A. N. Pushkov, É. B. Faĭnberg, T. A. Chernova, and M. V. Fiskina, Secular Variations of the Geomagnetic Field According to Recent Data. Using a consistent method, direct measurements were analyzed and analytic models constructed for the geomagnetic field and its secular variations for three overlapping time intervals:

1950—1975. Use of the most detailed and accurate information makes it possible to develop the series to $n = m = 9$, and the expansion is used to solve practical problems: preparation of new magnetic charts, reduction of data from surveys made at various times to the same epoch, forecasting of the field for the next five years.

1880—1970. Data from component surveys and observatories were used, the series was developed to $n = m = 6$, and the results were used to study the space-time features of the structure of the field with existence times of less than 100 years.

1500—1970. Data from angle measurements were used; the limited nature of the information permitted development of the series only to $n = m = 4$, and the results were used to study the space-time features of field structure with existence times of less than 600 years.

Analysis of the morphology of the field at various times makes it possible to distinguish effects that have different spatial and temporal characteristics.

First-order effects: global features of the spatial structure, variation amplitudes 25 γ/yr, existence time greater than the time interval considered. These effects include the decrease in the magnetic moment, the uniform component of westward drift at a rate of 0.2° per year, the northward shift of the dipole component, and the asymmetry of the fields of the Northern and Southern Hemispheres.

Second-order effects: large regional features of the field's spatial structure ("continental anomalies") and the corresponding foci of secular variation of the Atlantic type. Spatial dimensions of features 40—60°, existence time ~600 years, variation amplitudes 60—160 γ/yr. The features have a tendency to shift westward. The number of features is greater in the Southern than in the Northern Hemisphere, and this increases the asymmetry of the field.

The third-order effects are characterized by spatial dimensions of 20—30°, existence times of 40—70 years, and variation amplitudes of 40—100 γ/yr. The features first arise in the equatorial region and have westward and southward (Southern Hemisphere) and northward (Northern Hemisphere) velocity components; the southward and northward components increase with increasing distance from the equator. The accuracy of global representations is inadequate for study of these features, and must be filled in by the construction of more detailed charts, as is possible for Europe and the USSR, the USA, and Canada.

Conversion from the set of coefficients or the structure of the field to its sources is not possible within the framework of the Gauss-series expansion. Attempts to overcome this difficulty have been made by considering various combinations of harmonics separately and by constructing current functions and dipole or multipole models.

Seeking an expansion that takes account of the features of the space-time structure of the field and makes it possible to distinguish independent structures, we used an expansion in the natural orthogonal components. The field is represented by the series $H_{ij} = \sum T_{ki} X_{kj}$, where the T_{ki} are functions that depend only on the time i and the X_{kj} are natural functions that form, on a given set of points j, an orthogonal system that describes the spatial structure of the field. The principal property of the functions T_{ki} and X_{kj} consists in their being uncorrelated, i.e., different terms of the expansion describe different space-time features of the field. The previously described results of spherical analyses served as initial material for the expansion. The expansion was carried out on a BESM-6 computer. The results of the analysis permit more confident designation of effects with various characteristic times and spatial dimensions and estimation of the characteristic time of first-order effects at 1200 years, of the second-order effects at 600 and 300 years, and of the third-order effects at 120 and 60 years. Thus, in combination with the expansion in Gauss series, the natural-component expansion broadens the possibility for interpretation of the morphology of the field and its variations from the standpoint of S. I. Braginskiĭ's magnetoacoustic waves or Hyde's free field decay.
