CHANGES IN THE ELECTRICAL ACTIVITY OF THE HUMAN BRAIN DURING
THE INITIAL PERIOD OF MUSCULAR ACTIVITY

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The number of investigations dealing with the electric activity of the brain during muscular activity is very
limited owing to practical difficulties. There has been no special study of changes in electrical activity of the
brain during the initial period of work, although some authors have noted that the beginning of muscular activity
was accompanied by the appearance of fast activity in the electroencephalogram of the same type as muscle
potentials [5] or by depression of the \( \alpha \)-rhythm [4].

The aim of the present work was the systematic study of changes in the electrical activity of the brain
during the initial period of muscular activity.

EXPERIMENTAL METHOD

The electroencephalogram was recorded during the performance of work by the method described earlier
[2]. Reliable contact between the electrode and the scalp was achieved by careful application of stick-on elec-
trodes to the muscle-free parts of the scalp; paste and additional "bracing" of the leads were employed. Standard
positions of the electrodes were determined experimentally.

The electrical activity of the brain was recorded by means of a 4-channel ink-writing electroencephalo-
graph (made at the AMN SSSR experimental plant). Bipolar recording was usually used. The movements investigated in this work were familiar and habitual for the subject: work on bicycle-ergometer of moderate power (15-50 revolutions of the pedals per minute), various types of rhythmic hand movements with different loads, static muscle exertions (trunk, arms, legs). A total of 80 experiments were carried out on 7 subjects. At rest all the subjects showed an \( \alpha \)-rhythm and the response to eye opening and eye closure was of the usual kind.

EXPERIMENTAL RESULTS

The beginning of muscular activity gave rise to depression of the \( \alpha \)-rhythm in the electroencephalogram
during which most of the subjects showed activity of the \( \beta \)-rhythm type. As the work proceeded small groups of \( \alpha \)-waves, alternating with periods of \( \alpha \)-rhythm depression, began to appear against this background. The frequency of the \( \alpha \)-rhythm increased by 1-2 cps as compared with its frequency at rest; the amplitude was decreased. Sometimes some of the temporal leads showed slower activity at a frequency of 3-4 cps. Later, the bursts of \( \alpha \)-rhythm became more definite and prolonged, while periods of its depression diminished in duration. The frequency of the \( \alpha \)-rhythm itself decreased and the amplitude increased until the two returned to the values observed at rest. In some cases it was possible to discover a definite periodicity in the appearance of the bursts of \( \alpha \)-waves, coinciding with the rhythm of the movement.

Further continuation of work was accompanied by \( \alpha \)-rhythm which was not significantly different from \( \alpha \)-rhythm at rest.

The time which elapsed from the beginning of work until the appearance of \( \alpha \)-rhythm with frequency and
amplitude characteristic for the resting state was taken as the duration of the initial period of work. Figure 1
shows the Initial period of muscular activity upon flexion and extension of the arm on an ergograph with a load
of 1.5 kg. The beginning of the familiar muscular activity was accompanied by depression of the \( \alpha \)-rhythm and
the appearance of fast activity of \( \beta \)-rhythm type in the encephalogram; as the work continued, the fast activity
was gradually replaced by \( \alpha \)-rhythm.
In this experiment muscle potentials were recorded from the active muscles simultaneously with the EEG. The electromyogram shows that as work continues the duration of the bursts of muscle potentials decreases and becomes stabilized, which denotes gradual perfection of the movements performed as compared with the initial period [1].

Fig. 1. Changes in the electrical activity of the brain in subject G, during performance of work. During the initial moment of muscular activity the EEG shows depression of the α-rhythm. On continuation of work there is restoration of the α-rhythm to its resting characteristics. Sections a, b, c are a continuous record of the same EEG, c) recorded 1 min 30 sec after the beginning of work. The lower trace in each section - electromyogram; bursts of muscle potentials correspond to the rhythm of the movement.

The EEG changes described above as characterizing the beginning of work were not always sufficiently clear. The degree of change of the EEG components and the duration of the initial period of work could show considerable fluctuations. Even in one and the same experiment the changes in electrical activity of the brain during the beginning of work were not constant but depended on the character and power of the work performed earlier and subsequently in that particular experiment.

Fig. 2. Changes in the electrical activity of the brain in subject K-o on repeating the work. Diminution of the Initial period is noted. a) First performance of the work; b) repeat of performance of the work; ↓ - signal denoting beginning of movement; upper tracing - recording of the rhythm of movement.