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ELECTROMAGNETIC HYPOTHESIS OF THE TRANSMISSION OF MENTAL SUGGES--ETC(U)

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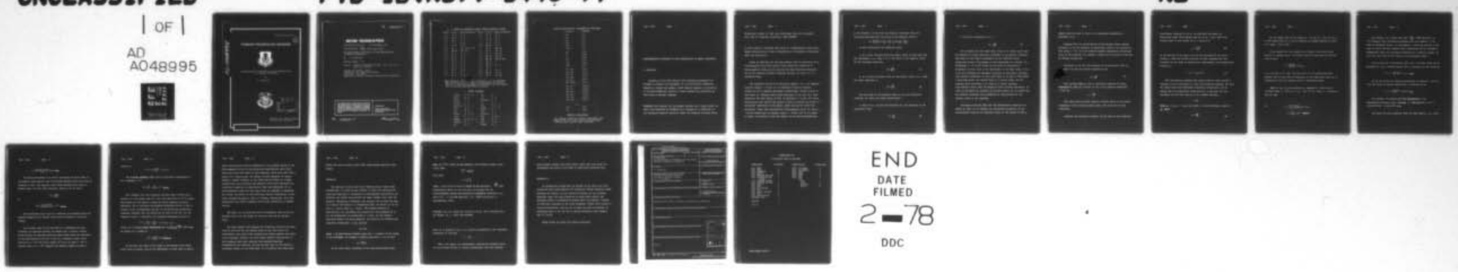

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ELECTROMAGNETIC HYPOTHESIS OF THE TRANSMISSION OF MENTAL SUGGESTION

by

V. Arkad'yev

FOREIGN TECHNOLOGY DIVISION

EDITED TRANSLATION

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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	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	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 HYPOTHESIS OF THE TRANSMISSION OF MENTAL SUGGESTION

V. Arkad'yev

Recently we have been hearing with increasing frequency* of attempts to explain the phenomenon of so called mental suggestion observed in humans and animals, which employs hypnosis or excitation of the electromagnetic field by a given organism and perception of this field by another organism.

FOOTNOTE: The occasion for the present article was a report under the same title presented by Professor N.A. Ivantsov at a conference of the Biological Research Institute under the auspices of Moscow State

University in march of 1924. His deductions, just as the present ones, led to a negative conclusion. END FOOTNOTE

In this article I introduce some ideas of a mathematical nature which enable calculating the order of magnitude of the physical stimulators which may occur here.

Based on equations for the most general case of excitation of an electromagnetic wave-like field, which covers both radiation of electromagnetic waves by the atom and the small Hertzian oscillator and by the powerful wireless telegraph antenna, we arrived at the following ideas.

The radiating center is an electrical dipole, i.e., two opposing electric charges - +q and -q - at distance l from one another. Charges +q and -q perform sinusoidal oscillations, trading places in this case, or, changing their value according to the sine law, which amounts to the same thing, so that +q decreases to -q and vice versa. This occurs twice within time period T, which is called the period of electrical vibrations of the dipole, which can also be called the oscillator. Under such oscillations electromagnetic waves of length $\lambda = cT$ are formed near the dipole, where $c = 3 \cdot 10^{10}$ cm/s is the speed of light. At distance R from the dipole, in the plane perpendicular to its length l, we get from the theory of Hertzian waves the following expression for the force of the magnetic field H:

$$H = \frac{2\pi ql}{R\lambda}\left[\frac{2\pi}{\lambda}\sin 2\pi\left(\frac{t}{T}-\frac{R}{\lambda}\right)-\frac{1}{R}\cos 2\pi\left(\frac{t}{T}-\frac{R}{\lambda}\right)\right].$$

We must distinguish two different cases:

1. At a short distance from the dipole, which is much less than the wavelength, i.e., when $R \ll \lambda$, the force of the magnetic field has the following amplitude

$$H_0 = \frac{2\pi ql}{R^2\lambda} \quad (1)$$

2. At a greater distance from the oscillator, when $R \gg \lambda$, then the field amplitude is

$$H_0 = \frac{4\pi^2 ql}{R\lambda^2} \quad (2)$$

For the value of the electric field we also get different solutions for these two cases. Specifically -

1. When $R \ll \lambda$, we get the following for the amplitude of the electrical field

$$E_0 = \frac{ql}{R^3} \quad (3)$$

2. For great distances, $R \gg \lambda$,

$$E_0 = \frac{4\pi^2 ql}{R\lambda^2} \qquad (4)$$

Let us begin with the first case. Since it is often stated that the duration of these electrical processes in the bodies of mammals, from which we can expect propagation of the indicated waves, constitutes several thousandths or even hundredths of a second, for wavelength $\lambda = cT$ we get values on the order of thousands of kilometers. We will stop at the conditions of the first case, $R \ll \lambda$, if we are investigating phenomena occurring at distances no greater than several kilometers. In this case there is no need to talk about a wave-like field; the excited field is a static field, and the organism which perceives it is found in a slowly changing electrostatic field. Here the magnetic field is quite negligible. In order to calculate the greatest anticipated effect let us assume that the internal processes are accompanied by electrization of the surface layers of the organism.

Proceeding from the idea that the electrostatic capacity of a sphere is equal to its radius, for approximate estimation of the electrostatic capacity of individual parts of the animal we take a number which is close to half of its transverse dimensions d, expressed in cm.

Assuming that the electrization of the surface layers reaches potential V, for the quantity of electricity found on the surface we find value q = Vd; l is the distance between oppositely electricized parts of the organism, for example, between the two sides of the head or between extremities.

According to (3) for the strength of the electrical field at distance R cm from the excited organism we get

$$E_0 = \frac{Vdl}{R^3}. \quad (5)$$

When in this field we have a perceiving organism of linear dimensions l, then at its ends we will have potential difference $V_1 = E_0 \cdot l_1$ or

$$V_1 = \frac{Vdll_1}{R^3}.$$

This electromotive force creates a current which is the direct stimulator of the receiving nerve cells. Its force can be thus calculated.

Assuming the electrical capacity of the parts of the receiving (perceiving) organism to be d_1, we find that the amount of electricity which flows during time T/4 is $q_1 = V_1 d_1$, while the average force of the current is $i_1 = 4d_1V_1/T$ or

$$i_1 = 4\frac{Vdd_1ll_1}{TR^2}. \qquad (6)$$

If the section of the organ is S and the [section] of the nerve centers s, then the current arriving on them, assuming that the structure of the organ is uniform and, consequently, its conductivity uniform, is

$$i = i\frac{s}{S} = 4\frac{s}{TSR^2}d_1dl_1lV. \qquad (7)$$

This calculation presumes that during time T/4 there occurs a complete flow of electricity q_1 over the receiving organism. For this the latter must have sufficient electrical conductivity. Let us assume that this electrical conductivity is σ and that the time necessary for the free flow of q_1 is, roughly speaking,

$$\vartheta = \frac{q_1}{i_1};$$

where $q_1 = d_1V_1$, $i = V_1/2r$ and where r is the resistance, equal to $\frac{l_1}{S\sigma}$. Hence

$$\vartheta = \frac{2d_1l_1}{S\sigma}. \qquad (8)$$

For the human body we can assume d_1 = 20 cm, l_1 = 150 cm, and σ is the conductivity of a 1/2$^0/_0$ solution of sodium chloride or about 0.01 1/Ωcm = 10^{-10} CGSE.

If we assume that the current as a result of the skin effect flows in a surface layer 1 cm thick, while the sections are 100 cm², then we find

$$\vartheta = \frac{2.20.150}{100.10^{10}} = 6.10^{-9}\,s,$$

i.e., the gap is so short (on the order of one hundred millionth second) that on the side of resistance of the human body there is no hindrance to the slow process which we calculated above.

Based on (6) we can calculate i_1, assuming V = 0.01 volt or 0.01/300 CGSE, T = 10^{-3} s, d = d_1 = 20, $l = l_1$ = 100, R = 5 meters or 500 cm. Then

$$i_1 = 4\frac{10^{-4}.20^2.100^2}{3.10^{-3}.125.10^6} \simeq 0{,}01\ CGSE.$$

or

$$i_1 = \frac{10^{-2}}{3.10^9} \simeq 3.10^{-12}\ \text{ampere}.$$

For current j in a fiber when $s/S = \frac{10^{-4}}{100} = 10^{-6}$ we find $j \simeq 10^{-15}$ amperes. This calculation presumes that the diameter of the fiber is extremely large - 0.1 millimeters - while the section of the organ is about 100 cm^2. Despite these assumptions and all preceding assumptions, which are extremely favorable for a positive result, we find that the force of the current is exceptionally small.

Let us ascertain the greatest work W per 1 cm fiber which can be performed by such a current during 10^{-3} s. According to the Joule law

$$W = j^2 rt = \frac{10^{-30} \cdot 10^{-3}}{10^{-2} \cdot 10^{-4}} 10^{7} = 10^{-26} \text{ ergs.}$$

If for the period of thermal oscillations we assume $T = 10^{-13}$ s, then the amount of energy constituting 1 quantum will be

$$w = h\nu = \frac{6{,}54 \cdot 10^{-27}}{10^{-13}} = 6{,}54 \cdot 10^{-14} \text{ erg.}$$

If, however, we proceed from the periodicity of the physiological process, then, assuming $\nu = 1000$ periods, $w = h\nu = 6.54 \cdot 10^{-27} \cdot 10^{3} = 6.54 \cdot 10^{-24}$ ergs.

The human eye only perceives about 60 light quanta, i.e., about

$$w = 60\frac{6,54.10^{-27}.3.10^{10}}{6.10^{-8}} \cong 2.10^{-10} \text{ erg.}$$

The energy developed in an entire centimeter of nerve fiber is one hundred times smaller than the minimum quantum which can still be referred to here. The magnetic field which develops here gives us results which are even less consoling. Based on (1) we find:

$$H_0 = \frac{2\pi V dl}{R^2 Tc},$$

or

$$H_0 = \frac{2\pi.10^{-4}.20.100}{3.25.10^{4}.10^{-3}.3.10^{10}} = 5.10^{-11} \text{ gauss.}$$

The calculation could still be conducted by proceeding from the magnetic moment of the current which could circulate in the nerve tissue.

Let us again look at the case which is improbable but more favorable for positive results. We assume that a circular current flows through the organism along the nerve fiber under the influence of the electromotive force of 1 volt (!). Assuming a fiber cross section of $s = 10^{-4}$ cm² and a length of 10 cm, we find $r = 10^{7}$ Ω; current force is $i = 10^{-7}$ amperes. The magnetic moment of such a circuit is

$$M = iS = 10^{-8}\left(\frac{10}{2\pi}\right)^2 \pi = 10^{-7} CGSM.$$

The greatest magnetic field will be calculated analogously to (3), assuming $ql = M$:

$$H_0 = \frac{M}{R^3} = \frac{10^{-7}}{125.10^6} \cong 10^{-15} \text{ gauss.}$$

Now, assuming that the radiating circular nerve circuit has a section of 1 cm² rather than 10^{-4} cm², the force will be 10^{-11} gauss. Both values are too small to cause any direct magnetic activity. Therefore, let us calculate the possible inductive effect of such a circuit on the corresponding circuit of the perceiving (receiving) organism. Assuming that the latter has an area of 500 cm², for the current we find $N = 500 \cdot 10^{-11}$; the induced electromotive force is

$$E = \left| -\frac{dN}{dt} \right| = \frac{5.10^{-9}}{10^{-3}} = 5.10^{-6} CGSM = 5.10^{-14}$$

volts. In a circular fiber resistances of $r \cong \frac{2\pi}{10^{-4}.0,01} \sqrt{\frac{500}{\pi}} \cong 8.10^7\ \Omega$ can be caused by a current of

$$j = \frac{E}{r} = \frac{5.10^{-14}}{8.10^7} \cong 10^{-21} \text{ amperes.}$$

We see that the value of the field or the current force which could occur in either case is too negligible to cause such an effect.

Human nerve centers could be affected to a far greater extent by the electromagnetic field of the electrical installations among which modern man lives and works. To this question, which arose more than a quarter of a century ago, the answer is still negative: We cannot observe a useful, harmful, or any other kind of effect on a human organism from the electrical and magnetic field which surrounds any electrical conductor or installation. When the frequencies of an electromagnetic field are very high (tens and hundreds of thousands per second) the effect of the electrical current (diathermia) on the human organism disappears. Then, at visible, ultraviolet, and X-ray frequencies this effect reappears with either beneficial or harmful results.

The effect on the mind need not be considered, since we do not consider this to be the effect of X-rays on the way the patient feels.

One might suppose that between the D'Arsonval currents and Hertz waves on one side and the thermal waves on the other there are intermediate rays which could irradiate the human organism and affect other organisms. However, now that rather powerful oscillations of this frequency have been obtained (the Glagolev-Arkad'yev ultrahertzian wave emitter), we can say that they do not produce a noticeable effect on the human mind. It is doubtful that they would affect the nerve centers, since these waves barely penetrate body tissue.

Addendum I

The numerical results here were obtained using simple rough calculations. It would be more correct to liken the radiating and receiving organisms to ellipsoids of corresponding conductivity and calculate the fields and currents for them. However, this will not produce a substantial difference. For example, let us take the case of a current developing in a neighboring body. By analogy to (6) we find $i_1 = 4q_1/T$, where $q_1 = E_0 d_1 l_1$. The induced quantity of electricity q_1 is calculated very exactly for the ellipsoid as in (1). By designating its receptivity $k = m/4\pi$, for the induced electrical moment (as on an inductor, for which we can formally use dielectric coefficient $\varepsilon=\infty$), we find

$$q_1 l_1 = k E_0 v,$$

where l_1 is the distance between poles and $v = 4\pi abc/3$ is the volume of the ellipsoid. By assuming a smaller semi-axis $c = b$, we find

$$q_1 l_1 = \frac{mab^2}{3} E_0.$$

On the other hand, according to the calculation method used here, $q_1 l_1 = d_1 E J_1^{\,2}$. Since in the ellipsoid the distance between poles $l_1 = \frac{4}{3} a$, then

$$\frac{mab^2}{3} = d_1 \left(\frac{4}{3} a\right)^2,$$

from which

$$d_1 = \frac{3}{16} \frac{mb}{\Lambda},$$

where Λ = a/b is the relative length of the ellipsoid. From permeability curves in the form of (l. c.*) we see that for length/diameter ratios corresponding to mammalian organisms, i.e., when 0.5 < $\Lambda < 5$ we get equality $m = 3\Lambda$ with an accuracy of approximately 10°/₀.

FOOTNOTE: See V.A. Arkad'yev. Zh.R.F.O. 46,22, 1914. Wireless Tel. and Teleph. No. 7, 1920. END FOOTNOTE

Hence it is apparent that d_1 is actually determined by the transverse dimensions of the body:

$$d_1 = \frac{9}{16} b.$$

Thus, the simple, yet nonstandard, calculation presented above for the induced charge is entirely permissible, even for somewhat more accurate results than those above, which were only meant for calculating the order of the order of quantities occurring here.

Addendum II

An interesting problem here is whether or not walls can offer protection from these magnetic and electrical fields. Magnetic fields penetrate all bodies. As for electrical fields, not all building materials offer the same protection in rapid field shifts. The screening effect is displayed by bodies which can conduct a current of sufficient strength at the given frequency. Bodies which cannot do this are dielectrics, and not all of them can serve as shields. In estimating this we can use the so called relaxation time (compare (8)) $\theta = \varepsilon/4\pi\sigma$.

These values are given for several materials.

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