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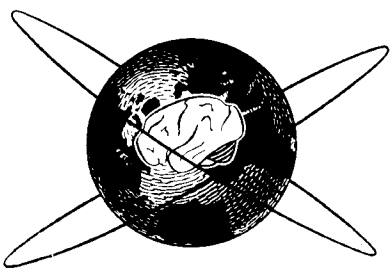

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ELECTROPHYSIOLOGICAL APPROACH TO THE PROBLEM OF FUNCTIONAL BRAIN HEMISPHERE ASYMMETRY.

The research here reported- only the part of more extensive and multidirectional work- was an attempt to apply neurophysiological methods in order to examine the functio nal differences between the brain hemispheres. According to the opinion shared by the majority of authors, no problem of cerebral dominance exists in animals. In spite of this, we decided during experiments performed upon 74 cats to pay attention to the asymmetrical EEG patterns resulting from the asymmetrical behavior of the basic neurophysiological mechanisms. We were chiefly interested in the synchronisation and desynchronisation mechanisms, which- as stated in the publications of Delgado and Hamlin /1962/ Housepian and Purpura /1963/- play the same role in the nervous system both of humans and of animals. This is why the animal observations of the different asymmetrical behavior of the bioelectrical reactions in both brain hemispheres can be transferred in some degres to human conditions and therefore enable - as we suppose - an explanation of the mechanisms by which cerebral dominance may come into action.

In acute and chronic experiments electrical or chemical stimulation was used and also methods combining both these types of stimulation.Neurohormones and other substances with a marked pharmacological action were applied directly and indirectly. The direct mode of application of the drug into the brain centers consisted in using double wall Grossman cannulas inserted intracerebrally by means of a stereotactic apparatus. Drugs were also injected into the lateral brain ventricle through Feldberg cannulas. The location of the recording and stimulating electrodes was checked by histological examination.

A. Synchronising mechanisms

1. Spontaneous cortical spindles /SCS/ were observed in 20 cases. In experiments with " encephale isole" there

usually prevailed synchronised periods in the form of SCS. In animals immobilized by flaxedil SCS were seen after 25 mg of amytal had been injected in a single dose. Asymmetrical SCS forms appeared in 32%. Asymmetry consisted in the amplitude difference and in the asynchronic duration of spindles.

2. Recruiting responses / RR/ - obtained after low frequency stimulation of the unspecific thalamic system / CL and CM/ - were found in 28 cases, 57% of which showed asymmetrical behavior of recruited activity. Asymmetry involving usually several RR parameters had different patterns in homonymous areas of both hemispheres.

A special kind of asymmetry resulted from the one-sided polarity reversal of the recruited waves, which are usually surface- negative. In one of 3 cases - shown in fig. 1. the carboline compound administration into the head of the caudate nucleus caused an inhibitory influence upon the unspecific thalamic centers, which was in turn revealed in the transient appearance of asymmetrical recruited waves of positive sign.

3. Caudate spindles /CS/ were examined only during the acute experiments." Encephale isole" preparations were more susceptible to give this kind of reaction. Asymmetrical CS were led from the cerebral cortex during different periods in all experiments in which caudate nucleus stimulation was performed.

B. Desynchronising mechanism

Arousal reaction /AR/ in the form of cortical desynchronisation accompanied by the theta rhythm in the hippocampus was studied in 45 cats. AR asymmetries were found in 10 cases.

C. Mechanisms of self-sustaining hypersynchrony

The asymmetrical mode of paroxysmal discharge /PD/ propagation within both the hemispheres was observed in 23 cases out of a total number of 33 acute and chronic experiments. In 16 cases the starting point of the propagating PD was localized in the hippocampus stimulated both electrically and chemically. In 7 cases the PD source was placed in the amygdaloid nuclei complex. During the next 6 experiments PD diffused from the head of the caudate nucleus towards the cortex and subcortical structures. In the remaining 4 cases PD arose from the nucleus centralis

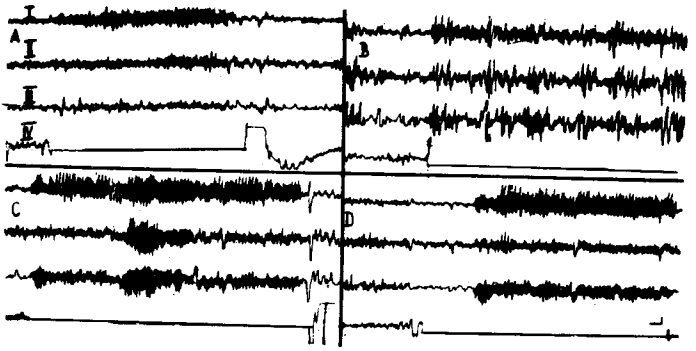

Fig. 1. Chronic experiment, cat 17. Asymmetrical polarity reversal of the recruiting response after the simultaneous chemical stimulation of the right caudate nucleus and electrical stimulation of the left CL. A- recruiting response before chemical stimulation, B-15 min. after stimulation, C- sign reversal of the left recruiting response, D- 1 hour after the drug administration. I and II- symmetrical leads from the sigmoid and suprasylvian gyrus, III and IV- symmetrical leads from CL. Low frequency stimulation time was marked by the horizontal line. Vertical bar- 50uV, horizontal- 1 sec.

lateralis of the thalamus.

From the experiments described the following inferences can be drawn:

1/ all the neurophysiological mechanisms taken into consideration and accessible to EEG methods may show asymmetrical patterns in the homonymous fields of both brain hemispheres.

2/ periodically appearing asymmetry -besides the record samples representing bilateral synchrony and symmetry - give evidence of the great complexity in the interhemispheric relations, on the one hand of the " unison " work, and on the other of the remarkable reciprocal independence.

3/ no specific neurophysiological mechanism, due to which the cerebral dominance might be expressed, was found. The EEG differences between brain hemispheres were not absolute from the neurophysiological point of view one might speak only of different dominance gradients.

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