In acute experiments on cats anesthetized with pentobarbital and chloralose, the method of recording focal responses was used to study projections of various parts of the orbito-frontal and basal temporal cortex and also of the hippocampus in the region of the pons. Different formations of the fronto-basal zones of the neocortex were shown to have local projections in the rostral zones of the pons and relatively diffuse projections in its caudal zones. Projections of the hippocampus in structures of the pons are less well marked than those of the fronto-basal zones of the neocortex and their focal responses are more diffuse in character. Representation of all the structures studied is found only in the nuclei of the gray matter of the pons. The orbito-insular zone of the orbito-frontal cortex is not represented in the caudal zones of the reticular formation; the basal temporal cortex has no projection in the middle cerebellar peduncles.

INTRODUCTION

Recent morphological studies have shown that after destruction of various parts of the neocortex degeneration of fibers takes place in the region of the pons and that there is a definite topical localization in the distribution of these fibers [5-11, 15]. The projective which has been studied in most detail is that of the orbito-frontal cortex (OFC), which has direct corticopontine connections with the various nuclei of the pontine reticular formation (RF) and also with the pontine nuclei in the gray matter of this region [8, 9]. Many of these fibers terminate in the caudal part of the pons. As regards projection of other cortical zones, the presence of direct pathways to the pons has been discovered for the somatosensory [6, 7], visual [10], auditory [11], and parietal cortex [15].

Structures of the archipaleocortex also have connections with the pons. In particular, the hippocampus is connected with the pontine RF in both directions [2, 12, 14, 16]. Descending pathways from the hippocampus to the pontine RF run both along the precommissural part of the fornix and along descending fibers of the medial forebrain bundle (MFB).

These data on the presence of corticopontine connections do not, however, bridge the gap in our understanding of the character of the influences of the various cortical structures (of both the neo- and the archipaleocortex), on pontine structures or the possible diversity and specificity of their functions. Nor is this yet possible by means of the results of single physiological investigations which have been undertaken from different standpoints and by the use of different techniques [1-4, 12, 20, 21].

In the present investigation the method of recording evoked potentials (EP) was accordingly used to study projections of the prefrontal and orbito-insular zones of OFC (the proreal and posterior orbital gyri), the basal temporal cortex (BTC), and the pole and base of the temporal lobe and hippocampus (areas CA1 and CA3 of the dorsal hippocampus) in structures of the pons in cats.
EXPERIMENTAL METHOD

Experiments were carried out on adult cats anesthetized with a mixture of pentobarbital (30-40 mg/kg) and chloralose (25 mg/kg). The surgical procedure consisted of removal of the temporalis muscles and wide exposure of the lateral surface of the hemispheres. Access to the various zones of OFC and BTC was obtained after drainage of the eye and removal of all parts of the orbit except its rostro-basal part, and also of a considerable part of the squamous part of the temporal bone. To obtain access to the dorsal hippocampus, suction of a limited volume of brain tissue located above and anteriorly to the lumen of the lateral ventricle was carried out. The recording electrode was inserted into the pontine structures after removal of the tentorium cerebelli on the side of investigation. The cerebral cortex and hippocampus were stimulated by means of bipolar ball electrodes (interpolar distance 2-3 mm) by square pulses, 0.1-0.5 msec in duration. Focal responses were recorded by steel electrodes 150-300 μ in diameter, which were inserted into various parts of the pons using coordinates taken from the atlas [19]. The positions of the electrode tracks were verified histologically.

EXPERIMENTAL RESULTS

Projections of Various Cortical Structures in the Regions of the Pons. In response to stimulation of the various cortical regions EP appeared over the whole extent of the pons (in RF, the nuclei of the gray matter, and in the region of the middle cerebral peduncles), starting from Fr = A2 to Fr = P4 according to [19].

Projections of the proreal gyrus in the rostral zones of these structures were organized topically and were local in character. In the caudal zones of these structures, however, responses of a diffuse character were observed. EP to stimulation of the proreal gyrus were found in the ventrolateral and ventromedial zones of the pontine RF, in the medial and lateral structures of the nuclei of the gray matter, and also in the region of the middle cerebral peduncles (Figs. 1a and 2a).

In the case of stimulation of the second subdivision of OFC (the orbital gyrus) focal responses were recorded in the same structures as to stimulation of the proreal gyrus. Regions with the most marked responses to stimulation of the orbital gyrus were located in formation between Fr = A1 and Fr = P2 (Figs. 1b and 2b).

The distribution of EP to stimulation of the orbital gyrus was similar to the localization of responses recorded to stimulation of the proreal gyrus. At the same time, the wide distribution of focal responses in the rostral zones of these pontine structures and their smaller numbers in the caudal zones during stimulation of the orbital gyrus than during stimulation of the proreal gyrus must be noted. The focus of maximal intensity of responses in the rostral zones to stimulation of the orbital gyrus lay in the medial zones of RF. No well-marked responses were observed in the caudal zones of RF.

EP to stimulation of BTC appeared in the ventral and central regions of the rostral part of RF (Figs. 1c and 2c). Displacement of the projections of BTC in the medial direction was a characteristic feature of responses recorded from a more caudal zone of the pons. The focus of maximal intensity of the responses also lay in the medial parts of the nuclei of the pontine gray matter. Focal responses to this stimulation were absent in the lateral parts of the gray matter and in the region of the middle cerebral peduncles.

Projections of the hippocampus in the pontine structures were diffuse in character, especially in its caudal zones (Figs. 1d and 2d). More marked responses were observed in the rostral part of RF, where the representation of the hippocampus was shaped like a half-moon open in the medial direction (Fr = APO). Local responses were observed in the dorsal zones of the nuclei of the pontine gray matter. The low density of marked responses in the middle cerebral peduncles also was a characteristic feature.

Characteristics of Focal Pontine Responses. In most cases EP arising in different zones of the pons to cortical stimulation were positive-negative in character (Fig. 3A). EP recorded from nuclei of the gray matter of the pons sometimes began with a negative phase (Fig. 3A, 2). The amplitude of the initial positive phase of EP in the rostral zones of the pons was 90-180, and in the caudal zones 80-160 μV. Its duration was 45-70 and 30-40 msec respectively (Fig. 3A). The amplitude of the initial negative phase of the responses was 25-85 μV.

Attention must be drawn to the significant differences in the characteristics of focal responses arising in the pontine RF, the nuclei of the gray matter, and the middle cerebral peduncles. In the nuclei of the gray matter and cerebral peduncles the responses were local in character, as could be judged from the shorter latent period, the greater steepness of rise of the initial phases of the responses, and their shorter duration.