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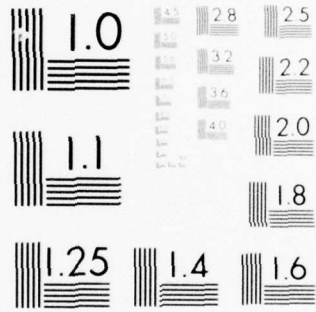
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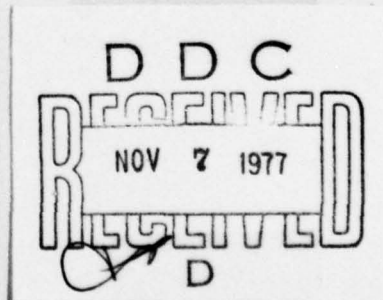
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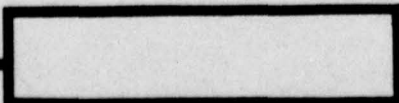
ELECTROMAGNETIC FIELDS AND CONTROL
IN BIOLOGY

by

A. S. Presman



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ELECTROMAGNETIC FIELDS AND CONTROL IN BIOLOGY

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	<i>А а</i>	A, a	Р р	<i>Р р</i>	R, r
Б б	<i>Б б</i>	B, b	С с	<i>С с</i>	S, s
В в	<i>В в</i>	V, v	Т т	<i>Т т</i>	T, t
Г г	<i>Г г</i>	G, g	У у	<i>У у</i>	U, u
Д д	<i>Д д</i>	D, d	Ф ф	<i>Ф ф</i>	F, f
Е е	<i>Е е</i>	Ye, ye; E, e*	Х х	<i>Х х</i>	Kh, kh
Ж ж	<i>Ж ж</i>	Zh, zh	Ц ц	<i>Ц ц</i>	Ts, ts
З з	<i>З з</i>	Z, z	Ч ч	<i>Ч ч</i>	Ch, ch
И и	<i>И и</i>	I, i	Ш ш	<i>Ш ш</i>	Sh, sh
Й й	<i>Й й</i>	Y, y	Щ щ	<i>Щ щ</i>	Shch, shch
К к	<i>К к</i>	K, k	Ъ ъ	<i>Ъ ъ</i>	"
Л л	<i>Л л</i>	L, l	Ы ы	<i>Ы ы</i>	Y, y
М м	<i>М м</i>	M, m	Ь ь	<i>Ь ь</i>	'
Н н	<i>Н н</i>	N, n	Э э	<i>Э э</i>	E, e
О о	<i>О о</i>	O, o	Ю ю	<i>Ю ю</i>	Yu, yu
П п	<i>П п</i>	P, p	Я я	<i>Я я</i>	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
 When written as ë in Russian, transliterate as yë or ë.
 The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

GREEK ALPHABET

Alpha	Α α	α	Nu	Ν ν
Beta	Β β	β	Xi	Ξ ξ
Gamma	Γ γ	γ	Omicron	Ο ο
Delta	Δ δ	δ	Pi	Π π
Epsilon	Ε ε	ε	Rho	Ρ ρ ϱ
Zeta	Ζ ζ	ζ	Sigma	Σ σ ς
Eta	Η η	η	Tau	Τ τ
Theta	Θ θ	θ	Upsilon	Υ υ
Iota	Ι ι	ι	Phi	Φ φ
Kappa	Κ κ	κ	Chi	Χ χ
Lambda	Λ λ	λ	Psi	Ψ ψ
Mu	Μ μ	μ	Omega	Ω ω

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English
sin	sin
cos	cos
tg	tan
ctg	cot
sec	sec
cosec	csc
sh	sinh
ch	cosh
th	tanh
cth	coth
sch	sech
csch	csch
arc sin	sin ⁻¹
arc cos	cos ⁻¹
arc tg	tan ⁻¹
arc ctg	cot ⁻¹
arc sec	sec ⁻¹
arc cosec	csc ⁻¹
arc sh	sinh ⁻¹
arc ch	cosh ⁻¹
arc th	tanh ⁻¹
arc cth	coth ⁻¹
arc sch	sech ⁻¹
arc csch	csch ⁻¹
—	
rot	curl
lg	log

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ELECTROMAGNETIC FIELDS AND CONTROL IN BIOLOGY.

A. S. Presman.

Pages 341-350.

The analysis of the accumulated experimental material and some general biological considerations ~~make~~ it possible to allow/assume the effect of electromagnetic fields ^(SMF) ~~(EMP)~~ from infra-low to superhigh frequencies on control biological processes. It is possible to assume that EMP play the significant role in evolution and the vital activities of organisms, since:

1. Is presented probable the existence of three forms of the biological activity of the EMP: effect on the organisms of the EMP of environment, electromagnetic interactions within organisms and interaction between organisms with the aid of EMP.

2. These three forms of the activity of EMP are connected mainly with control in living nature at all levels of its functioning - from the molecular to organizmennogo.

3. At the base of the biological activity of EMP lie/rest faster the informational interactions, than energy. The main role plays not the conversion of electromagnetic energy into other forms, but the

information, transmitted with the aid of EMP.

4. With development of technology in the living environment of organisms appear iskusstveno create the EMP, which can affect organisms.

Let us attempt to show the validity of these positions, on the strength of general biological considerations and on the basis of the experimental data. Let us examine the possible ways of the explanation of the nature of the different manifestations of the biological activity of EMP.

The evolution of living nature occur/flow/lasted with existence in the environment of the sources EMP, overlapping virtually entire frequency range in question - from the slowly changing magnetic and electric fields of earth to the superhigh-frequency radioizluchaeniy of the Sun. But living nature exists and evolves in interaction with environment. Therefore it is possible to a priori predpolgat' that the EMP of any frequency region of the spectrum they played some role in the evolution of living organisms and that this was reflected in the processes of the vital activity of organisms.

The intensities of natural EMP are small, but the quanta of energy are considerably less than kT . Therefore it is highly improbable, that EMP we could serve as energy source for living organisms, as it takes place in the relation to infrared and luminous radiations. Are presented, however, probable the informational functions of EMP in living nature. Indeed informational interactions with the aid of the EMP of the region of the spectrum in question can be realized in all living environments of organisms - in the

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atmosphere, in sea water, in the earth's crust and finally in tissues of organism. But with statistical reception/procedure and the corresponding coding informational signals can transmit the EMP of very low energy.

To the communication/connection of the control of the vital activity of organisms with the EMP of environment indicates the presence of conformity between alternations in the EMP and the fundamental biological rhythms, confirm by the generalized data (Fig. 1).

With the 11-year cyclic recurrence of an increase in the level of magnetic activity (Yanovskiy, 1964) coincide increases in the number of populations of animals (Willy, 1959) to of the outbreak of epidemics (Berg, 1960). In favor of the fact that this is connected precisely with magnetic activity, testifies the reliably established/installed correlation of the numbers of cardiovascular and neuro-psychic diseases with magnetic storms during periods from 7- before the 35-daytime (Friedman a oth., 1963).

Page 342.

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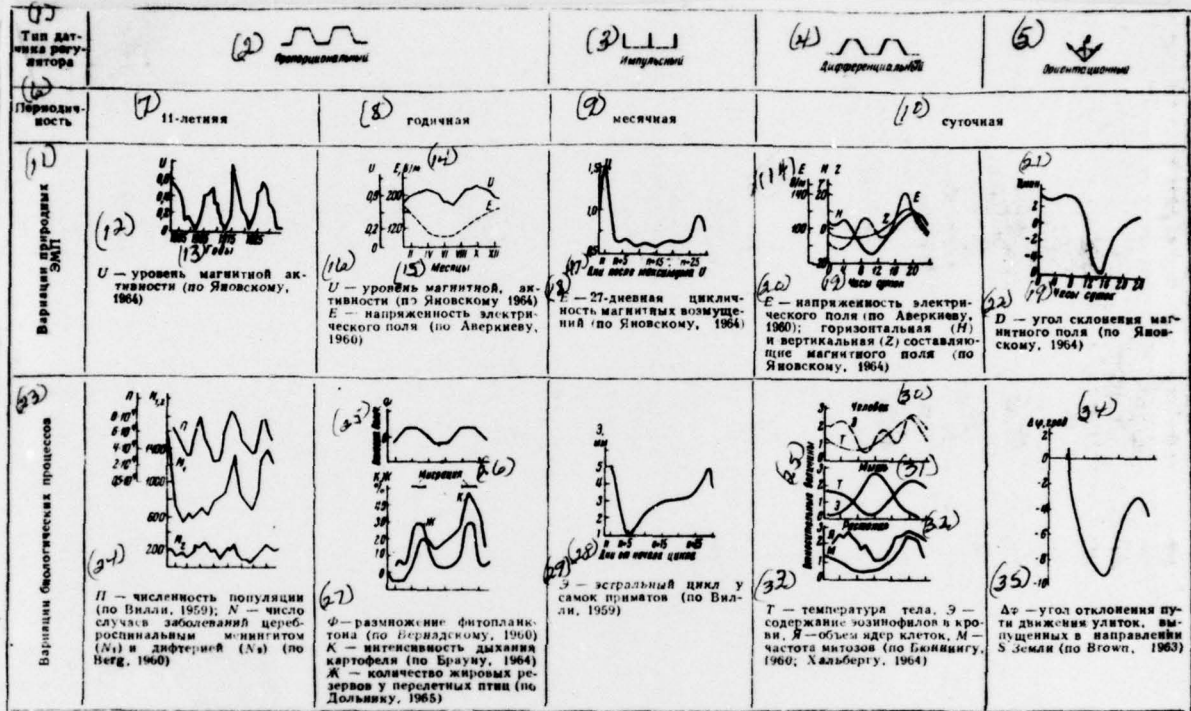


Fig. 1. Rhythms of natural electromagnetic fields (EMP) and of biological processes.

Key: (1). Type of the sensor of regulator. (2). Proportional. (3). Pulse. (4). Differential. (5). Orientational. (6). Periodicity. (7). 11-year. (8). annual. (9). monthly. (10). diurnal. (11). Variations in the natural EMP. (12). U, the level of magnetic activity (on Yanovskomu, 1964),. (13). Years. (14). water in oil. (15). Months. (16). U is a level magnetic, activity (on Yanovskomu 1964); E is an electric intensity (on Averkijevu, 1960). (17). They after maximum U. (18). E is a 27-daytime cyclic

recurrence of magnetic perturbation (on Yanovskomu, 1964). (19). Hours of days. (20). E is an electric intensity (on Averkiyevu, 1960); the horizontal (H) and vertical (Z) components of magnetic field (on Yanovskomu, 1964). (21). min. (22). D is an angle of depression of magnetic field (on Yanovskomu, 1964). (23). Variations in the biological processes. (24). P - the number of population (according to Willy, 1959); N is a number sluchasv of the diseases by cerebrospinal meningites (N_1) and by diphtheria (N_2) (on Berg, 1960). (25). Relative values. (26). Migrations. (27). ϕ - the reproduction/multiplication of phytoplankton (on Vernadskomu, 1960); K - the intensity of the dvkhaniya of potatoes (according to Braun, 1964); \mathcal{M} are a quantity of fatty reserves in migratory birds (on Dol'niku, 1965). (28). Days from the beginning of cycle. (29). \mathcal{S} - oestral cycle in the females of primatov (according to Willy, 1959). (30). Men. (31). Mouse. (32). Plants. (33). T - the temperature of body, \mathcal{S} - the content of eosinophils in the blood, \mathcal{A} - the space of the nuclei of cages, \mathcal{M} - the frequency of mitosis (on Byunningu, 1960; to Khal'bergu, 1964). (34). deg. (35). $\Delta\phi$ - the angle of deflection of the path of motion of the snail/cochleas, released in napravlenyi S of earth (according to Brown, 1963).

Page 343.

To the maximums of the annual periodicity of the level of magnetic activity correspond the maximums of biological processes of the plants (Vernadskiy, 1960; Braun, 1964) and of animals (Dol'nik, 1965). In these examples a periodic increase in the level of magnetic activity

it is possible to examine as "the proportional" sensor of control.

A series of biological processes (especially connected with reproduction/multiplication) occur/flow/lasts with 27-28-daytime rhythm. Through the same approximately intervals are repeated the weak magnetic storms, which it would be possible to examine as "pulse" sensor for the regulation, for example, of oestral cycles in the females of primatov.

Many processes of vital activity proceed with the "tsirkadnoy" rhythmicity, synchronous with diurnal-periodical changes in environment. These rhythms are retained at constant temperature, illumination, pressure. Therefore (and partly according to other considerations) they consider that the control of rhythms is realized by a endogenous mechanism - "biological clock", not depending on environment (Shnol', 1964). However, there are foundations for assuming (Brown, 1963) that these "hours" are synchronized by external "differential" sensors - the diurnal periodical electrical and magnetic fields of earth (Averki, 1960). The curve/graphs (Fig. 1) illustrate correlation (positive and negative) between changes in the fields and biological processes of different organisms (Byunning, 1960; Khal'berg, 1964).

Malnitnoye field can yavlyae'sya and by "orientational" sensor. This indicates conformity between daily variations in the direction of the motion of snail/cochleas relatively the magnitnoso of meridian (Brown, 1963) and the corresponding changes in the angle of depression of the magnetic field of earth.

Are known finally the short-range fluctuations of the magnetic

intensity of earth - with periods from several minutes to hundredth fractions of a second. It is characteristic that in this same range occur the oscillations of bioelectric activity.

Thus, general biological considerations and the given comparisons lead to zakyucheniye, that the questions of the effect of natural EMP on biological control deserve on the drayney measure of serious study.

The second form of the biological activity of EMP - the electromagnetic control of processes in organism - long is already established/installed by electrophysiology for a low-frequency range (approximately to 1000 Hz). There are foundations for assuming (Presman, 1964) interaction between cages and macromolecules with the aid of EMP and more high frequencies. Here can lie/rest the roots of the unexplained thus far nature of some selective interactions between cages and macromolecules at living organism.

The question concerning the third form of the biological activity of EMP - the electromagnetic communication/connections between individuals of one, and it is possible, and the different types of animals - is interesting in connection with the existence of distant interactions between them, such, as call of the individual of contradictory/opposite sex/floor, the coordination of simultaneous maneuvers in the flocks of birds and fishes, the coordination of the activity of community insects and, etc.

The most convincing experimental data on the biological activity of EMP are obtained for the latter of 10-15 years. Are established/installed the different manifestations of the biological effect of the EMP of different frequencies, magnetic and electric

fields. It turned out that to EMP react the different organisms - from the unicellular to man. Action EMP is reveal/detected at all levels of the functioning of organisms - from the molecular to the systemic, and also in vitro at cellular and molecular energy levels (Presman, 1961, 1965; Boyenko, 1964; Letavet, 1964; Barnothy, 1964; Gol'dberg, 1965).

Page 344.

In Fig. 2 given exemplary/approximate spectral distribution of the intensities of the natural EMP of environment and the experimentally established/installed minimum threshold intensities, at which reveal/detected biological effect EMP in experiments on spinal and invertebrate animals, on plants, at cellular and molecular energy levels.

Frequencies approximately to 1000 Hz can be, apparently, examined as characteristic for living organisms. This is the range of alternations and natural EMP and biological processes. In this frequency range it was possible to reveal/detect threshold intensities for biosystems, the considerably lower, than intensities of natural EMP. In this case the uchsvitel'nost' of biosystems render/showed on several orders higher than that, that is presented probably from the examination of interactions EMP with the molecules of biological substances (Barnothy, 1964).

In the range from the high to superhigh frequencies natural EMP - atomospheric discharges and solar noises - are the noncoherent radiation, total intensities of which sharply decrease with an increase in the frequency. These EMP cannot be considered as the

synchronizing regulators of biological rhythms in the complete organisms, since threshold intensities for biosystems in this range significantly higher of the corresponding intensities of natural EMP. However, even, here the sensitivity of the biosystems to of EMP significantly higher theoretically obtained from the examination of effects at molecular energy levels.

In the entire region of the spectrum in question the uncommonly high sensitivity to of EMP is noted mainly of the complete organisms; it is the higher, the more complex the level of organization. This one must not fail to consider in the study of the problem concerning the nature of the biological effect of EMP. Are incorrect the confirmations of some scientists, that the reactions of the complete organism generally cannot be considered as proof of the existence of the biological effect of EMP and that this action compulsorily must be revealed/detected on simple physicochemical systems.

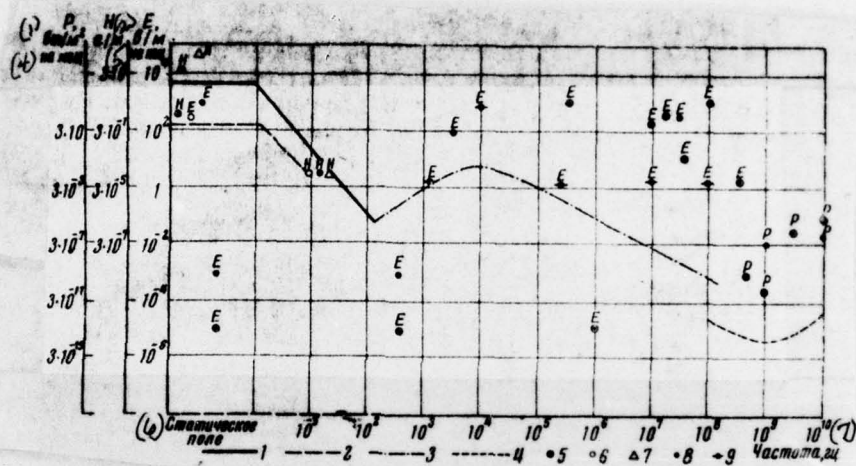


Fig. 2. Intensity of natural electromagnetic fields (EMP) and the sensitivity of the biosystems: 1 - the magnetic field of earth; 2 - the electric field of earth; 3 - atmospheric discharges; 4 - solar noise. Threshold intensities of the reaction: 5. vertebrates; 6 - invertebrates; 7 - plant; 8 - at cellular level; 9 - at molecular

energy levels.

Key: (1). W/m^2 . (2). $\frac{A}{m}$. (3). water in oil. (4). to MHz.
(5). on kHz. (6). Permanent field. (7). Frequency, Hz.

Page 345.

Are incorrect the attempts to search for the mechanisms of the biological effect of EMP only at microscopic level. Such views disregard the specific "organization" in living nature, which is inherent in it the "sverkhadditivnost'", which develops itself in the fact that with the complication of biosystems appear the new properties, which do not possess the component system cell/elements (Dent-Derdi, 1964; Foerster, 1965).

Apparently, the different manifestations of the biological effect of EMP are connected also with the different, still not studied mechanisms, characteristic for each level of organization. So, yet guessed the nature of the elektrovzbudimosti of cage, although about the physicochemical processes, connected with this phenomenon, is known already much. In the first stages for the researchers it is necessary to use the method of "black box" and, on the strength of experimentally established/installed "input" and "output" characteristics, to select the appropriate equivalent schemes. Let us examine this in an example of the features of the different manifestations of biological effect EMP, illustrated in Fig. 3.

The character/nature of the action of EMP on macromolecules depends in vitro also on the value of the affecting energy and on frequency. During heating protein solution/opening by VHF field the

dependence of the percentage of denaturation on time of action just as with usual thermal denaturation - is exponential (Marha, 1963). The same character/nature has the time/temporary dependence of a change in the optical activity the 0.4-0.50/o- of the solution/opening of glycogen under the effect of feeble VHF field. With concentration 0.10/o dependence bears multistage sarakter (Van Everdingen, 1941).

The dependence of molecular effects on frequency also is double. For example, the activity of catalase is reduced at selective frequencies in low-frequency range, and in ultrahigh-frequency-range it is observed smooth dependence on frequency (Chirkov, 1964). The distinct resonance character/nature of the effect of an increase in the activity of gamma globulins of man in the range ultrahigh-frequency is shown by Bach, etc. (Bach a oth., 1961).

On the base of such special feature/peculiarities of the action of EMP on macromolecules can lie/rest the different mechanisms, caused by the multiple staging of the structural organization of macromolecules, for example by synchronous conformational oscillations (Shnol', 1965). One should consider possible the rol6rastvoritel4-water, which possesses at the molecular energy levels of series unique properties (Klotts, 1964). Resonance absorption can be connected also with dipole-dipole passages because of the fluctuations of proton distribution in protein molecule (Vogelhut, 1960), and with piezoelectric resonance (Tul'skiy and other 1965) and with nuclear-quadrupole resonance, etc.

The character/nature of the reactions of cages and unicellular organisms depends on that, which macrostructures directly they affect

EMP. The effects, connected with the reaction of central structures (nuclear organelles), depend on the affecting energy two-phase. Examples of this dependence are a change in the phagocytic activity of parametsiy under the action of the VHF field (Kulin, Morozov, 1964) and of the rate of growth of bacteria in magnetostatic field (Gerenser a oth., 1962). The effects of the action of EMP on the peripheral excitable structures of cage in practice do not depend on energy, if it is higher than the threshold of response. This is illustrated by a change in the excitability of the nerve of frog (Kamienski, 1964) and of parametsii (Presman, Rapoport, 1965) under the action of VHF field.

Resonance character/nature bear the effects, connected with the action of EMP on central structures, for example the retardation of an increase in the cages of mammals (Knoepp a oth., 1962), but smooth frequency dependence is observed in the efektakhdeystviya of EMP to the peripheral excitable structures of cage - the motor reaction of the neuromuscular preparation of frog and parametsii (Presman, Rapoport, 1964).

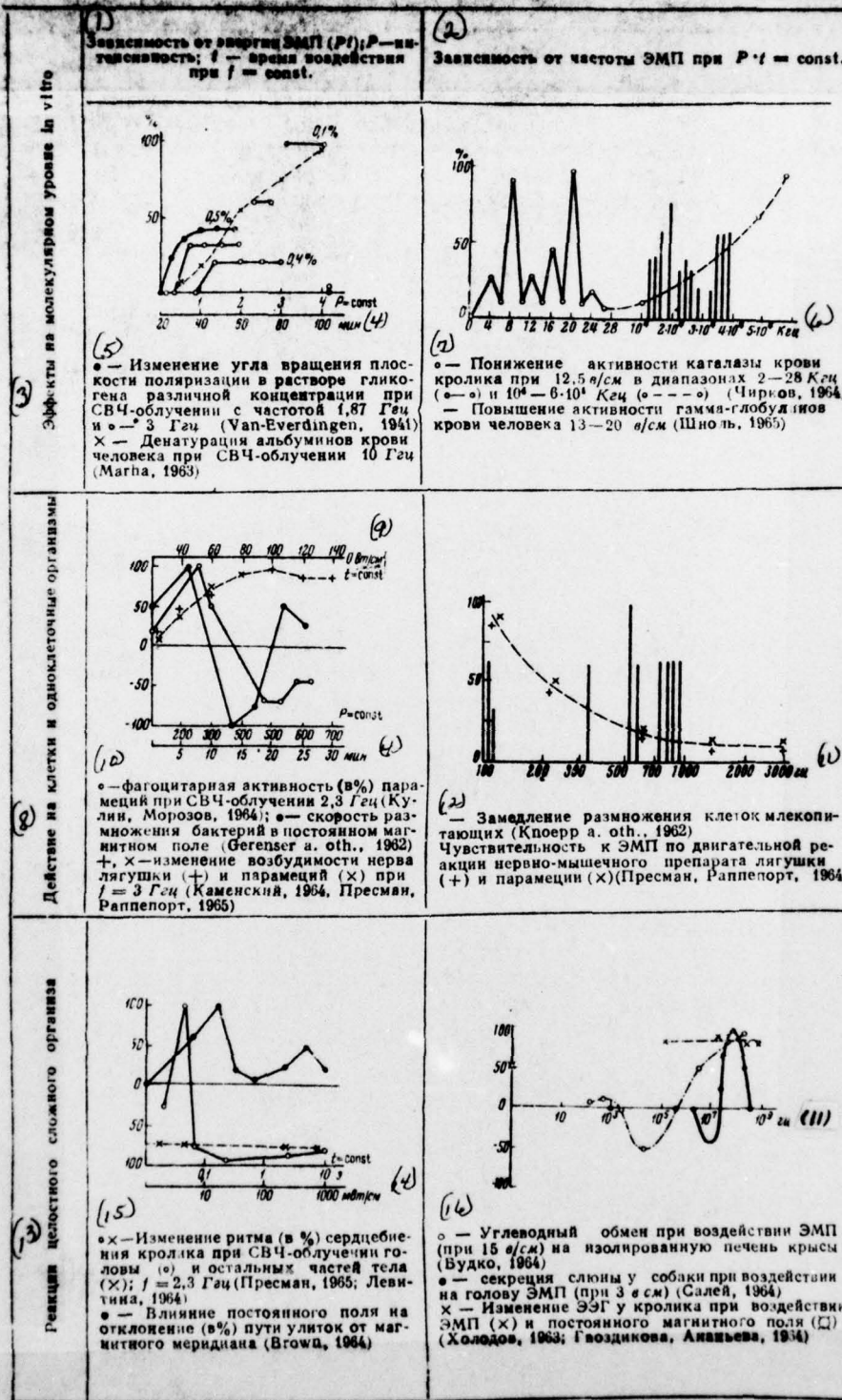


Fig. 3.

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Fig. 3. The features of the biological effect of EMP.

Key: (1). Dependence on the energy of EMP (Pt); P is intensity; t - time of action with $f = \text{const.}$ (2). Dependence on the frequency of EMP with $P \cdot t = \text{const.}$ (3). Effects at molecular energy levels in vitro. (4). min. (5). $\circ -$ is a change of the angle of rotation of plane of polarization in the solution of glycogen of different concentration during SHF [CB4 - superhigh frequency]-irradiation with the frequency of 1.87 GHz and $0 - 3 \text{ GHz}$ (Van-Everdingen, 1941); X - the denaturation of albumins of the blood of man during the SHF-irradiation of 10 GHz; (Marha, 1963). (6). KHz. (7). $\circ -$ is decrease in the activity of catalase of the blood of the rabbit with of 12.5 V/cm in ranges 2-28 kHz ($\circ - \circ$) and $10^4 - 6 \cdot 10^4 \text{ kHz}$ ($\circ - - - \circ$) (Chirkov, 1964) - an increase in the activity of gamma globulins of the blood of man 13-20 V/cm (Shnol', 1965). (8). Action on caged and unicellular organisms. (9). W/cm². (10). $\circ -$ is a phagocytic activity (in o/o) of parametsiy during the SHF-irradiation of 2.3 GHz (Kulin, Morozov, 1964); $\bullet -$ the velocity of the reproduction/multiplication of bacteria in magnetostatic field (Gerenser a oth., 1962); +, x are a change in the excitability of the nerve of frog (+) and of parametsiy (x) with $f = 3 \text{ GHz}$ (Kamienki, 1964, Presman, Rapoport, 1965). (11). Hz. (12). - The retardation of the reproduction/multiplication of the cages of mammals (Knoepp a oth., 1962); the sensitivity to of EMP according to the motor reaction of the neuromuscular preparation of frog (+) and of parametsii (x) (Presman, Rapoport, 1964). (13). Reactions of complete complex organiza. (14). mV/cm. (15). $\alpha x \sim$ is a change in the rhythm (in

o/o) of palpitation of rabbit during the SHF-irradiation of head and of the remaining parts of the body (x); $f = 2.3 \text{ GHz}$ (Presman, 1965; Levitina, 1964); • - The effect of static field on the divergence (in o/o) of the path of snail/cochleas from magnetic meridian (Brown, 1964). (16). • - is a carbohydrate exchange/metabolism under the influence of EMP (with 15 V/cm) on the isolated/insulated liver of rat (Budko, 1964); • - the secretion of saliva in dog under the influence on head EMP (with 3 V/cm) (Saley, 1964); x is a change EEG in rabbit under the influence of EMP (x) and of magnetostatic field (\otimes) (Kholodov, 1963; Gvozdkova, Anan'yeva, 1964).

Page 347.

In the reactions of the central systems of complex organisms to EMP it is observed both two-phase and dvukhgorbaya dependence on the affecting energy. An example of the first is the change in the rhythm of heart sokrshcheniy in rabbit during the SHF-irradiation of head (Presman, 1965), the second - a change of the behavior of snail/cochleas in constant nagnitnom field (Brown a oth., 1964). The effects of the action of EMP on peripheral system in practice do not depend on frequency; as an example can serve the retardation of heart rhythm in rabbits under the influence by VHF field on skin receptors (Levitina, 1964).

It is difficult to establish/install the true frequency dependence of the reactions of complex organisms to action EMP on frequency, since on it they depend the depth of penetration of the

energy of EMP in the cloth of body and ^{of} absorption in those or other structures. To this dependence can affect the anatomical location of cloths with the different lektricheskimi parameters. Therefore directly it is not always possible to establish/install, is the observed reaction the result of the direct effect of EMP on peripheral or on central systems. For example, the in practice the same effects of change EEG in rabbits appear under the action of the VHF fields, which are absorbed in the surface cloths of body, and the ultrahigh-frequency-fields, which penetrate to the internal structures of central nervous system, and even magnetostatic field (Kholodov, 1963; Gvozdikova, Anan'yeva, 1964). On the other hand, is noted the two-phase frequency dependence of a change of the slyunovydeleniya of dog in ultrahigh-frequency-range (Saley, 1964) and carbohydrate exchange/metabolism in the isolated/insulated liver of rat in the range of low and vykhokikh frequencies (Budko, 1964). At the same time the results of the number of experiments with sufficient certainty indicate (Presman, 1964, 1965) the broadband sensitivity to of EMP and peripheral and central systems of the organism of vertebrates.

The feature of the biological effect of EMP on the organism of vertebrates it is the kummulyatsiya of weak actions. In this case is observed the two-phase and dvukhgorbaya dependence of kummulyativnogo effect on the number of vozdeystviyl. The appearing physiological changes are retained sufficiently long time and even can be irreversible (Presman, etc., 1961; Boyenko, 1964; Letavet, 1964; Barnothy, 1964; Goldberg, 1965; Presman, 1965). Let us note finally

the essential difference in reaction rate peripheral and central nerve systems to the EMP: the first is very rapid, the second - with latent period from dozens before the hundreds of seconds (Gvozdkova, Anan'yeva, 1964; Kamienski, 1964).

The existence of the second form of the biological activity of EMP-HF and SHF-interaction at molecular energy levels - escape/ensues of the mentioned above resonance effects. On the possible interaction between cages it is possible to judge only by indirect data - the high sensitivity of the cages to of EMP and recently open generation in cages (Volkers, Candib, 1960; Malakhov, 1965).

Indirect data confirm the possibility of existence and third form of the biological activity of EMP - electromagnetic interactions between the organisms: so, is reveal/detected, on one hand, the ability of human organism to the perception of the H.F.-fields of very small intensity - order 10^{-4} V/m (Plekhanov, 1965), with another - the generation of VHF fields (Gaski, 1960).

Summing up, is presented some considerations about the possible nature of the biological activity of EMP.

EMP they play essential role in the control of the processes of vital activity all levels of the functioning of organisms, from internal coordination to interactions in biodfere.

Page 348.

The electromagnetic control provides largely the dynamic equilibrium between living organisms and the environment.

In any organism there are central systems, receiving the electromagnetic information about alternations in the geophysical

factors and the respectively controlling processes of vital activity, and also peripheral systems, "which mediate" between central and external agencies. Of unicellular organisms this control is realized by central systems of nucleus and organelles, but peripheral - by surface excitable structures. In vertebrates the fundamental control provides the central nervous system (and the connected with it systems of regulation), but peripheral - surface receptor apparatus. At the same time there are central and peripheral systems in organ/controls, is retained self-contained cellular regulation. Thus, in vertebrates is a "multistage" system of central and peripheral mechanisms. The controlling systems lowest unicellular occupy intermediate position.

With respect to external electromagnetic controls the mechanisms of peripheral systems are low-inertia and broadband in frequency, intensity and the according to character/nature of modulation. Central izbiratel'no react only to small alternations in the natural EMP. These mechanisms are inertial, capable of kummulirovat' weak actions, uzkoplosny in frequency, intensity, the according to character/nature of modulation.

Under inadequate external agencies the "signals of prevention/warning" from peripheral mechanisms produce either a rapid decay in the sensitivity (inhibition) of central systems, or they stimulate the control of the processes of vital activity in the direction, contradictory/opposite to that, that occurs under the adequate influence.

In complex organisms selective interaction between cages and molecules occurs apparently by means of the resonance and coded

communication/connections to EMP. Is presented probable existence and to common/general/total signaling for the rapid and coordinated making more active of entire organism during sharp emotional excitations in especially critical for an organism situations.

If periodic natural EMP synchronize the processes of vital activity in accordance with changes in environment, then the sporadic changes in the EMP (for example magnetic storms) are, obviously, interferences with electromagnetic control in organism. In normal organism peripheral and central systems shield organism from such interferences, but this protection is disrupted in the pathological states, when adaptive abilities are attenuate/weakened. Interferences must be artificially create the EMP whose parameters in the general case fall outside the predel' of the adaptive possibilities, which evolutionary formed in the interaction of organisms with natural with EMP.

The EMP of different frequencies they can cause the identical disturbance/breakdown of the biological regurlirovaniya, when at any frequency, inadequate to biological rhythms, is introduced "harmful" information or if EMP is detected in biological structures and creates constant "background" and finally when the EMP of any frequency it disrupts one or the other electromagnetic interaction. Obviously, it is possible to fit EMP with such parameters in order that is directed to affect one component/link or the other in multilateral electromagnetic regulation, to directed change the course of the determined biological processes, to compensate for the disturbance/breakdowns of regulation with pathological states, etc.

03-10-77

PAGE 21

Page 349.

The examined here problem forms already certain new range of biology, which can be call/named "electromagnetic biology". The development of this range is interesting not only in cognitive aspect, but also from the viewpoint of the possible practical application/uses in medicine and agriculture, in the solution of the different problems of bionics.

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Pages 349-350.

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