Biophysical effects of steady magnetic fields

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Biophysical Effects of Steady Magnetic Fields: Proceedings of the Workshop. Les Houches, France, February 26–March 5, 1986. Springer-Verlag, Berlin; Heidelberg; New York; London; Paris; Tokyo, 1987. pp. 231.

The book contains the proceedings of the first workshop devoted to the study of interactions of steady magnetic fields with biological objects and with macromolecules. Among the participants of the conference there were physicists, chemists, biologists and physicians, and this determined the division of the book into 6 parts. The first part contains investigations on diamagnetic orientation of macromolecules and membranes. If biopolymers or membranes such as the outer segments of the retinal rods of the eye, the lipid mono- and bilayers, are suspended in water, then the most prominent reaction of these objects is their alignment under the action of a strong magnetic field of intensity of 1–10 T. A change in the orientation of macromolecules affects the course of many important biological processes. Torbet (Grenoble) discovered considerable deviations in the kinetics of the polymerization of fibrin—the principal elements in the process of coagulation of blood, while Melville with coauthors (England) have demonstrated the effect of the magnetic field on phase transitions of the type gel-liquid crystal in bilayer phospholipid membranes. R. P. Liburdi and T. S. Tenforde (USA) in studying the penetrability of monolayer liposomes have discovered that its changes upon application of a field of 7.5 T are noticeable only near the phase transition point, and this can be related to the formation of seeds of another phase with an increased diamagnetic susceptibility.

The second part of the book examines less traditional objects—ferroliquids which respond to fields of the order of several millitesla. Such sensitivity is explained by the presence of single-domain particles of a size of a few tens of nanometers covered by some kind of polymer preventing agglomeration. In medicine the interest in ferroliquids is due to the fact that they can be utilized, in principle, as carriers of drugs that can be controlled externally by the application of a magnetic field.

The third part contains 7 short notes devoted to the influence of weak magnetic fields of the order of several tens of gauss on biological and chemical reactions involving radicals. In this field possibly the greatest understanding has been achieved of physical mechanisms of the action of a magnetic field, since it has been demonstrated long ago that sensitivity to such a weak field is due to the presence of intermediates with nonzero spin. A. J. Hoff and E. J. Lous (Holland) gave a brief review of work on the effect of a field on photosynthetic reactions, in particular, on the primary transport of an electron in a reaction center. The estimates made by them made it possible to suppose that in the case of a reasonable lifetime of radical pairs attached, for example, to membrane proteins, the intensity of the earth's magnetic field is sufficient for such significant changes in the rates of radical reaction that they can be utilized for constructing a magnetic compass. K. Schulten with coauthors (FRG) have used the method of molecular dynamics to study the effect of a magnetic field on biradical reactions for radicals attached to the polymer CH_3–$(CH_2)_n$–CH_3 and have obtained reasonable agreement between theory and experiment. Within the same laboratory a theoretical model has been developed of a physiological magnetic compass which is based on the dependence of the yield of triplet products of a biradical reaction on the intensity and orientation of the field. The authors consider that the most suitable candidate for the role of such a biradical reaction is the reaction of the phosphorylization of rhodopsin—a protein localized in the outer segments of the retinal rods of the eye.

The fourth part of the book is a collection of short communications on the purely physiological effects of fields of intensity of ~ 1 T. This includes variations in the somatosensory human potentials, lowering of the temperature of certain sections of the epidermis by 0.3–5 °C, that can be associated with changes in the circulation of the blood. As a rule, the physical mechanisms of these phenomena are entirely unclear, however the lowering of the skin temperature can be partially explained by an increase in the thermal convection of the air arising in the region of high field gradients due to the paramagnetic nature of oxygen molecules. The same section contains the article by J. Bouvet and G. Maret (France) on the study of embryonic development in the presence of a strong magnetic field. They have deomonstrated that the development of quail embryo in the course of 16 days does not change in comparison with a control process, in any case if the field intensity does not exceed 6.4 T. In discussing the numerous and contradictory data in the literature concerning the anomalies in embryonic development the authors suppose that these anomalies are due to poor temperature control, which is required in the presence of high field gradients.

The fifth part of the book discusses problems of magnetic orientation and magnetoreception of live organisms in the earth's magnetic field. It is well known that many organisms (bacteria, insects, fish, birds and mammals) contain biogenic magnetite—ferromagnetic particles which are aligned under the action of the earth's field in spite of thermal motion. For bacteria and algae the size of the magnetic inclusions, apparently, is sufficient to explain their directed motion, and two papers by R. B. Frankel, L. Kirschvink and M. M. Walker (USA) are devoted to this subject. A large fraction of the articles contains important phenomenological information on the behavior of carrier pigeons in different "magnetic" situations: on the magnetic equator, within magnetic anomalies, after a brief application of a strong magnetic field, etc. This line of investigations is at present at the stage of accumulation of facts and physical hypotheses are not seriously discussed.

The last part of the book includes four short communications on medical applications of NMR-spectroscopy, which, generally speaking, are not closely related to the main

material of the book.

On the whole the book, in spite of a certain fragmentary nature, is a useful and timely attempt to bring together specialists in different fields for the solution of problems in magnetobiology. Among the merits of the book one should include its aim towards understanding the mechanisms of the action of a magnetic field on live organisms and the absence of descriptions of different "miraculous" medical applications which abound in this field of medicine. The book is useful to a wide circle of specialists involved in magnetobiology, and to physicists investigating the effect of a magnetic field on processes in which radicals take part.

Structure data of organic crystals

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Landolt-Börnstein. Numerical Data and Functional Relationships in Science and Technology. New Series. Group III. Vol. 10: Structure Data of Organic Crystals. Subvol. a: $C_1 \ldots C_{15}$. Springer-Verlag, Berlin; Heidelberg; New York; Tokyo, 1985. pp. 634.

The book under review (Volume 10, a) is a continuation of the volume III/5 "Structural data for organic crystals" published in 1970 and forming a part of the well-known multivolume reference work "Landolt-Börnstein. Numerical Data and Functional Relationships in Science and Technology."

Volume 10 includes structural data and some additional information (the method of recording x-ray reflections, the method of refining the structure and individual items of information concerning stereochemistry) for all organic compounds (including element-organic and also coordination compounds with, at least, one organic ligand) with the number of carbon atoms up to fifteen, the crystal structure of which is either completely or partially established by the method of x-ray structural analysis (publications covering the period 1969–1982).

The following items are included: the gross formula of a compound, its designation quoted by the authors of the paper, taken from "Chemical Abstracts" or deduced from the structural formula in accordance with the IUPAC nomenclature. This is followed by purely crystallographic data: the space symmetry group, the parameters of the elementary cell, the density of the crystals (experimental and x-ray values), the number of formula units in an elementary cell and the weight of one such unit, and the volume of an elementary cell.

And, finally, information is given on the habit and color of the crystals (for natural minerals also their origin), the solvent from which they are grown, and the method of crystallization.

Also the value of the R factor is given which characterizes the accuracy of structural determination.

Optical constants, and melting and boiling temperatures are given only in those cases when they had been determined in the reference being quoted. The list of the data is completed by the structural formula of the compound and the reference.

In the introduction in addition to the general characteristics of the tables and the order of arrangment within them of the data being quoted, a list is given of the symbols and abbreviations being used, and also a list of the symbols of the space symmetry groups.

It should be noted that similar information for compounds with the number of carbon atoms from 16 to 168 form the contents of the next volume 10b which also includes an index of the substances and an index of the cyclic compounds included in volumes 10a, b.

The "Landolt-Börnstein" reference series is a well-known scientific publication that has acquired a good reputation, which enumerates in concentrated form different characteristics of various substances. All this also applies to Volume 10a which is included in the III group (crystallography and solid-state physics) of the New Series. The information contained in this volume can be useful for synthetic chemists, analytical chemists, crystal chemists, crystal growth specialists, and crystal physicists.

Translated by G. M. Volkoff