245

PUBLICATIONS

ACHIEVEMENTS IN MAGNETOBIOLOGY

Moscow REAKTSIYA BIOLOGICHESKIKH SISTEM NA MAGNITNYYE POLYA (Responses of Biological Systems to Magnetic Fields) in Russian 1978 signed to press 24 Feb 78 pp 3-5 and table of contents

[Introductory article by Yu. A. Kholodov, Institute of Higher Nervous Activity and Neurophysiology, USSR Academy of Sciences, Moscow: "Achievements in Magnetobiology", and table of contents from the above collection, Nauka, 2250 copies]

[Text] Only six years have elapsed since the publication of the first collection of articles on magnetobiology [1] by the Scientific Council on the Complex Problem "Cybernetics" of the USSR Academy of Sciences, but there appeared many publications on this problem during this time (particularly in the USSR). All-Union Symposiums on Individual Problems of Magnetobiology were held in Moscow (1971, 1972, 1974), Baku (1972), Belgorod (1973), Frunze (1974), Leningrad (1975), Kaliningrad (1975), and Yalta (1975) [1-4, 7, 8, 13, 15]. Monographs were published [5,6,14,16-18] and survey articles were written [9,10]. Dozens of dissertations on individual problems of the biological effects of magnetic fields (MF) were defended, which indicates the development of this branch of biophysics in our country.

At present, there exist not less than 2000 published sources on the biological effects of MF. Magnetobiology is discussed in textbooks [12,20] and in encyclopedias [11, 19].

Practically no one doubts the biological effect of MF, but the question of how this effect is realized has not yet been answered satisfactorily. Therefore, the mechanism of the MF effect on biological systems received primary emphasis in the articles of this collection. In essence, each author gives some attention to this basic problem of magnetobiology, but articles treating exclusively this problem are included in the first section of this collection. The authors of the articles in this section are of physicochemical specialization. Each of them stresses the aspect which is the most important in his opinion in the many-sided process of the interaction of MF with biological objects, maps out various approaches to the solution of this important problem, and lays the foundation of a general theory of primary mechanisms (it is clear that there are more than one) of the biological effects of MF.

JPRS-14

The second part of the collection is written by physicians and biologists who focused their attention on the properties of biosystems (whether it is a mitochondrion or a population of organisms). Here, an MF often plays the role of a convenient instrument for studying a biosystem, although the ecological role of this physical factor is already reflected in some works. It is regrettable that the effects of weakened magnetic fields (WMF) on biological objects have not been sufficiently studied, and the role of biomagnetic fields in the functioning of biological systems and in magnetobiological responses is still not clearly understood.

It is shown that organisms react to MF both through reflexes, just as to other stimulants, and directly, since MF have a penetrating effect and can act directly on the central nervous system. The second route of influence was demonstrated in experiments with isolated preparations of the central nervous systems of mammals and with surviving nervous systems of invertebrates. It is interesting that the isolated central nervous system responded to MF better than the intact system [18].

We should also mention the third route of MF effects on the organism which is indirect in nature. The point is that aqueous solutions of many substances, including drinking water and solutions of pharmacological preparations, change their biological properties after treatment in MF [6].

Thus, by redirecting the effects, the researcher can vary the degree of the influence of the same MF on a biological object for the purpose of control. The length of exposure also contributes to the nature of the response to an MF which is characterized by a long latent period and considerable aftereffects. In the case of intermittent exposure, the summation of the effects is observed, which is used in physiotherapy [12], and when the exposure time is increased, adaptation is observed. However, the ultimate biological effect is determined not only by localization and length of exposure, but also by the characteristics of the biological object itself.

At the organism level, the response to the MF is determined by the specific and genetic characteristics, age (young organisms, particularly embryos, are sensitive to MF), sex (males are more sensitive than females), individual characteristics, and the functional state.

The above information shows which elements of the biological system are most vulnerable to the magnetic effect, but do not determine the degree of the biotropism of individual parameters of this effect.

The characteristics of the biological effectiveness of some MF parameters are treated in the third section of the collection. It was written by authors with engineering specialization. It is hoped that the information given in this section will help in raising the methodological level of magnetobiological experiments in which only the magnetic field intensity was mentioned most frequently.

It is also necessary to indicate the MF gradient and vector, and for variable MF, the frequency and the pulse shape should be given. The length of exposure to the MF and its localization also determine the value of the biological effect.

The above discussions dealt with biological effects at fixed MF parameters. It was shown that the effectiveness of exposure increases if one or several parameters of the effect are varied during the exposure [19]. For example, an intermittent effect is stronger than a continuous effect, and the effect of changing frequency is stronger than the effect of fixed frequency, etc.

It should be concluded that, by artificially changing the MF parameters, one can, to a certain degree, control the behavior of the organism, influencing in a contactless way its regulation systems.

The ultimate goal of magnetobiological studies -- the possibility of controlling the activities of biosystems -- can be accomplished by including feedback in the circuit of the automated controlled experiment. The materials of this collection have outlined the ways of achieving this goal. It is hoped that the complex theoretical and practical problems of magnetobiology will be solved through joint efforts of various specialists.

Bibliography

1. "Effects of Artificial Magnetic Fields on Living Organisms." 1972. Materials of All-Union Symposium, Baku.

2. "Effects of Natural and Weak Artificial Magnetic Fields on Biological Objects." 1973. Materials of All-Union Symposium, Belgorod.

3. "Effects of Magnetic Fields on Biological Objects." 1975. Materials of the III All-Union Symposium, Kaliningrad.

4. "Hygienic Evaluation of Magnetic Fields. 1972." Materials of the Symposium, Moscow.

5. Dubrov, A. P. 1974. "Geomagnitnoye pole i zhizn'" [Geomagnetic Field and Life], Leningrad, Gidrometeoizdat.

6. Klassen, V. I. 1973. "Voda i magnit" [Water and Magnet], Moscow, Nauka.

7. "Space and Evolution of Organisms." 1974. Conference Materials, Moscow.

8. "Magnitnoye pole v meditsine" [The Magnetic Field in Medicine]. 1974. TRUDY KIRG MED IN-TA [Proceedings of the Kirghiz Medical Institute], Frunze, 100.

9. Maykelson, S. M. 1975. "Radio-Frequency Radiation. Magnetic and Electric Fields," in the collection: "Oznovy kosmicheskoy biologii i meditsiny" [Fundamentals of Space Biology and Medicine], Vol 2, Book 2, Moscow, Nauka, p 9.

10. Nakhil'nitskaya, Z. N. 1974. "Biological Effects of Magnetic Fields," KOSMICHESKAYA BIOLOGIYA I AVIAKOSMICHESKAYA MEDITSINA [Space Biology and Aerospace Medicine], No 6, p 3.

11. Novitskiy, Yu. I. 1973. "Magnetobiology," "Detskaya entsiklopediya" [Children's Encyclopedia], Moscow, Pedagogika, p 62.

12. Pasynkov, Ye. I. 1975. "Fizioterapiya" [Physiotherapy], Moscow, Meditsina.

13. "Responses of Biological Systems to Weak Magnetic Fields." 1971. Symposium Materials, Moscow.

14. Travkin, M. P. 1971. "Zhizn' i magnitnoye pole" [Life and the Magnetic Field], Belgorod.

15. "Physicomathematical and Biological Problems of the Effects of Electromagnetic Fields and Air Ionization." 1975. Materials of the All-Union Scientific and Technical Symposium, Moscow, Nauka.

16. Kholodov, Yu. A. 1970. "Magnetizm v biologii" [Magnetism in Biology], Moscow, Nauka.

17. Kholodov, Yu. A. "Chelovek v magnitnoy pautine" [Man in a Magnetic Cobweb], Moscow, Znaniye.

18. Kholodov, Yu. A. "Reaktsii nervnoy sistemy na elektromagnitnyye polya" [Responses of the Nervous System to Electromagnetic Fields], Moscow, Nauka.

19. Kholodov, Yu. A. 1974. "Magnetobiology," BSE [Great Soviet Encyclopedia], Vol 15, p 167.

20. Beier, W. 1975. Biophysik, VEB Gorg Thieme. Leipzig.

Contents

10,233
CSO: 8144