the Mohorovicic discontinuity may not correspond to a horizon with a velocity  $V_h = 7.5-8.5$  km/sec, but to a refracting boundary with  $V_h \geq 8.5-9.0$  km/sec, situated at depths of 17-21 km. Thus, it is not impossible that there is a thickened solid crust in the oceans (two or three times thicker than is now assumed).

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#### GEOTECTONIC CRITERIA FOR FINDING PETROLEUM AND GAS DEPOSITS

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA GEOLOGICHESKAYA in Russian No 8, 1977 pp 113-119

[Article by V. D. Kozyrev, All-Union Petroleum Scientific Research Geological Prospecting Institute, "Geotectonic Criteria for Finding Petroleum and Gas in New Territories"]

[Abstract] The most important geotectonic criteria for evaluating the possibilities of finding petroleum and gas in new territories are discussed. These criteria include: type of basin, thickness of sedimentary filling,

degree of activity of development and time of the last stage in compensated downwarping of the basin. Perigeosynclinal, mobile internal and perioceanic platform depressions always developed actively. This is expressed in the present-day structure by a sharply dissected basement, breaks and unconformities or differentiation of the cross section. Such depressions are always commercially petroleum and gas productive zones on ancient or recent platforms. The richest of these are recent Mesozoic-Cenozoic downwarplings in recent stages of development. Depressions rich in hydrocarbons, closed in the Paleozoic, without fail open in the direction of adjacent depressions with recent Mesozoic-Cenozoic downwarping. Intermontane depressions, as a result of the high degree of dislocation and disturbance of the traps, are rich only under the condition of a still more recent (Cenozoic, less frequently Neogene-Quaternary) downwarping before closing.  
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#### GEOLOGICAL CIRCUMSTANCES OF CHECHENO-INGUSHSKOYE EARTHQUAKE OF 1976

Moscow BYULLETEN' MOSKOVSKOGO OBSHCHESTVA ISPYTATELEY PRIRODY, OTDEL GEOLOGICHESKIY in Russian No 4, 1977 pp 78-84

[Article by B. A. Borisov and G. I. Reysner, "Geological Circumstances of the Checheno-Ingushskoye Earthquake of 1976"]

[Abstract] This is a report on the results of geological-geomorphological investigations of the region of the Checheno-Ingushskoye earthquake which occurred in the Northern Caucasus on 28 July 1976. It is postulated that the earthquake focus was associated with the intersection of a transverse dislocation with longitudinal structures which have very recently been active. The region of occurrence of the Checheno-Ingushskoye earthquake was earlier pointed out by geologists as one of the most seismically dangerous. The data presented in this paper make clear that the geological conditions in the focal region of this earthquake were such that one could have expected an earthquake with a magnitude close to the maximum known in the Caucasus. It is shown that geologists had insisted on this with every review of seismic data, regardless of what methods had been employed. The examples of the Dagestanskoye (1970) and Checheno-Ingushskoye (1976) earthquakes indicate that the most serious attention must be given to geological data during seismic regionalization.  
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#### VELOCITY SECTIONS OF UPPER MANTLE BASED ON DEEP SEISMIC SOUNDING DATA

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 7, 1977 pp 27-41

[Article by A. V. Yegorkin, V. Z. Ryaboy, L. N. Starobinets and V. S. Druzhinin, "Soyuzgeofizika" Trust, "Velocity Sections of Upper Mantle According to Land Deep Seismic Sounding Data"]

[Abstract] A study was made of the velocity structure of the upper mantle to depths of 100-150 km along deep seismic sounding profiles with a total extent of more than 4,500 km, situated within the limits of the East European Platform, Turanskaya and West Siberian Shields, Urals and Kazakh Folded Region. It is found that in the upper mantle of the platform regions there are horizontal large-scale velocity inhomogeneities whose linear dimensions vary from tens to hundreds of kilometers. Also examined are the problems involved in explosive seismology methods. The experimental data from deep seismic sounding are interpreted by computer analysis of the solutions of direct seismic problems for velocity models inhomogeneous in vertical and horizontal directions.

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#### SPATIAL-TEMPORAL CHANGES IN $v_p/v_s$ BEFORE STRONG EARTHQUAKES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 7, 1977 pp 91-98

[Article by G. A. Sobolev and L. B. Slavina, Institute of Physics of the Earth, "Spatial and Temporal Changes in  $v_p/v_s$  Before Strong Earthquakes on Kamchatka"]

[Abstract] In the investigated region of the seismically active zone of Kamchatka the distribution of regions of increased and reduced  $v_p/v_s$  values does not remain fixed. Several months before an earthquake of the 14th energy class (magnitude 6) in the region of a future focus there will be reduced  $v_p/v_s$  values. For the four studied earthquakes a local minimum preceded the corresponding earthquakes by 5, 7, 2 and 8 months; onset of the anomaly was noted on the average a year before the earthquake; the linear dimensions of the anomalous sector were about 100 km. Before an earthquake of the 16th energy class (magnitude  $> 7$ ) a decrease in the  $v_p/v_s$  value occurred over the course of not less than four years but a local minimum was noted a month before the earthquake. The  $v_p/v_s$  value, computed for a specific weak earthquake and different stations, is dependent on the location of the focus of the weak earthquake and the station relative to the focus of the future strong earthquake. The appearance of spatially localized reduced  $v_p/v_s$  values and zones of high  $v_p/v_s$  field gradients can serve as a prognostic criterion for evaluating the site and time of earthquakes on Kamchatka of energy class 14 (magnitude 6) and above.

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#### DETERMINING SITE OF FUTURE STRONG EARTHQUAKES USING RADON VARIATIONS

Tashkent UZBEKSKIY GEOLOGICHESKIY ZHURNAL in Russian No 3, 1977 pp 39-43

[Article by A. N. Sultankhodzhayev, S. U. Latipov, T. Zakirov and L. A. Khamidov, "Possibility of Prediction of the Site of Occurrence of Strong Earthquakes from Radon Variations"]

[Abstract] The authors investigated the possibility of predicting the site of strong earthquakes on the basis of radon variation in ground water. It was established that with an increase in the distance of the observed points from the focus of a future earthquake the effect of a stressed state of rocks on the content of radon is lessened; the maximum influence is in the epicentral zone. This circumstance makes it possible to judge the site of impending earthquakes. The first attempt at a mathematical solution of this problem revealed that when in a single direction there are at least three points where information is continuously registered on changes in radon content it is possible to determine the coordinates of a future earthquake.

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#### CRUSTAL STRUCTURE DETERMINED BY USE OF DEEP SOUNDING DATA

Tashkent UZBEKSKIY GEOLOGICHESKIY ZHURNAL in Russian No 3, 1977 pp 24-29

[Article by F. Kh. Zunnunov and N. V. Barsukova, Institute of Geology and Geophysics Uzbek Academy of Sciences, "Earth's Crust According to the Results of Repeated Interpretation of Deep Seismic Sounding Data Along the Profile Arys'-Balkhash"]

[Abstract] The Arys'-Balkhash profile with a length of 523 km, worked by a system of continuous profiling in 1964, from southwest to northeast intersects the Sredne-Syrdar'inskaya depression, Karatauskiy anticlinorium, Chu-Sarysuyskaya depression and the Chu-Iliyskiy anticlinorium. The Moho here lies at a depth of 41-48 km. The results of an analysis of the hypsometry of the principal discontinuities in the earth's crust indicate that the Karatauskiy and Chu-Iliyskiy anticlinoria correspond to an increase in the thickness of the consolidated earth's crust to 44-48 km, and in the central part of the Chu-Sarysuyskaya depression there is a local reduction to 37 km. The "basalt" layer is represented by a gradient medium in which the velocities increase with depth from 7-7.6 to 7.1-7.8 km/sec and it has a relatively sustained thickness of 13-18 km. The "granite" layer has a thickness of 23-29 km; a reduction to 23-25 km is observed in the Sredne-Syrdar'inskaya, Chu-Sarysuyskaya depressions, and an increase to 27-29 km occurs in the Karatauskiy and Chu-Iliyskiy anticlinoria. The sedimentary layer is characterized by a mean velocity from 2.4 (Sredne-Syrdar'inskaya depression) to 4.6-5 km/sec (Chu-Sarysuyskaya depression). Regardless of how the data are interpreted, it appears that there is an increase in the

thickness of the consolidated crust in the Karatauskiy and Chu-Iliyskiy anticlinoria and its local reduction in the central part of the Chu-Sarysuyskaya depression.

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#### DECREASE IN INTENSITY OF STRONG EARTHQUAKES IN UZBEKISTAN

Tashkent UZBEKSKIY GEOLOGICHESKIY ZHURNAL in Russian No 3, 1977 pp 44-47

[Article by R. N. Ibragimov and M. O. Ryzhkova, Seismology Institute Uzbek Academy of Sciences, "Regional Patterns of Decrease in the Intensity of Strong Earthquakes in the Territory of Uzbekistan"]

[Abstract] A clarification of the laws and patterns of decrease in the intensity of earthquakes, especially strong ones, is one of the principal problems in seismotectonics. This is attributable to the fact that the nature of the dropoff in intensity with increasing distance from the epicenter is taken into account in the compilation of seismic maps, which are the basis for determining intensity and seismic danger in the planning of construction projects. In this paper an attempt is made to determine the coefficient of decrease in earthquake intensity (CDEI) for individual earthquakes for which macroseismic data are available, including the structural-tectonic structure of the region and to determine its areal changes. It was found that earthquakes with different CDEI can be genetically related to similar tectonic conditions (faults, fold development). Within the limits of each structural-tectonic unit there were earthquakes with high CDEI. In tectonic zones the range of variations of CDEI values differs. The influence of different geological factors (tectonic structure, history of geological development, degree of homogeneity of geological structure, its lithological characteristics, and physicochemical parameters of the section) is reflected in the shape of the isoseists and accordingly is directly reflected in the CDEI. Zones with increased CDEI values are characterized by a microblock structure and repeated reworking of the structural plan.

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#### DRILLING OF BOREHOLE INTO CRYSTALLINE BASEMENT

Moscow SOVETSKAYA GEOLOGIYA in Russian No 6, 1977 pp 110-116

[Article by R. Kh. Muslimov, V. A. Lobov, T. A. Lapinskaya, I. Kh. Kaveyev and V. I. Filippovskiy, "Results of Drilling of Borehole 20 000 into the Crystalline Basement in the Tatar SSR"]

[Abstract] The paper describes the drilling of superdeep borehole 20 000 into the Tatarskiy arch; the planned depth is 7,000 m. Drilling of the hole will make it possible to study the mineralogical composition and properties of rocks of the crystalline basement and the degree of their metamorphism and carry out geophysical and geothermal investigations of the cross section of the borehole, ascertain the presence of collector rocks and possible inflows of highly thermal mineralized waters and gas. The first stage in the drilling has been completed. Since 24 March 1973 workers have drilled 5,005 m of rock, of which 1,884 m is through sedimentary deposits of the Paleozoic and 3,121 m is through the crystalline basement. The core is taken at 25-m intervals. For the first time in the eastern part of the Russian platform it has been possible to penetrate the buried foundation (basement) with a thick cross section of reliably Archaean formations, extremely different in composition and origin. Among these are representatives of both originally sedimentary deposits, whose study will make it possible to ascertain the peculiarities of ancient sedimentation, and representatives of originally magmatic deposits, providing evidence of the tectonic history of the region. Study of the penetrated rocks will make it possible to obtain essentially new data on the geology of the Precambrian on the Russian platform. The borehole is in a tectonically active zone. This is expressed in intensive fissuring. The crystalline basement was found to contain highly fissured, permeable zones with active circulation of fluids through them.  
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#### STRESSED STATE IN EARTHQUAKE FOCI IN ARMENIA

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR, NAUKI O ZEMLE in Russian  
Vol 30, No 3, 1977 pp 42-49

[Article by N. K. Karapetyan, Institute of Geophysics and Engineering Seismology Armenian Academy of Sciences, "Stressed State in the Foci of Armenian Earthquakes and the Mechanism of Their Occurrence"]

[Abstract] For determining the elements of the mechanism of earthquake foci (applicable to the conditions prevailing in Armenia) the author used the A. V. Vvedenskaya method, based on the theory of dislocations (IZVESTIYA AKADEMII NAUK SSSR, SER. GEOFIZ., No 3, 1956). The study of the stressed state at earthquake foci was made on the basis of the distribution of the signs of displacements in the first arrivals of longitudinal waves. Data on the signs of the first displacements in longitudinal waves were taken from seismograms of stations in the seismic network of the Caucasus, stations in the teleseismic network of the USSR, and also from the BCJS and Summari bulletins. All determinations of the dynamic parameters of earthquake foci were made in a stereographic projection, using a Wolf grid. The position of each point corresponding to a definite station was determined in the grid using two angular coordinates: the azimuth of this station relative to the earthquake epicenter and the angle of emergence of the

longitudinal wave from the earthquake focus. The angles of emergence of the longitudinal waves from the focus in the case of close epicentral distances ( $\Delta \leq 800$  km) were determined by geometrical computations using the known depth of the earthquake focus, epicentral distance and the velocity section of the earth's crust. In the case of great epicentral distances ( $\Delta \gg 800$  km) the angle of emergence of longitudinal waves from the focus was determined from the graph of the dependence of the angle of incidence of P waves on epicentral distance. By clarifying the position of the nodal lines on the Wolf grid, and therefore the position of their poles, it is possible to determine the directions of the axes of compression and dilatation. Figure 2 in the text shows the horizontal projections of the axes of compression operative at earthquake foci. Figure 3 shows the horizontal projections of dilatations operative at earthquake foci. Figure 4 shows the horizontal projections of the axes of intermediate stresses, that is, the axes in the direction of which the stresses are equal to zero.

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#### INTERPRETATION OF GRAVITY ANOMALIES IN BLACK SEA

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 7, 1977 pp 99-103

[Article by Yu. Ya. Vashchilov and V. A. Kucherinenko, Far Eastern Scientific Center and Northeastern Complex Scientific Research Institute, and Institute of Physics of the Earth, "Interpretation of the Gravity Anomaly in the Northwestern Part of the Black Sea"]

[Abstract] The investigated region is the peripheral zone of the Black Sea depression. The principal structures are the East European and Scythian platforms and the suboceanic depression of the Black Sea, separated from one another by deep faults which have roots extending into the mantle. The authors have made an attempt to refine the position of the boundary between the two platforms by means of quantitative computations of the gravity anomalies for density inhomogeneities of the basement and the sedimentary mantle of the region. The study of the gravity field of the shelf in the northwestern part of the Black Sea was carried out on the assumption that its principal peculiarities are attributable to the existence of a gravity anomaly primarily of block origin. A statistical analysis of the results of a quantitative interpretation of the gravity anomalies indicates that this assumption is justified. The results of the quantitative interpretation of  $\Delta g$  anomalies over blocks were used for constructing two cross sections of the crust on the basis of gravimetric data for sectors and directions for which no deep seismic sounding data are available. Each of these profiles is discussed in detail.

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#### IV. UPPER ATMOSPHERE AND SPACE RESEARCH

##### News

TASS ANNOUNCES LAUNCHING OF "KOSMOS-937"

Moscow PRAVDA in Russian 25 Aug 77 p 2

[TASS Report: "'Kosmos-937'"]

[Abstract] The artificial earth satellite "Kosmos-937" was launched in the Soviet Union on 24 August 1977. The satellite was inserted into an orbit with the following parameters:

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

TASS ANNOUNCES LAUNCHING OF "KOSMOS-938"

Moscow PRAVDA in Russian 26 Aug 77 p 1

[TASS Report: "'Kosmos-938'"]

[Abstract] The artificial earth satellite "Kosmos-938" was launched in the Soviet Union on 24 August 1977. The satellite was inserted into an orbit with the following parameters:

- initial period, 89.7 minutes;
- apogee, 365 kilometers;
- perigee, 189 kilometers;
- orbital inclination, 62.8 degrees.

SIMULTANEOUS LAUNCHING OF EIGHT "KOSMOS" SATELLITES

Moscow PRAVDA in Russian 26 Aug 77 p 1

[TASS Report: "In Space Orbit"]

[Text] On 24 August 1977 the following artificial earth satellites were launched in the Soviet Union: "Kosmos-939," "Kosmos-940," "Kosmos-941," "Kosmos-942," "Kosmos-943," "Kosmos-944," "Kosmos-945," and "Kosmos-946." All eight satellites were inserted into orbit by a single carrier-rocket.

The satellites carry scientific apparatus intended for the continuation of space research.

Trajectories of all eight satellites are close to the planned orbits. Initial parameters of the orbits are:

- period of revolution, 115.2 minutes;
- apogee, 1,518 kilometers;
- perigee, 1,448 kilometers;
- orbital inclination, 74 degrees.

In addition to the scientific apparatus the satellites carry radio systems for the precise measurement of orbital elements and radiotelemetry systems for transmitting data on the operation of the instruments and scientific equipment to earth.

The apparatus installed on the satellites is functioning normally. The coordination-computation center is processing the incoming information. [4]

#### TASS ANNOUNCES LAUNCHING OF "KOSMOS-947"

Moscow PRAVDA in Russian 28 Aug 77 p 2

[TASS Report: "'Kosmos-947'"]

[Abstract] The artificial earth satellite "Kosmos-947" was launched in the Soviet Union on 27 August 1977. The satellite was inserted into an orbit with the following parameters:

- initial period, 89.7 minutes;
- apogee, 346 kilometers;
- perigee, 211 kilometers;
- orbital inclination, 72.8 degrees.

The satellite carries a radio transmitter operating on a frequency of 19.995 MHz.

#### EXPERIMENTS ABOARD "KOSMOS-936" BIOSATELLITE DESCRIBED

Moscow PRAVDA in Russian 24 Aug 77 p 6

[Article by A. Burnazyan, "The Biosatellite Has Returned"]

[Text] Still another experiment in circumterrestrial space was successfully completed on 22 August. The descent module of the "Kosmos-936," which carried different biological objects and scientific research instrumentation of the USSR, CzSSR, France and the United States, landed in the intended region.

The biosatellite carried white laboratory rats, higher and lower plants, insects, very simple animal organisms, colonies of cells and seeds of plants. Different types of investigations were carried out: physiological, biological, physical, radiobiological and radiation-physical.

The experiments on the preceding "Kosmos" vehicles demonstrated that prolonged weightlessness does not cause a damaging effect on intracellular processes, including those which are related to the transmission of hereditary information. At the same time, the bodies of the white rats were found to contain changes of an aspecific nature. On the new biosatellite work was continued on the further study of the mechanisms of these changes and attempts to prevent them by means of artificial gravity. This is one of the principal and fundamental differences between this experiment and preceding ones.

The "Kosmos-936" carried a centrifuge. The use of artificial gravitation in physiological investigations pursues two purposes. On the one hand, the animals placed in the centrifuge will serve as an object of additional control relative to "nonrotating" rats ("pure weightlessness"). And second, plans call for obtaining an answer to the question as to the extent to which artificial gravity can prevent the development of the changes arising in the body and its individual physiological systems under the influence of weightlessness.

One of the physiological experiments on the biosatellite was related to the matter of the participation of the vestibular apparatus in body adaptation to weightlessness. Studies are being made of the equilibrium function and other vestibular-motor reactions in three groups of animals: those subjected to the influence of artificial gravity, those subjected to "pure" weightlessness, and these same animals from which the vestibular apparatus had been surgically removed.

Within the framework of the program of physiological investigations on the biosatellite specialists carried out a Soviet-American experiment for studying the lifetime of erythrocytes and also a Soviet-French experiment related to investigation of the influence of spaceflight factors on body immunological reactivity.

In general, the conditions for keeping the animals in this experiment did not differ significantly from the preceding biosatellites. The latter, incidentally, is also of more than a little importance because it corresponds to the requirements of comparability and proper sequence of experimental results.

The "Kosmos-936" descent module carried 30 white rats (10 of which were in the centrifuge), growing from the very time of birth under sterile conditions. A large consignment of such animals was supplied by specialists from the CzSSR specially for this experiment.

The basic objective of the investigations of other biological objects on the "Kosmos-936" satellite was a further study of the essence of the effect of weightlessness on growth, development and functioning of living organisms. Higher plants, Crepis, pine, corn, spores of phycomycetous fungi, and also young and adult specimens of Drosophila were not novices in spaceflight, except for seeds of corn. American specialists, in collaboration with Soviet researchers, studied the nature and rates of ageing of Drosophila under weightlessness conditions.

Almost all the biological experiments aboard the satellite were carried out using a specially designed instrument, the "Biofiksator," fabricated for the growing and fixing of sprouts. Activation of the instrument, feeding of water and fixing agents, were accomplished automatically in accordance with a stipulated program. This sort of unique instrument, developed with the creative cooperation of biologists and engineers, has successfully undergone all tests.

It has become a rule that simultaneously with the flight of a biosatellite a so-called synchronous control experiment is carried out on the earth. There was no exception in this case.

The space "passengers" on earth, directly at the landing site, encountered a mobile laboratory. It is a complex array of technical equipment which ensures the immediate collection of biological materials, their fixing and preservation for subsequent study and analysis in different laboratories of the Soviet Union, and also for their dispatch to specialists in other countries.

The "Kosmos-936" satellite was used in carrying out an interesting physical experiment -- the "Heat Exchange" experiment. The purpose of this experiment is to study how, under weightlessness conditions, heat fluxes are formed and how they are distributed between the heated object and its surroundings. This problem is important for planning the atmosphere and interior of cabins of future spaceships. This apparatus was developed and fabricated by specialists of the CzSSR.

A new stage of research on the development of special means of radiation protection was initiated in a series of radiobiological and radiation-physical experiments aboard the "Kosmos-936." For the first time specialists made use of the interesting idea of using an electric field artificially created near the satellite for reflecting charged elementary particles in space.

The effect of so-called heavy particles on cosmonauts and the biocomplexes of spaceships is causing serious concern to scientists. This sort of radiation effect can be especially significant during prolonged flights. For their further study specialists used the "Kosmos-936" for continuing a series of Soviet-French experiments under the "Bioblok" program.

The biosatellite was used in a joint Soviet-American experiment on radiation dosimetry. Its purpose was a study of the dose and spectral characteristics of cosmic radiations and circumterrestrial space and also an investigation of the passage of charged particles of cosmic radiations through the protective matter and biological shielding. For this purpose a standardization of the experimental methods developed by Soviet and American specialists is being carried out. In addition to the use of Soviet and American detectors, for the first time the biosatellite will be used in a broad program for the joint calibration of detectors on accelerators in the USSR and in the United States.

The flight of this biosatellite made possible considerable progress in unraveling the secrets of space and served for further strengthening of the international cooperation of scientists.

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### Abstracts of Scientific Articles

#### MAGNETIC EFFECT OF ASYMMETRIC RING CURRENT OF PROTONS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 4, 1977 pp 559-565

[Article by A. S. Kovtyukh, M. I. Panasyuk and E. N. Sosnovets, "Magnetic Effect of the Asymmetric Ring Current of Protons"]

[Abstract] On the basis of data from the "Molniya-1" artificial earth satellite on the intensities of the proton fluxes in the energy intervals 31-92, 67-122 and 182-377 KeV the authors have computed the magnetic field of the ring current of protons of such energies during the time of the moderate geomagnetic storms of 25 January and 18 April 1974. It is shown that the ring current of protons of the studied energies is the basic source of the symmetric part of disturbances of the geomagnetic field in the low latitudes. The value of the asymmetric part of the magnetic field of the ring current at the time of the main phase of the storm of 25 January 1974 is considerably less than the longitudinal asymmetry of geomagnetic field disturbances observed at this time in the low latitudes.

[223]

#### PARAMETERS OF VERTICAL FLUX OF EXCESS ELECTRONS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 4, 1977 pp 579-588

[Article by R. N. Basilova, N. L. Grigorov, L. F. Kalinkin, Ye. I. Kogan-Laskina, G. I. Pugacheva and I. A. Savenko, "Energy Spectrum and Latitudinal Variation of the Vertical Flux of Excess Electrons According to Measurements Aboard the 'Kosmos-490' Satellite"]

[Abstract] This paper gives the results of measurements of the spectra of electrons in the energy range 80-2300 MeV for the equatorial region, middle and high latitudes. The spectra for the equator and the middle latitudes have the form:

$$N(\geq E_e) = (2.6 \pm 0.2) \cdot 10^{-1} E_e^{-0.74 \pm 0.02}_{0.03} \text{ (cm}^2 \cdot \text{sec} \cdot \text{sr)}^{-1},$$

$$N(\geq E_e) = (1.3 \pm 0.3) \cdot 10^{-1} E_e^{-0.77 \pm 0.05} \text{ (cm}^2 \cdot \text{sec} \cdot \text{sr)}^{-1},$$

where  $E_e$  is electron energy in MeV. In the high latitudes the electron spectrum has a different character and exhibits a marked dropoff when  $E_e \geq 260$  MeV. The latitudinal variation of electrons with energies  $E_e \geq 80, 260$  and  $540$  MeV is illustrated. For all energies in the vertical flux there is a decrease in the flux with a decrease in the cutoff rigidity of the measurement site in the interval 12-16 GV.

[223]

#### GRAVITATIONAL SYSTEM FOR SATELLITE STABILIZATION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 4, 1977 pp 499-510

[Article by V. I. Pen'kov and V. A. Sarychev, "Gravitational System for the Stabilization of Satellites with a Joint Suspension Having One Degree of Freedom"]

[Abstract] The possibility of constructing a gravitational stabilization system with a joint suspension having one degree of freedom was discussed by one of the authors in a previous paper (V. A. Sarychev, KOSMICH. ISSLED., 2, 33, 1964). This gravitational stabilization system consists of two solid bodies joined by a viscoelastic suspension system. In this new paper the authors have obtained the conditions for asymptotic stability of the position of equilibrium. It was possible to determine the optimum parameters ensuring the maximum rate of attenuation of characteristic oscillations of the system. The authors demonstrate the possibility of compensation of the perturbing effect of ellipticity of the orbit with retention of asymptotic stability of the position of equilibrium of a satellite with such a gravitational system.

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#### REDUCTION OF ASYMMETRIC VEHICLE TO STATIONARY ROTATION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 4, 1977 pp 517-525

[Article by Ye. M. Loskutov, "Optimum Reduction of an Asymmetric Vehicle to a State of Stationary Rotation in a Stipulated Direction"]

[Abstract] A study was made of the problem of reducing an asymmetric space vehicle from a state of arbitrary rotation to a stipulated rotational motion with a definite value of the vector of the kinetic moment of the vehicle

both in the axes of an absolute coordinate system and in coupled axes. The vehicle is controlled by a system of reactive orientation microengines which create moments along the principal central axes of inertia of the vehicle; the expenditure of the working body of the system is optimized with an unstipulated time of reduction. Two cases were investigated: the case of small (in a definite sense) angular mismatches between the initial and final positions of the kinetic moment of the spacecraft with a fixed final angular velocity and the case of stipulated angular mismatches between the initial and final positions of the vector of the kinetic moment with a free final angular velocity.

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#### ACCURACY IN DETERMINING ACCURACY IN DETERMINING SPACECRAFT MOTION PARAMETERS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 4, 1977 pp 546-553

[Article by B. Ts. Bakhshiyani, R. R. Nazirov and P. Ye. El'yasberg, "Guaranteed Characteristics in the Accuracy in Determining the Parameters of Motion of Space Vehicles"]

[Abstract] The authors analyze the possibilities of using guaranteed characteristics for evaluating the accuracy in determining the parameters of motion of a spacecraft under the condition that the principal parameters of the distributions of probabilities of errors in initial data are not known and only the set to which the parameters belong is stipulated. A study is made of a case when this set conforms to quite general limitations imposed on the mathematical expectation and a covariation matrix of errors. It was possible to determine the conditions under which the determined expressions for the upper boundary of the accuracy characteristic give a precise upper limit of this characteristic in the considered set. It is shown that the expressions derived in earlier studies for the guaranteed characteristics of accuracy are special cases of the expressions found in this study.

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#### OBSERVATION OF RADIATION CONDITIONS FROM ARTIFICIAL EARTH SATELLITES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 4, 1977 pp 598-602

[Article by I. N. Senchuro and P. I. Shavrin, "Results of Observation of Radiation Conditions Aboard Artificial Earth Satellites with a Semisynchronous Orbit in 1965-1971"]

[Abstract] The article gives the results of dose measurements made aboard 12 "Molniya-1" artificial earth satellites from 1965 through 1971. The measurements were made using IK-4 ionization chambers shielded with a layer of

matter  $0.7 \text{ g}\cdot\text{cm}^{-2}$  and SI-3BG gas-discharge counters with a minimum shielding of  $3 \text{ g}\cdot\text{cm}^{-2}$ . It was found that the mean monthly dose of radiation penetrating through the  $3 \text{ g}/\text{cm}^2$  of matter in the "Molniya-1" orbits varies by a factor of 2 for the most part due to the electrons of the earth's outer radiation belt. The contribution of protons of solar cosmic rays to the total dose is insignificant. The mean annual dose levels due to different components during the period 1968-1970 are given in Table 1. The authors emphasize the importance of these and other results for checking on the trajectory coefficients method in predicting radiation effects on spacecraft construction components.

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#### PERIODIC MOTIONS OF AXIALLY SYMMETRIC SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 4, 1977 pp 526-532

[Article by Yu. V. Barkin and A. A. Pankratov, "Periodic Motions of Axially Symmetric Satellite Relative to Center of Mass in an Elliptical Orbit"]

[Abstract] In this paper the Poincaré small parameter method is used in an investigation of the existence of periodic rotational motions of an axially symmetric satellite in an elliptical orbit under the influence of gravitational moments of a central body. The author has determined the analytical conditions for the existence of periodic solutions and their qualitative and numerical investigation is presented. The paper gives a four-parameter family of periodic Poincaré solutions as a solution of the problem. The results are easily generalized for the case of a satellite having an arbitrary dynamic structure and also for the case of more complex potential fields.

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#### INVESTIGATION OF MAN'S ROTATION IN SPACE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 4, 1977 pp 533-539

[Article by G. G. Bebenin and Yu. N. Glazkov, "Some Results of an Investigation of Man's Rotation in Space"]

[Abstract] The authors present a biomechanical model of man as a system of solid bodies for investigation of the rotational motion of man about his center of mass in unsupported space due to motion of his extremities. The article gives the results of an investigation of the proposed system using an electronic computer. A general approach is given to the synthesis of control systems using individual means for the movement of cosmonauts, taking into account the influence of perturbing moments during movements with the extremities. In the paper it is shown that in addition to investigations by means of simulation of weightlessness (aircraft flights in a

Kepler orbit, neutral buoyancy in a hydromedium, stands with different degrees of freedom) mathematical modeling makes it possible to determine the dynamics of human rotations and also to determine the necessary initial data for the development of technical means for ensuring the activity of a cosmonaut beyond the limits of a spaceship.

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#### TURBULENCE OF CIRCUMSOLAR PLASMA AND SOLAR WIND VELOCITY

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 3, No 7, 1977 pp 322-325

[Article by A. I. Yefimov, O. I. Yakovlev, V. M. Razmanov and V. K. Shtrykov, Institute of Radioengineering and Electronics, "Turbulence of Circumsolar Plasma and Solar Wind Velocity According to Data from Radio Probing Using the 'Venera-10' Vehicle"]

[Abstract] The authors analyze observations of changes in the energy spectrum of radio waves of the "Venera-10" space vehicle during their propagation in inhomogeneous circumsolar plasma for elongations of  $0.6-6^\circ$ . The experiments were carried out in 48 communications contacts with the craft during April-July 1976 at a frequency of 928 MHz. It was found that the spatial spectrum of turbulence of circumterrestrial plasma is close to a Kolmogorov spectrum. The plasma is highly turbulent and the degree of inhomogeneity has an increased value in the region of distances from 2 to 5 and from 12 to 20 solar radii. The determined solar wind velocities are close to the values following from the Parker theory. The raw data presented in the paper indicate the existence of a special region where there is an increased turbulence of plasma and where the formation of shock waves is possible.

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#### DETERMINING AXIS OF ORIENTATION OF AES GAMMA TELESCOPE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 15, No 4, 1977 pp 635-639

[Article by Yu. A. Gur'yan, Ye. P. Mazets and I. A. Sokolov, "Determining the Orientation of the Axis of a Gamma Telescope Aboard an Artificial Earth Satellite. II. Method for Computing Orientation"]

[Abstract] In an earlier study (KOSMICH. ISSLED., 15, No 2, 1977) the authors described a relatively simple device for determining the orientation of the axis of a gamma telescope which was used in an experiment for investigating gamma radiation of the atmosphere aboard the "Kosmos-461" satellite. The

basis for operation of the device was the principle of registry of the mechanically modulated albedo radiation of the earth in the IR and visible ranges. In this second part of the study the authors develop a method for a relatively rapid and simple determination of data on the principal angular values characterizing the motion of a satellite relative to its center of mass and data on orientation of the telescope relative to the local vertical. The satellite was put into a circular orbit with an altitude  $h = 500$  km. During almost the entire time of the experiment the satellite rotation about its center of mass had the nature of regular precession. Specific examples of determinations of the telescope axis are given.

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