of the latitudes of five astronomical stations organized by international agreement and placed around the entire globe on the 39°8′ parallel of northern latitude. One of these stations is in Kitab (Uzbek S.S.R.). A summary of the observations and the derivation of the coordinates of the pole are carried out in a central bureau which presently is located in Mitsuzawa (Japan).

The international latitude service was organized when it became clear that the pole has two periodic motions about its central position: one with a period of 14 months and an amplitude of about 0.2″, corresponding to oscillations of the elastic earth's sphere, and the other with a period of one year, with amplitude 0.1″, due to meteorological phenomena, mainly seasonal changes of the barometric pressure and the snow cover on dry land. As a result of these two motions, the pole describes a complicated irregular spiral, alternately winding and unwinding, moving up to 10 meters away from its average position. In addition, however, the average pole has experienced a noticeable general motion during the last 70 years.

At the Prague Congress of the International Astronomical Union in 1967, it was resolved to refer the motion of the pole to its average position for 1903, called arbitrarily the international reference. Even a cursory glance at the trajectory of the instantaneous pole of the earth's rotation shows that at the present time the pole has moved from its origin and that in 1962–1967 it executed periodic oscillations around a point located approximately 0.2″ from the arbitrary origin in the direction of the 75° meridian of western longitude, i.e., in the direction of North America. More detailed investigations by a number of astronomers confirms the existence of such a secular motion of the pole with an average velocity of 0.0035″ annually, corresponding to 11 centimeters. It is not known whether such a motion existed in the remote past and whether it will continue in the future; at any rate it is utterly insufficient to explain the changes of the climate and the geological epochs, particularly the ice ages.

The motion of the pole relative to the earth's surface causes changes of astronomically determined geographical coordinates—latitude, longitude, and azimuth. If the entire earth's crust moves as a whole, a hypothesis for which there are definite indications, then the changes of the coordinates should be connected by certain relations, deviation from which points to individual displacements of individual sections, for example the drift of continents. However, the errors in the proper motions of the stars, even in the best catalogs, are of the same order as the observed or expected motions of the continents, and therefore the observations should be organized in such a way as to eliminate these errors. To this end, all the stations should observe the same stars with the same types of instruments and in accordance with a unified and coordinated program. In this sense, a corresponding recommendation was adopted at the aforementioned Prague Congress.

The secular motions of the earth's poles must be taken into consideration when using geographic coordinates determined by astronomical methods at different times, particularly in a general reconciliation of the geodetic trigonometric grids. Although this influence is very small, it will probably increase in the future.

[1] A. A. Mikhaĭlov, Astron. Zh. **45**, No. 3 (1968) [Sov. Astron.-AJ **12**, No. 3 (1968)].

[2] A. A. Mikhaĭlov, ibid. **47**, No. 3 (1970) [Sov. Astron.-AJ **14**, No. 3 (1970)].

K. I. Gringauz, Characteristics and Spatial Distribution of Low-Energy Plasma in the Magnetosphere and Its Connection with Geomagnetic Storms.

In a review article devoted to a low-energy plasma in the earth's magnetosphere (with particle energies ~ 200 eV $< E <$ 50 keV), it was noted that the development of experimental research on magnetospheric particles of low energies in 1959–1963 lagged far behind research on particles with subrelativistic and relativistic velocities, captured in the radiation belts (out of hundreds of publications on the radiation belts, there were only a few papers on low-energy plasma, mainly in the Soviet Union). The situation has now changed appreciably.

The present-day stage of research in the field of physics of the earth's magnetosphere (1966–1969) is characterized by the use on satellites of new high-sensitivity detectors for the registration of charged particles of low energies (canalotron multipliers) and a sharp increase in the volume of information obtained as a result of direct experiments in the magnetosphere. These experiments have shown convincingly that both the main features of the magnetosphere's structure and the phenomena such as magnetic storms and auroras are determined precisely by the low-energy magnetospheric plasma and its convection (large-scale motions). The particles making up the radiation belts are only a very small fraction of the charged particles populating the magnetosphere, and have little influence on the structure of the magnetic field in the space around the earth.

The magnetosphere has a tail that is elongated in the antisolar direction and has a quasistable structure, occupying a region with diameter $\sim 40 R_E$ (R_E = radius of the earth), and extending over millions of kilometers. The magnetic field in the tail, which differs appreciably from the interplanetary field, is the result of the superposition, on the magnetic field of the earth's dipole, of magnetic fields produced by a sufficiently stable system of electric currents which can be formed only by particles of the low-energy plasma.

Investigations by Vasyliunas (MIT), carried out with satellites OGO-1 and OGO-3, have confirmed that in the equatorial plane the regions of existence of the low-energy plasma in the daytime and nighttime parts of the magnetosphere are joined together, forming a single zone (Fig. 1). In the meridional plane near the earth, a layer of low-energy plasma, inside of which is located a magnetically-neutral layer of the tail of the magnetosphere, enters into the polar regions of the night part of the upper atmosphere along "open" (unclosed) force tubes (Fig. 2).

The reduction of the electron energy spectra obtained on the satellites OGO and "Vela" made it possible for Vasyliunas to determine the following average parameters of the quasi-isotropic streams of electrons in the center of the plasma layer of the tail of the magnetosphere: electron energy ~ 1 keV, density ~ 0.1–

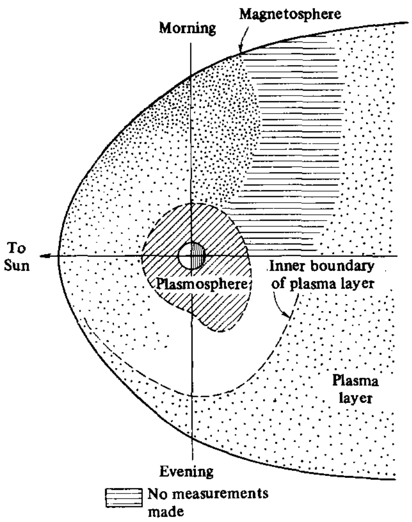

FIG. 1

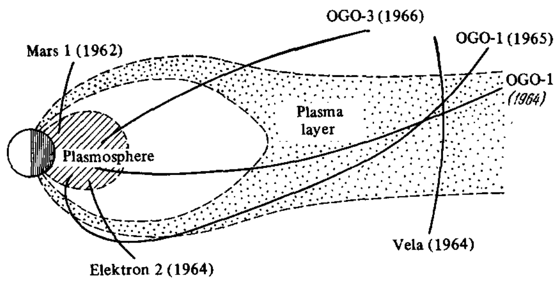

FIG. 2

$0.3\ cm^{-3}$. The individual values of the electron energy and their concentration can change by a factor of several times ten. The sum of the magnetic and plasma pressures over the cross section of the tail of the magnetosphere is constant and corresponds to the pressure of the solar wind on the magnetopause (the boundary of the magnetosphere).

A fact of fundamental significance is the observation of low-energy protons in the magnetosphere, by L. Frank (University of Iowa) in 1966, with the aid of an electrostatic analyzer with a canalotron on the OGO-3 satellite. Frank has shown that in the case of a geomagnetic storm there is a sharp increase in the streams of protons with energy < 50 keV at geocenter distances (3–5) R_E in the equatorial plane, forming a current ring producing a storm.

Rocket measurements by Chase (U.S.A.) carried out directly in auroras, have shown that the energy spectra and the electron fluxes producing the auroras are quite close to the electron spectra in the plasma layer of the tail of the magnetosphere. Vasyliunas (1969), projecting on the upper atmosphere a plasma layer of the magnetosphere tail along the geomagnetic force lines, reached the conclusion that this projection coincides with the aurora oval of Feldstein–Starkov.

Following the paper, films were demonstrated, with results of measurements of the energy spectra of the electrons and protons with $E < 50$ keV, performed by L. Frank on the satellites OGO-3 and IMP-4. The volume of the scientific information obtained in these experiments is so large that it cannot be represented with sufficient detail and clarity in the usual form of a scientific paper (for example in the form of an article or a report). Therefore the results of these experiments are given in the form of film, making it possible to present the dynamics of the investigated phenomena. The film with the results obtained from OGO-3 during one revolution of the satellite, from $13^h 30^m$ UT on 14 July 1966 to $15^h 21^m$ UT on 16 July 1966 involved 18,000 frames showing (condensed) approximately 550,000 individual measurements. On each of the frames are shown the position of the satellite relative to the boundaries of the magnetosphere and two simultaneously obtained energy spectra, of the electrons and of the protons. The rate of information transmission during the time of flight of OGO-3 reached 160 kilobit/sec.

The main content of the paper was published in the journal Izv. Vuzov, Radiofizika, v. 12, No. 9, 1. 1276, in an article by K. I. Gringauz, "Low-Energy Plasma in the Earth's Magnetosphere").

G. A. Smolenskiĭ and V. V. Lemanov, Hypersonic Waves in Crystals.

Hypersound is defined as elastic oscillations with frequencies exceeding 100 MHz. Experimentally, such oscillations, like ultrasonic oscillations, are obtained principally with the aid of the piezoelectric effect.

"From the point of view" of the crystal, hypersonic oscillations are none other than phonons, and in this lies the key to understanding the possibilities of hypersonic methods of investigation in solid-state physics. The phonon-phonon interactions, the interactions of phonons with free carriers and with magnons, the scattering of phonons by defects, the time of relaxation of phonons and their dispersion characteristics, the anharmonicity of the interaction forces in crystals, the behavior of soft modes under phase transitions—this is but a brief list of the phenomena that can be investigated with the aid of hypersonic methods.

The paper considers the results of certain investigations of the propagation of hypersonic waves in crystals of different types (dielectrics, ferroelectrics, semiconductors, ferrites), carried out at the Semiconductor Institute of the U.S.S.R. Academy of Sciences.

The investigations were carried out in a wide range of frequencies, 50–2000 MHz, and at temperatures 77–900° K.

Using as an example a large number of dielectric crystals, it has been shown that in the indicated frequency range, in sufficiently perfect crystals, the damping of hypersonic waves is due to the Akhiezer mechanism, the mechanism of the so-called phonon viscosity. It is shown that the damping correlates with the Debye temperature, and the anisotropy of the damping is determined by the anisotropy of the elastic moduli of third order.

The interaction of the hypersonic phonons with free carriers has been investigated with the piezoelectric semiconductor tellurium as an example. It is shown that at the corresponding polarizations and directions of propagation, the damping of the hypersonic waves is due practically entirely to the interaction with the free