Fiziologicheskii Zhurnal SSSR imeni I. M. Sechenova, vol. 55, no. 7, pp. 783–792, 1969

UNIT ACTIVITY IN THE RABBIT MOTOR CORTEX DURING FORMATION OF A DOMINANT FOCUS

T. D. LIPENETSKAYA and A. A. SOKOLOVA

Institute of Higher Nervous Activity, USSR Academy of Sciences;
Burdenko Institute of Neurosurgery, USSR Academy of Medical Sciences, Moscow

Studies of the dominant focus, as a general principle in the activity of neural centers, can make an important contribution to the understanding of conditioning mechanisms (15, 20).

A convenient model for study of the dominant focus is produced in the motor cortex by local application of a weak direct current (12). By the use of this method it is possible to study processes taking place in the zone of the dominant focus and also to observe changes in unit activity during conditioning.

Few microelectrode investigations of the dominant focus have been carried out on this model—by Morell (11), Voronin (4), and Shul'govskii, Kotlyar and Moroshkina (7, 21, 22). Direct recording of the EMG, essential for verification of the existence of a dominant state, was absent from these investigations. At the same time, the motor effect, which is the principal indicator of the existence of a dominant focus in the motor cortex, is known not to be directly dependent on strength of current, and polarization of the motor cortex itself does not always yield a motor effect in response to a hitherto indifferent stimulus (6, 9, 12–14, 16, 19). In addition, in the investigations cited above no analysis was made of changes in reactivity of each neuron, because the change in reactivity was judged from the total number of reacting neurons before and after polarization.

Changes in reactivity of single neurons during the formation of a dominant focus are reported herein. The main criterion of formation of the dominant focus was the presence of a motor effect in response to a hitherto indifferent (acoustic) stimulus. The EMG was therefore recorded in all these experiments parallel with unit activity and the EEG.

METHOD

Experiments were carried out on unanesthetized, unimmobilized animals fixed lightly to a frame. Extracellular recording was carried out with glass electrodes inserted into a burr-hole by means of the miniature micromanipulator devised by Melekhova et al. (10), fixed to the skull. The position of the burr-hole for insertion of the microelectrode was determined from movements of the contralateral limb in response to passage of a short burst of ac through the skull from a "Cortivar" electronic stimulator. Details of the technique of extracellular recording of unit activity concurrently with the EEG and EMG were described previously (17). The dominant focus in the motor cortex was formed as described by Rusinov et al. (6, 12–14, 19). The polarizing electrode (anode), consisting of silver wire with a soft brush at its end, was lowered onto the cortex near the insertion of the microelectrode. A silver disc reference electrode (2×5 mm) was applied to the rabbit's ear. The strength of the direct current was selected by smooth regulation (from 0 to 10 μamp) until the appearance of a motor effect in response to the stimuli applied. In these experiments the optimum current strength was between 0.5 and 1.5 μamp. The mean duration of polarization required to obtain a stable motor effect varied from 0.5 to 2 hr.

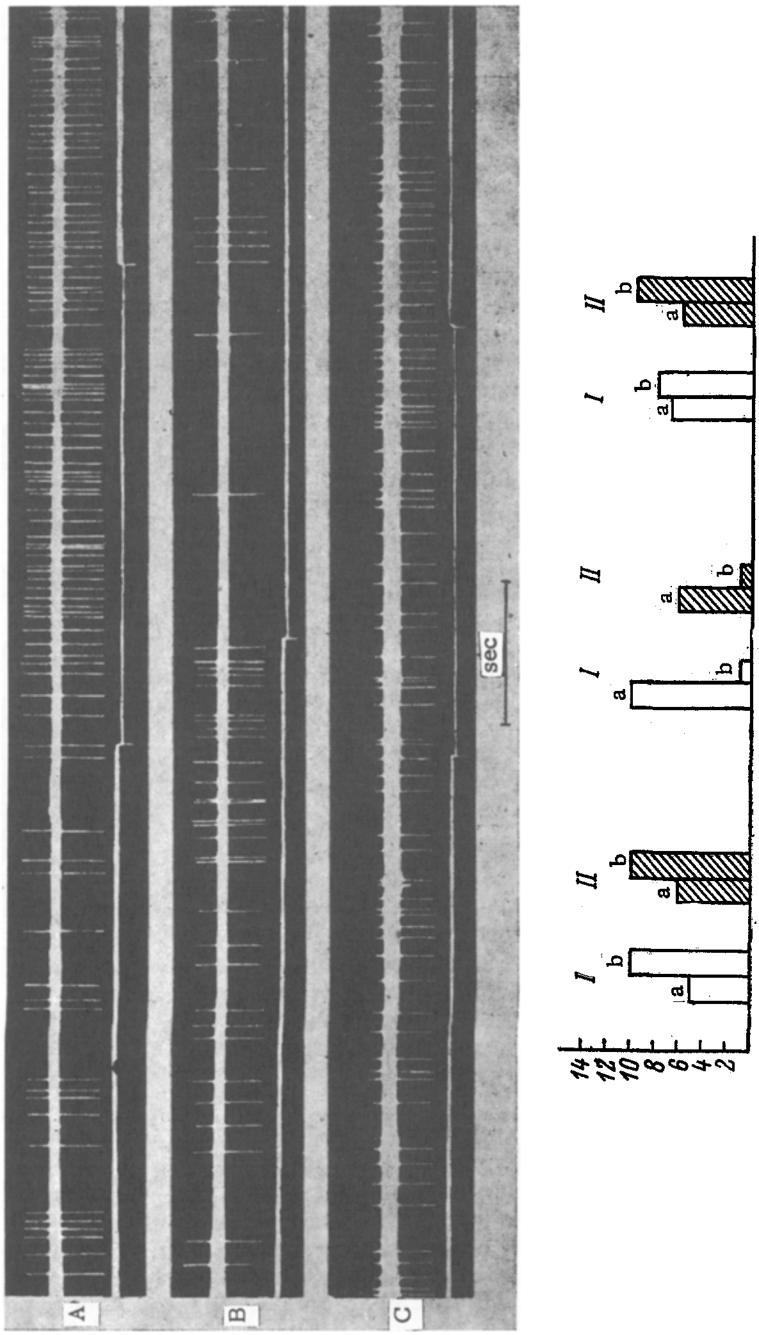

Fig. 1. Different types of unit responses to acoustic stimulation. Neurons: A) responding by increased frequency, B) inhibition, C) not responding. On each trace from above down: unit activity, stimulus. Below: representation of response of same neurons to acoustic stimulation (I) and mean data for six presentations of acoustic stimulus (II). Vertical axis: Number of impulses/sec: a) before, b) after beginning of stimulation.