BIOELECTRIC EFFECT OF CLOSING THE EYES ON THE OCCIPITAL AND FRONTAL LOBES OF THE CORTEX OF THE CEREBRAL HEMISPHERES IN MAN

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The bioelectric investigations of interzone relations which we carried out by means of a two-channel integrator, were set up with the aim of showing the possibility of using our method [1,2] when studying the progress of the processes of excitation and inhibition in the cortex of the cerebral hemispheres.

Closing the eyes, combined with the cessation of the action of light, brings the visual center to relative rest, as a result of which it may be supposed that the inhibitory process predominates in the visual center.

Thus, we consider that the visual center is inhibited when the eyes are closed. As a result of positive induction or irradiation, the adjacent zones of the cortex can turn out to be excited or inhibited.

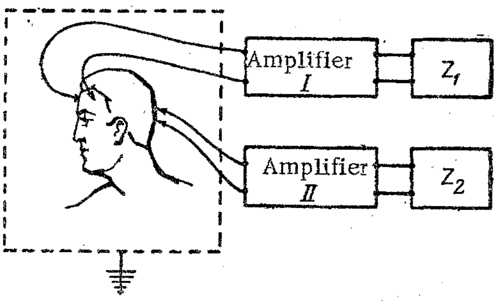

Fig. 1. Block diagram of the layout of the apparatus during 2-channel integration of the bioelectric currents of the brain.

The bioelectric effect, measured by picking up bioelectric currents from the two occipital protuberances of the intact skull, does not reflect the independent functional state of the visual center; it is the expression of the functional condition of the adjacent cortical zones, whose initial condition could be different. As a result, the same act of closing the eyes can lead to an increase or decrease of bioelectric effect in the occipital zone.

These reactions were studied many times by means of electroencephalography, usually for short periods of time: 10-60 seconds. A number of authors indicated that the increase in α-rhythms when the eyes are closed is detected well in the occipital zones and extends to all of the adjacent zones.

Our investigations show a somewhat different picture of the distribution of electrical activity among the cortical areas of the cerebral hemispheres.

The investigations were carried out in the usual surroundings for recording electroencephalograms. They differed only in the fact that the output of the two-channel symmetrical amplifiers was connected with a volt-hour meter which integrated the energy by time (Fig. 1), and not by means of trailing recording arms. In order to analyze the inequalities in the distribution of energy during the experimental period, the integral of the energy was measured for each 30 seconds.

Magnitude of the Bioelectrical Activity ("Total Bioelectric Effect") of the Human Brain When the Eyes are Open and Closed

Subject	Occipital area			Frontal area			Type of reaction
	P_1	P_2	R	P_1	P_2	R	
B-sov	3	6	+ 3	24	19	− 5	I
Vo-ev	60	70	+10	30	11	−19	
B-ev	11	31	+20	48	22	−26	
Vo-ob	45	56	+11	14	7	− 7	
I-ov	20	27	+ 7	9	7	− 2	
So-in	23	36	+13	34	23	−11	
M-ov	27	17	−10	19	12	− 7	II
K-ov	61	43	−18	28	17	−11	
G-ev	29	16	−13	8	5	− 3	
A-mg	30	20	−10	10	5	− 5	
G-ov	22	21	− 1	20	8	−12	
E-in	15	12	− 3	27	12	−15	
Z-ov	27	15	−12	18	6	−12	
E-in	38	24	−14	38	13	−25	
S-in	32	19	−13	22	18	− 4	
F-ov	23	22	− 1	15	17	+ 2	III
M-y	39	22	−17	28	75	+47	
G-ov	25	25	0	7	15	+ 8	

Symbols: P_1 − "total bioelectrical effect" during 5 minutes with the eyes open; P_2 − the same effect with the eyes closed; R − measure of reactivity.

In determining the nature of the general reaction, two readings per five minutes were taken with the eyes closed and open. The results of these investigations, carried out simultaneously for the occipital and frontal zones, are combined in the table.

The data obtained from patients in the orthopedic clinic without skull trauma or commotio are included in the table; they clearly show the presence of three types of reaction. The first type (I) is characterized by increased electrical activity in the occipital zone and simultaneous decreased activity in the frontal zone. This reaction was considered negative induction by us.

The second type of reaction (II) corresponds to decreased electrical effect in the occipital and frontal zones. This reaction is regarded by us as irradiation of the inhibitory process which encompasses both cortical zones.

The third type of reaction (III) represents decreased electrical effect in the occipital zone with simultaneous increase of this effect in the frontal zone. This reaction is evaluated as an example of positive induction.

In 60 investigations carried out by us, increase of electrical effect in the occipital zone did not lead to its increase in the frontal zone. This does not mean that excitation of the occipital zone (when closing the eyes) is localized in a limited area. Excitation irradiates to the neighboring zones, but does not diffuse to the frontal lobes, however. This is easily detected on moving the frontal electrodes to the temporal areas.

Wishing to follow the movement of induction and irradiation processes between the zones, we set up several experiments in which readings were taken on the meters of the integrators every 30 seconds.

Fig. 2 illustrates the distribution of energy in time during the appearance of the induction process.

It is not difficult to observe that the latent period t_2 for the frontal zone is four times greater than the period t_1.

The period of time t_2 is two minutes, which would require 3.6 meters of electroencephalographic tape. If the duration of continuous investigation (10 minutes) is taken into account, as well as the variability of electroencephalograms, it becomes clear why these mechanisms have not been detected with sufficient clarity in ordinary electroencephalography.

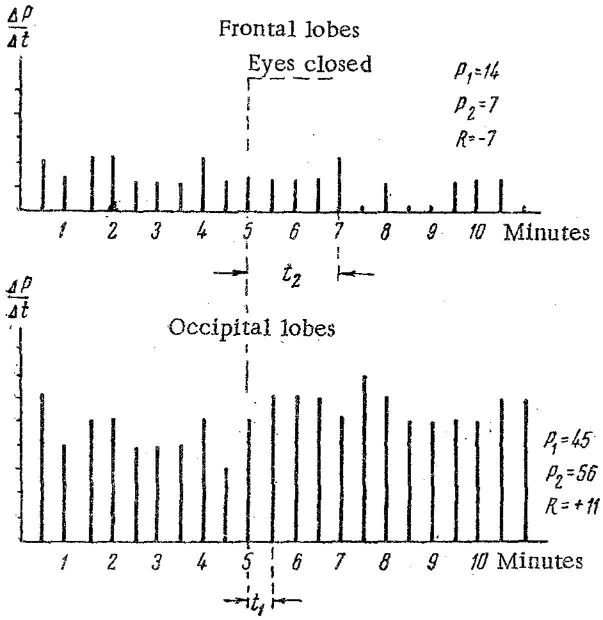

Fig. 2. Bioelectrical reactions in the occipital and frontal zones, typifying negative induction. Each column represents the amount of energy collected by the integrator during 30 seconds.

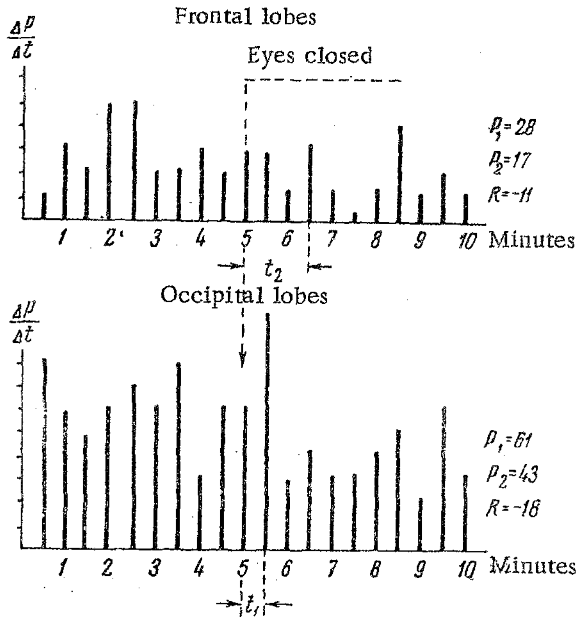

Fig. 3. Bioelectrical reactions in the occipital and frontal zones during irradiation of the inhibitory process.

Fig. 3. illustrates the irradiation of inhibition; it shows that the reaction of the frontal lobes lags with respect to the occipital lobes; the latent period (t_2) reaches $1\frac{1}{2}$ minutes.

In conclusion it should be mentioned that the method of integrating and differentiating energy by time during bioelectric investigations permits the analysis of interzonal relations in the cortex of the cerebral hemispheres of man.

LITERATURE CITED

[1] G.A. Shminke, Bull. Exptl. Biol. Med., No. 6 (1954).

[2] Ibid, Vol. XXXVIII, No. 11, pp 71-73 (1954).