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# INFLUENCE OF WELL-ORDERED MAGNETIC-DOMAIN STRUCTURES ON BIOMECHANICAL CHARACTERISTICS AND ON SYMMETRIES OF BIOLOGICAL OBJECTS*

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**Abstract**: *This report is devoted to the importance of symmetries in the phenomena of physiological effects caused by well-ordered magnetic-domain structures.*

Vital functions of the biosphere depend essentially on ecological conditions, which change during technical progress appreciably. One of such changes is the fast saturation of anthropogenic environment by bearers of micro-structured low-intensity (mainly magnetic- or electrical-) physical fields. Numerous well-ordered magnetic-domain bearers used in electronic and information engineering, and a variety of elements of the images on television screens as well as electret materials widely produced by mankind, etc. are at stake. The relations of symmetry, which describe inter-dispositions and kinds of separate domains in such polydomain complexes, define both functional qualities of these bearers and their influence on environmental biological objects in many respects. Qualitative materials for the generation of the named magnetic domains are from 1 up to 20 micron thick transparent **M**agnetic **F**ilms of **G**amete-type **F**errites (MFGF). We used

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these special modified films for experimental research described below. These magnetic-domain structures are active modifiers of environmental background electromagnetic fields and they are capable to generate their own low-intensity fields due to dynamics of interdomain borders, etc. (Figure 1).

Biological organisms also consist of a set of more or less well-ordered domains (forming sometimes hierarchical set of polydomain structures of different levels): ensembles of cells, cell membranes with repeating typical structural units, and other macromolecular or supramolecular biological structures, repeated many times. These polydomain biological objects with symmetry relations between separate domains are bearers of appropriate low-intensity and domain-structured physical- (mainly electrical- and magnetic-) fields, which, as it is known for a long time, are generated on them (for example, on boarders of different phase states – liquids, solids, etc). These low-intensity fields can have rather high-gradient, i.e., their values and mathematical sign can change appreciably on small distances (for example, in units and fractions of microns). It is possible to believe that these fields play an important role in self-organizing and cooperative behaviour of components of biological organisms.

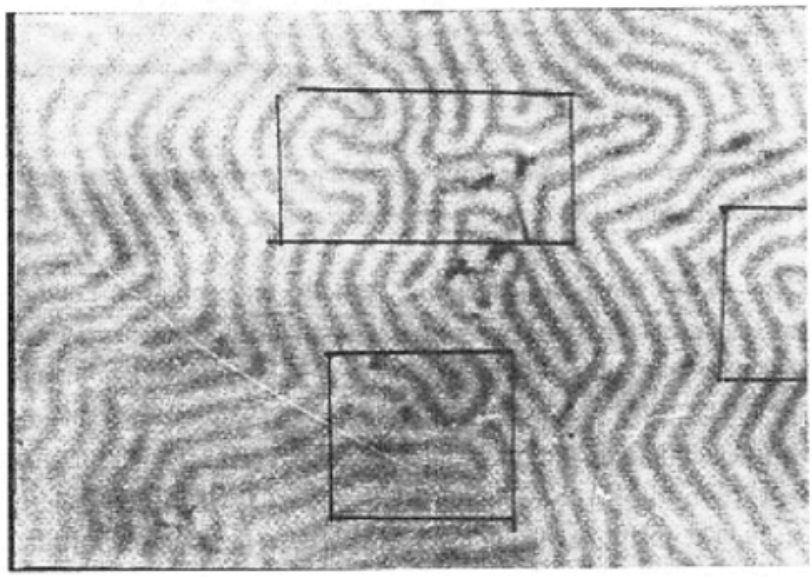

**Figure 1:** Labyrinth textures of magnetic-domain structures

The biological action of well-ordered magnetic-domain structures is demonstrated in this report, first of all, on morph-functional changes in human generative cells – spermatozoa (Figure 2-4). Magnetic-domain films of gamete-type ferrites (MFGF), which have a

possibility to generate low-intensity physical fields, have been used in magneto-biology for more than 10 years. Their advantages are firstly strict order (symmetrical character of a mutual arrangement and forms of separate domains) of strip, labyrinth or tessellation structures in a static mode, and secondly minimal density of magnetic defects. In 1989 the authors of this report described the character of influence of these structures on pathogenic pale treponema for the first time. Pale treponema is a 0.1 micron thick membrane cylinder, an elementary system for studying the behaviour of biological objects in a magnetic field. We have shown that at contact influence on medium, which contains of pale treponema, the increase of mobility of treponema is observed. We have also shown, that the character of spiralization and symmetrical design changes depending on the intensity of the field.

Spermatozoa are specialized cells consisting of oval head and an about 1 micron thick flagellum. Flagellum of spermatozoon is also a membrane cylinder, but its internal structure is more complex, than that of the treponema, and it consists of well-ordered microtubules and fibrils. In the present work we investigated behavior of spermatozoon under influence of low-intensity physical fields, induced by MFGF with different width of domain structures. Human spermatozoa were maintained on MFGF at 37 °C for 30 minutes and they were fixed by 2.5 % solution of glutar aldehyde at phosphate buffer (pH = 7.2). After dehydration and drying in a critical point of sublimation carbonic acid, they were studied with Hitachi Co. electron microscope.

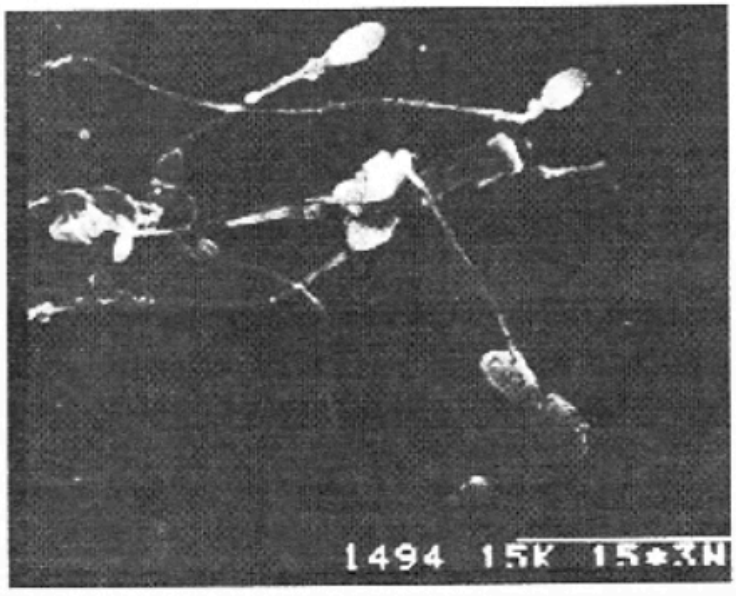


Figure 2: Human spermatozoa in normal state

We have shown that morphology of flagella changed naturally under influence of MFGF and these changes depend on the width of the symmetrized domain structures. On low-domain structures ($p < 1$ micron) the bends of the flagella are observed, resulting in a flagellum representing a broken line with an angle of 120° between pieces. The breaking points, apparently, coincide with zones of change in the internal structure of the flagellum.

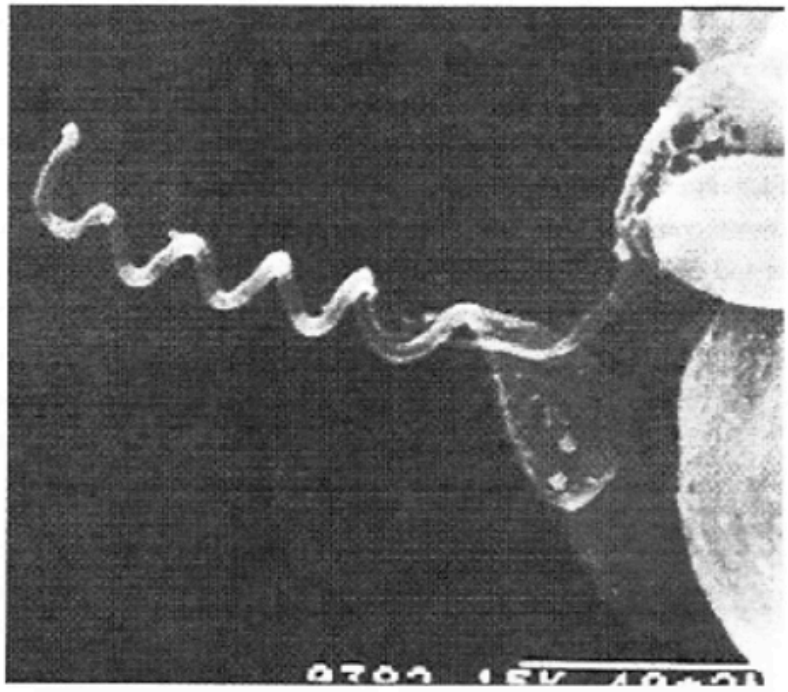

**Figure 3**: Human spermatozoa obtain unusual spiral morphology under short-term influence of MFGF with special parameters

Incubation of spermatozoa on MFGF with domain width of $p$=18.6 microns results in occurrence of spiral structures of flagella. Incubation of spermatozoa on MFGF with domain width $p$=26.6 microns lead to more expressed curling of flagellums, which form a ring consisting of several coils of spirals close to one another. Flagella can be twisted around of the head of the spermatozoon or around the cytoplasmic drop of the neck of the spermatozoon. In both cases, a prolonged influence (60-90 minutes) of the magneto-domain structure leads to pathospermia, to violations of mobility of cells and to changes of the symmetrical characteristics of their form.

The change of morphology of spermatozoa under action of magnetic-domain structures allows putting a question about genetic safety of generative cells in vivo. We investigated the state of spermatogenesis of mice, which were placed on a surface of MFGF with various widths of domain ($p$=5,3; $p$=18,6; $p$=26,6 microns) for various terms (10, 30 and 70 minutes). The state of spermatogenesis was defined as the state of synaptonemic complex (SC) of meiotic chromosome and as morphology of testicles. SC represents an original skeleton of chromosomes in meiosis, the estimation of its configuration allows to estimate presence and degree of chromosome reorganizations at meiotic division of the predecessors of sexual cells. For research of SC, a material of homogenized testicles of mice males was placed on a surface of a hypotonic solution, which was located on a surface of a plastic foil.

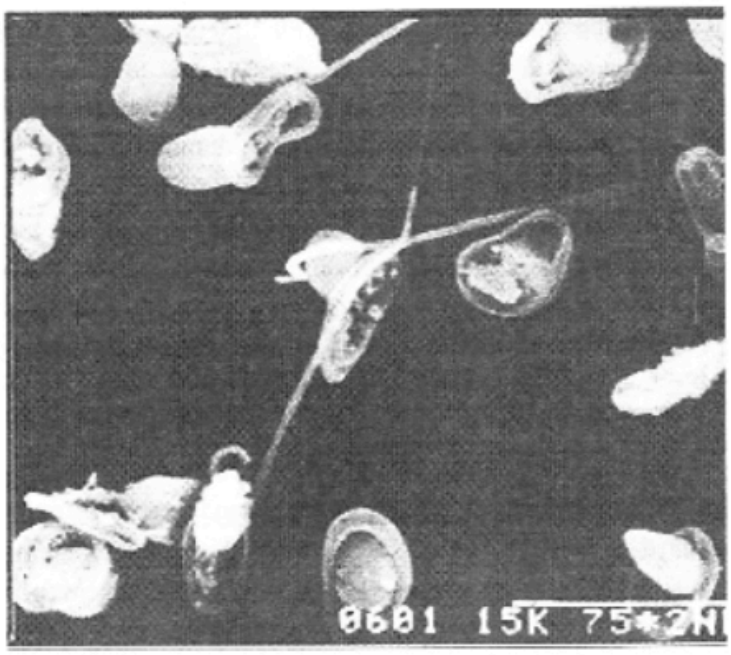


**Figure 4**: Human spermatozoa obtain unusual "turban" morphology under short-term influence of MFGF with special parameters

Parts of plastic with preparations of spread-eagle nucleuses and spermatozoa were investigated with electronic microscope JEM-100-C. Morphology of testicles was studied with different transmission electronic microscope. We have shown that when mice were influenced by action of MFGF for 70 minutes, the degeneration of SC and infringement of co-orientation of their chromosomes were observed. At research of ultra structure of testicles, degenerate changes of the cells – predecessors of spermatozoa

(with change of symmetric characteristics of their form) – were also observed after 70 minutes of incubation on MFGF with various width of domain structures.

Another thematic example is the study of the influence of MFGF on aggregation of platelets. We applied a method of artificial aggregation (in vitro) of blood nuclear-free plates in addition of inductor of aggregation (ADF) to plasma of blood enriched with platelets. This method was used as a basic method for analysing of aggregation process. Initially, plasma of blood was taken from 10 patients, who were conditionally healthy. Results have shown that MFGF influenced essentially a degree of aggregation of platelets (in vitro) in case of plasma of the healthy people. For example, wide-domain films ($p_{02}$=40-46.6 microns) intensify aggregation of platelets of 2.5 times, whereas narrow-domain films ($p_{02}$=3-5 microns) depress this aggregation. In this connection we chose a variant of MFGF with domain width of 15.0-18.0 microns for magneto-therapy.

Clinical researches were carried out on 46 patients with chronic venous disease on their legs (fifteen of these patients had trophic ulcers). The duration of a therapeutic session on each leg was 1.0-1.5 minutes. In the course of a session, the device with MFGF was moved basically in a direction from the large finger of the toe to the knee with a speed of approximately 1 centimetre per second both on the forward part of the leg and above calf. The distance from the surface of the MFGF up to the surface of the skin was about 5-15 mm, and the plate of the MFGF was directed parallel to an appropriate part of the leg.

In the course of the magneto-therapy, side effects were not observed. Anesthetic effect was observed after one or two treatments. Antispasmodic, antihydrophic and trophic effects were realized on the fifth or sixth treatments with gradual fading of symptoms of diseases. The authors' theoretical explanation of similar phenomena of the expressed physiological influence of MFGF is connected in many respects to the representations of solitonic self-organization of energy in non-linear biological media (concept of bio-solitons) and of paramagnetic properties of oxygen, natrium, potassium and calcium as well. Our research has shown that the influence of symmetric structured MFGF is well founded and that it's a basis of effective method for the treatment of patients with chronic venous diseases in the stage of trophic disease. This method and devices can be offered to practical public health services.