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JUL 77 P GULYAYEV, V ZABOTIN, N SHLIPPENBAKH

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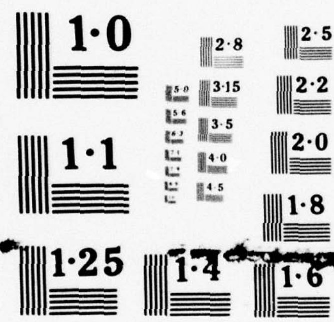

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ELECTROMAGNETIC FIELDS OF LIVING BEINGS

by

P. Gulyayev, V. Zabotin, N. Shlippenbakh

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Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

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

GREEK ALPHABET

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

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rot	curl
lg	log

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ELECTROMAGNETIC FIELDS OF LIVING BEINGS.

P. Gulyayev, V. Zabotin, N. Shlippenbakh.

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We measured the electric field component, which appears in space (in air) around the isolated/insulated nerve, muscle and the heart of frog, heart and muscles of man (at a distance to 250 mm), and the electric component of the emission/radiation of bumblebee, wasp of fly and dixa midge (at a distance to 1000 mm).

Was measured electric (but not magnetic) field in air, and not in the cloths of body or the liquid mediums of organism. Measurements conducted by the means of special sensor - the sounding amplifier, designed by V. I. Zabotin. The input impedance of instrument - order 10^{11} ohm at frequencies from 0 to 10 Hz and order 10^{10} ohm at frequency 300 Hz. Sensor reacts only to electric (nonauditory) oscillations.

The electric field of the isolated/insulated organ/controls of frog was measured by two methods, one of which was represented in

Fig. 1. The sciatic nerve of grassy frog was arrange/located on the stimulating electrodes, the silver grounded plate and Plexiglas support/socket. It was held in tension (in air) because of the cohesive forces of humid nerve with Plexiglas support/socket on one hand, and on the other hand - with plate and electrodes. In this case the nerve had insignificant sagging/deflection on the order of 1 mm. The length of nerve from support/socket to plate was on the order of 3-6 cm. and from plate to end/lead 2-3 cm. The irritated part of the nerve was separate/liberated from its remaining part by the grounded shield, presenting by itself metallic case with the gash, through which it passed nerve. therefore was possible to completely remove the field of the artifact of stimulation and to record the field of nerve in the undistorted form/species. The field of the artifact of stimulation was hardly noticeably only with stimulus 10 times exceeding that necessary for normal stimulation. Nerve with necessity was wetted by physiological solution for a preservation from drying.

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Electric are field component they were recorded by the probes, which were made in the form of circular metallic disks from 0.5 to 6 cm. in diameter. Probe was connected to the input of the sensor (separate unit), placed into the shielded chamber. Special holder with measuring rule and remote control made it possible to arrange/locate sensor at the determined distance from nerve. By the shielded cable sensor was connected with the amplifier, outlying beyond the limits of the chamber, in which conducted the measurement.

For a protection from external electrical interferences the working chamber was shielded by sheet iron 1 mm thickness and on the one hand it was covered by the dual iron grid, made in the form of the hinged/reversible blind, making it possible to have an admission into the chamber. The size/dimension of the chamber 215 x 66 cm. (see Fig. 1). A similar measuring circuit has already been utilized by other researchers [1].

Applying the usual physiological methods of investigation on artifacts, we severed nerve, wetted it by ammonia or replaced by wet filament. In all these cases the field disappeared, therefore, our recordings they are not the artifacts of the stimulating equipment.

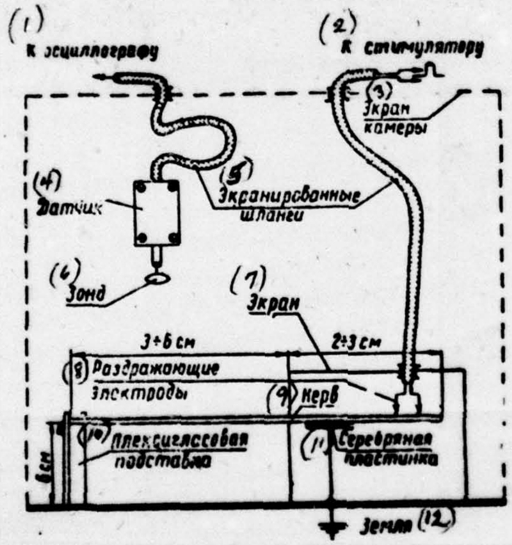

Fig. 1. Measuring circuit of the electric field of the isolated/insulated nerve of frog.

Key: (1). To oscillograph. (2). To stimulator. (3). Screen of the chamber. (4). Sensor. (5). Shielded hoses. (6). Probe. (7). Screen. (8). Stimulating electrodes. (9). Nerve. (10). Plexiglas support/socket. (11). Silver plate. (12). Earth.

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Recording electric field component conducted on the screen of double-beam cathode-ray oscillograph, and stimulation was realized by the electron stimulator (with radio-frequency output/yield), developed in our laboratory.

Visual observations were realized in mode/conditions "the waiting from stimulator" scanning/sweep of time with repetition frequency from 1 to 100 periods per second. Photographing conducted in the mode/conditions of the single starting/launching of scanning/sweep from the knob/button of stimulator.

Nerve with its activity remains completely motionless and therefore it does not appear any artifacts, bonded with the motion of the subject of investigation. Figure 2 shows the electric field component of the isolated/insulated nerve of the frogs, recorded from distance 6 mm and 61 mm, perpendicularly the middle of the axis of nerve. With an increase in the distance the amplitude and the form of components changes. The maximum distance, with which the components still are noted against the background of noise, depends on the functional state of nerve. (In our experiments it was equal approximately by 250 mm).

For the establishment of the artifacts, which appear from the motion of muscle, the latter is stretched and fixed so that does not change its length during excitation. Stimulation conducted by single stimuli. The probe was arrange/located against the middle of muscle at a distance 6 mm and 61 mm. Figure 2 shows that first appears the field of nerve and then the field of muscle, abstract/removed by the direct contact of probe with the middle of muscle.

Figure 2 shows also the electric field component of the heart of frog. Frog was record/fixed on the grounded metallic plate. The thoracic cavity of the frog above the heart is opened and heart raised for the head of ventricle by the miniature silver hook, connected with the fine/thin caprone filament, attached to backstop.

Figure 3 depicts the graph/diagram of the dependence of the amplitude of the potential of the field, which appears in air around the sciatic nerve of frog, on the distance between the probe and the nerve. Experimental points on curve/graph correspond to the averaged values of six experiments. Our experiments showed this dependence as experiments of Burr and Mauro [1].

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This dependence at a distance from nerve, large 0.5 cm., is subordinated to the equation

$$V = \frac{K_1}{(r + K_2)^2},$$

where V - the potential of the point of field earth referenced or the stress of field (mV), of r - the distance of probe from nerve (cm.), K_1 and K_2 - constant values.

Substituting in formula numerical value $K_1 = 111$ and $K_2 = 3.48$, after obtaining equation in numerical coefficients, that approximates the experimentally found dependence of the voltage of the field of nerve from distance to probe,

$$V = \frac{111}{(r + 3{,}48)^2},$$

Calculated curve of the approximating equation and experimental curve coincide and a little diverge only at distances approximately 0.5 cm.

from nerve.

The measurement of the electric field of the body of man conducted in the shielded chamber. Tested at usual clothing lie/rested by face upward, its head rested on pad. Hair tied themselves by cotton knee plate. The probe was arrange/located in space above the face of tested. Figure 4a shows the electric field component of the heart of man, recorded at a distance 30 mm from head. The right strut of man was grounded. The experiment showed that the recording of the electric component of the field of heart was possible at a distance even 250 mm from man.

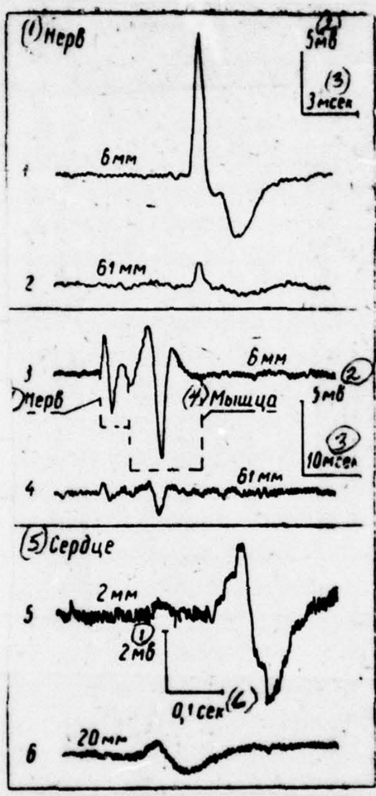
(1) Нерв
(2) 5мв
(3) 3мсек
6мм
61мм
6мм
(2) 5мв
Нерв
(4) Мышца
(3) 10мсек
61мм
(5) Сердце
2мм
(1) 2мв
0,1сек (6)
20мм

Fig. 2.

Fig. 2. Oscillograms of the electric fields of the isolated organ/controls of frog (nerve, neuromuscular preparation, hearts).

Key: (1). Nerve. (2). mV. (3). ms. (4). Muscle. (5). Heart. (6). s.

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With sensitization of equipment and decrease in the background noise of the latter, this distance will be increased.

In Fig. 4b represented electric field of musculature with the stress of the right strut, probe is arranged at a distance 30 mm overhead in the range of front. The curve of c shows the simultaneous recording of the electromyogram of the same leg, but during the imposition of the discharge electrodes on leg. The comparison of registration on line b and c shows that the amplitude of stress with air removal/diversion is decreased, form on the whole remains the same.

It exists continuously in the course of an entire life of man, indeed muscles always to some degree are strained. Each pose of body has its form of electric field, during a change in the pose is changed the field, but it is sufficiently complicated, since in the body of man there is 532 muscles.

The source of the field of nerve is the action current, the invariable/unchanged accompanying nerve impulse.

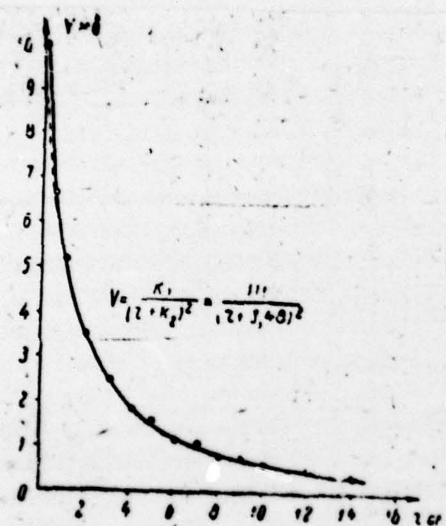

Fig. 3.

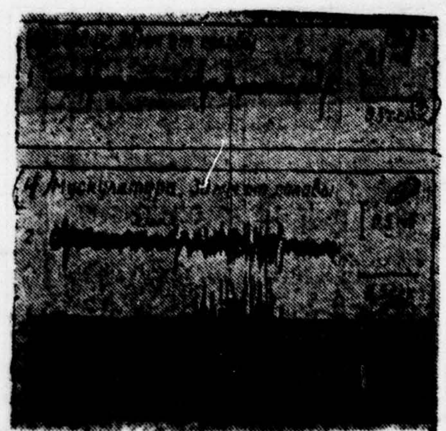

Fig. 4.

Fig. 3. Dependence of the amplitude of electric intensity from the distance of probe to nerve.

Fig. 4. Oscillograms of the electric fields of heart and musculature of man.

Key: (1). Heart 30 mm from head. (2). mV. (3). s. (4). Musculature 30 mm from head. (5). Galvanically from leg.

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Just as the field of heart and musculature, the electric field of nerve has in the first approximation, three of components: internal, electrotonic and applied field. Nerves are usually deeply hidden in the thicknesses of the cloths of body. Therefore the exterior of the field of nerve around man has too weak intensity/strength and is not recorded by contemporary equipment. The electric field of nerves surrounds our body continuously and changes in accordance with the activity of nerves. Since a quantity of large nerves in the body of man more than 4 million, the external and electrotonic part of the field are very complex. Besides the field of heart, nerves and muscles, there is one additional source of the electromagnetic radiation of living beings - this is the electric charge of body, which appears during motion. The wings and the body of birds and insects in flight are charged electrically and radiate electromagnetic waves. The flight of insects and birds causes such disturbance/perturbations in medium as infrasonic, acoustic, ultrasonic waves and electrostatic field. Acoustic waves we hear, infra- and ultrasound to us is directly unattainable, but we can record by its means of microphone and oscillograph. The disturbance/perturbations of electrostatic field (electromagnetic waves) can be recorded by our instrument. Were investigated the emission/radiations of the following insects: bumblebee (Bombus hortorum L), wasp (Pseudovespera vulgaris L); fly (Galliphora erythosephala Mg and Petina), dixa midge (Aedes communis De greer), the determination of the form/species made by Saulich A. Kh.

We experimentally established that the bumblebees, wasps, the dixa midges and the flies, freely flying in airspace, radiate electromagnetic waves. Field is registered at a distance almost of one meter from insect.

We have is developed the special amplifier with the high impedance of input, which allows without touch to body (in air) to measure under conditions of screened chamber the electric field of heart and musculature of man at a distance to 250 mm and the electric field, radiated by insects, at a distance to 1000 mm.

Electric field will bear the information about the functional state of the organs of body. Therefore instrument can be used for recording electric processes in the heart and other organ/controls of the body of man, which is important for the diagnosis of diseases and checking of therapeutic actions. This method of recording is singularly feasible in the case of scald/burns and injuries of skin, when the usual imposition of electrodes is impossible.

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The biologists instrument will allow to conduct investigation of the electromagnetic fields, radiated by insects, by birds and by other animals (imposition of electrodes for the objective of investigation in the similar cases also impossibly).

Bibliography.

1. H. S. Burr, A. Mauro. The Jale J. of Biology and Medicine v. 21, N 6, 1949.
2. J. H. Seipel, R. D. Morrow. J. Of the Waschington Academiy of Sciences, v. 50, N 6, 1960.
3. J. A. Gengerelli, J. Holter Normann, B. Glasscock Wilford. The J. of Physiol, v. 50, 1961.
4. J. A. Gengerelli, J. Holter Normann, B. Glasscock Wilford, The J. of Physiol., v. 57, 1964.
5. G. Baul, R. Mc Fee. Amer. Heart. J., v. 66, N. 1, 1963.
6. R. A. Stratbucker, C. M. Hyde, S. Wixson. JEEE Trans Bio. Med. Elektron. v. 10, N. 4, 1963.
7. M. A. Хведелидзе, С. И. Думбадзе, Т. Д. Сургуладзе. В сб.: «Бионика». М., Изд-во АН СССР, 1965.
8. W. K. Volkers, W. Candib. JRE International Conveilnon Record. Part. 9. March 21—24, 1960.

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