course of the meeting, it became clear that it would be very difficult for surveys in a single country to recruit sufficient patients and offspring to obtain meaningful results. Extrapolations from animal data suggest that many thousand offspring of patients treated with cytotoxic drugs will have to be studied to detect an increase in genetic disease resulting from such treatment[3]. Examination of survivors from atomic bomb explosions have also shown that large numbers are needed to detect the effects of radiation[4].

At the first meeting, therefore, an international collaborative study was suggested, using a standardized protocol so that results could be pooled. A smaller group, including representatives of the Union Internationale contre Cancer, later met to formulate practical arrangements for initiating the study. The types of cancers to be studied would include childhood cancers, testicular tumours, and Hodgkin's and other lymphomas. Transplant patients and others treated with immunosuppressive drugs known to be mutagenic, such as cyclophosphamide[7,8], might also be included. Records would be kept of fertility, outcome of pregnancy including spontaneous abortions, birth weight, malformations and cancer in the offspring. Samples of blood would also be obtained from the patient, the other parent and the offspring, and stored in the hope that studies of chromosomes, protein (K. Berg, Oslo) or DNA variants would prove possible — potentially these could yield much more detailed information than records of clinical abnormalities[5]. At present, however, such studies are much more laborious and expensive; the DNA studies, though potentially the most informative, are also the most expensive (P. Pearson, Leiden).

Such a programme would benefit the patients and their offspring by providing information on the levels of genetic risk incurred from ever more aggressive cancer treatments. It is possible that the relative mutagenicity of different treatments could be assessed, so that the genetic risk could be reduced. Scientifically, the results could be compared with the extrapolations already made from animal work[6] to assess the validity of such extrapolation. Most important, data would become available on the effects that known doses of strong mutagens have on germ-cell mutation in man. This will be a major step in tackling the problem of mutation as a cause of human genetic disease. □

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Geophysics

International Geomagnetic Reference Field revision

from David R. Barraclough

THE International Geomagnetic Reference Field (IGRF) is a series of mathematical models of the main geomagnetic field and its secular variation. The models consist of sets of spherical harmonic (or Gauss) coefficients. IGRF has become widely used for deriving values of geomagnetic components used in, for example, studies of magnetic anomalies and investigations of charged particle motions in the ionosphere and magnetosphere.

Since it was first adopted by the International Association of Geomagnetism and Aeronomy (IAGA) in 1968 (IGRF 1965, ref.1), IGRF has been revised three times: IGRF 1975 (ref.2); IGRF 1980 (ref.3); and now IGRF 1985. Details of the derivation of the original IGRF and of its development up to 1981 have been given by Zmuda[4] and Peddie[5].

The latest revision of IGRF was considered by Working Group 1* (analysis of the main field and secular variations) of IAGA Division 1 during the Fifth General Assembly of IAGA held in Prague in August 1985. The following additions and modifications to IGRF 1980 were recommended.

- The extension of the definitive international geomagnetic reference field (DGRF) to 1980.0 by the adoption of a new model (DGRF 1980) to replace IGRF 1980.
- The addition of an international geomagnetic reference field for the interval 1985.0 to 1990.0 (IGRF 1985) consisting of a model of the main field at 1985.0 and a predictive model of the secular variation for use in adjusting the main-field model to dates between 1985.0 and 1990.0.
- The adoption of a provisional international geomagnetic reference field for the interval 1980.0 to 1985.0 (PGRF 1980), defined by linear interpolation between the coefficients of DGRF 1980 and IGRF 1985 (main field).
- The addition of a series of main-field models for the epochs 1945.0, 1950.0, 1955.0 and 1960.0 (IGRF 1945, IGRF 1950, IGRF 1955 and IGRF 1960).

DGRF now spans the interval 1965.0 to 1980.0 with four main-field models for 1965.0, 1970.0, 1975.0 and 1980.0 (DGRF 1965, etc.). For dates between the epochs of the models, linear interpolation between the coefficients of the two models on either side of the date is to be used. A similar procedure is to be used for dates in the interval 1945.0 to 1965.0, using the IGRF 1945, IGRF 1950, IGRF 1955, IGRF 1960 and DGRF 1965 models, as appropriate. Extrapolation back to 1940.0 will probably be reasonably accurate, though this was not formally recommended by the working group.

Further revision of DGRF is not anticipated. The pre-1965 models (IGRF 1945 to IGRF 1960) will probably be replaced by definitive models in 1987. The newly adopted DGRF 1980 model replaces the former PGRF 1975 and IGRF 1980. The present PGRF 1980 will be superseded when a definitive model of the main-field at 1985.0, different from IGRF 1985, is adopted.

The main-field models for 1960 to 1985 have 120 coefficients each and extend to degree and order 10. The main-field models for 1945 to 1955 and the predictive secular-variation model have 80 coefficients and extend to degree and order 8. The coefficients are given in the Schmidt quasi-normalized form[6] and refer to a sphere of radius 6,371.2 km. When converting between geodetic and geocentric coordinates the use of the international atomic unit (IAU) ellipsoid[7] is recommended; this ellipsoid has an equatorial radius of 6,378.16 km and a flattening of 1/298.25.

The coefficients of the IGRF models and computer programs for synthesizing field values are available from:

- World Digital Data Centre C1, British Geological Survey, Murchison House, West Mains Road, Edinburgh EH9 3LA, UK.
- World Data Center A, National Oceanic and Atmospheric Administration, EDIS/NGSDC (D62), 325 Broadway, Boulder, Colorado 80303, USA.
- World Data Center A for Rockets and Satellites, Code 601, NASA/Goddard Space Flight Center, Greenbelt, Maryland 20771, USA. □

*The membership of Working Group 1-1 is: D.R. Barraclough (chairman), W. Mundt (vice-chairman), F.S. Barker, V.P. Golovkov, P.J. Hood, F.J. Lowes, N.W. Peddie, Qi Guizhong, S.P. Srivastava, R. Whitworth, D.E. Winch, T. Yukutake and D.P. Zidarov.

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