Extraprimary Cortical Evoked Potentials in Freely Moving Cat Following Photic Stimulation

The special experimental conditions under which sensory evoked responses irradiate beyond the corresponding cortical receptive primary areas are well known, especially those realized under chloralose[1,2] and barbiturate[3,4] anaesthesia.

But the barbituric secondary responses, described by FORBES and MORISON[3], have a latency up to 80 msec. In the same way, the evoked potentials recorded in the suprasylvian gyrus[5] and in the motor cortex[6] under chloralose anaesthesia have latencies of 15–40 msec. But we have recorded[7] short-latency evoked potentials in the suprasylvian gyrus and in the motor cortex in freely moving cats following somesthetic stimulation.

Moreover, we have found[8] somatotopical arrangement. Considering these findings, we have made a systematic analysis of the evoked potentials recordable on the lateral surface of the hemisphere following photic stimulation.

Material and methods. The experiments were carried out on four adult, unanaesthetized, freely moving cats, carrying recording epidural electrodes previously introduced aseptically during barbiturate anaesthesia. The photic stimuli were induced by means of the photostimulator Keiser, generating a very short flash (0.2 msec); the stimulator was placed outside the sound-proof room in front of the window. Stimuli were given for periods lasting 1 sec. Usually 15 cortical points were explored by means of a 15-channel electroencephalograph Alvar and 3 to 6 cortical points by oscillographic recording.

Results. It is possible to distinguish three types of evoked activity. The evoked potentials recorded from primary optic area show (electrode 11) characteristic morphology of primary evoked potential, i.e. the positive phase with latency of 15 msec is followed by a negative phase peaking at 25 msec. The late waves of evoked potentials will not be analysed in this paper.

Similar morphology of evoked potentials may be seen within the paraoptic areas, i.e. medial part of lateral gyrus (electrodes 9 and 10), dorsal parts of the suprasylvian gyrus (electrodes 13 and 14). Surprisingly, this type of evoked potential was recorded in the medial ectosylvian gyrus too (electrode 20). This second type of evoked activity differs from the first one by a lower amplitude of the initial positive phase. The latencies of the positive and negative peaks are either the same or

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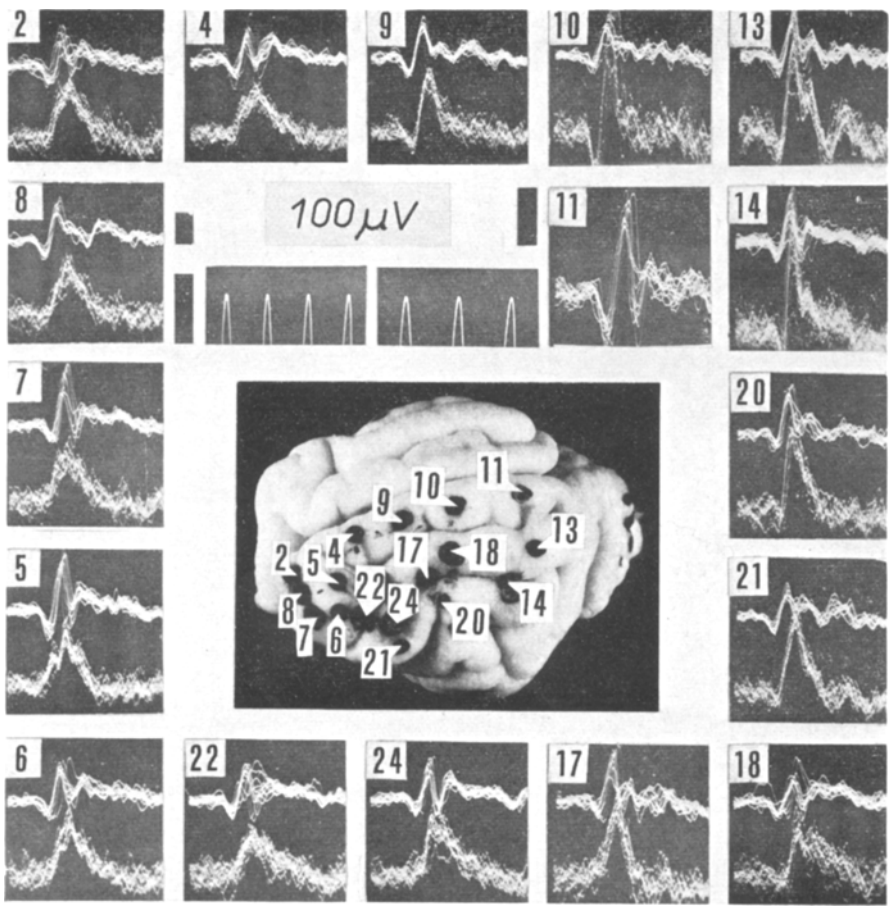

Cortical evoked potentials following photic stimulation in the cat. In the centre of the figure – the photographed brain of the cat. The sites of recording electrodes were checked post mortem by means of electrocoagulation. The number of dimples made following this procedure and number of oscillograms correspond to each other. Top trace of each pair from primary optic area (electrode No. 11) and bottom trace from different cortical lead. Positivity is downward and stimulus occurs at the beginning of trace. Calibration on the right side for oscillogram No. 11 and on the left side for other oscillograms (in all cases: 100 μV and 20 msec).

somewhat longer in comparison with the respective peaks of the primary evoked potential.

Photic responses recordable from other parts of the lateral surface of the hemisphere represent the third group of evoked potentials. The typical feature of these evoked potentials is the dominating negative phase. The initial positive wave is very seldom detectable. As far as the positive phase is recorded, its latency is from 11 to 16 msec. The onset of the following negative phase has a latency from 14 to 20 msec. The predominating negative phase peaks at 26 to 31 msec. On the ascending limb of this negative wave a small notch is detectable primarily within the sigmoidal gyri.

Discussion. Findings obtained during our experiments are comparable with results of KREINDLER's laboratory[9] and of other authors[10–13]. But it is obvious from our findings that the short-latency photic evoked potentials are quite well detectable from other cortical areas than have hitherto been defined.

There remain especially two questions to be answered. First, the question of the electrogenesis of these extraprimary evoked potentials. We are in agreement with KREINDLER's[13] point of view that the extraprimary evoked potentials are realized by thalamic afferences via the paucisynaptic chains and joining predominantly apical dendrites in the superficial layers of the cortex.

Secondly, the question of their thalamic relay. According to VASTOLA[14], there is a direct pathway passing from the lateral geniculate body into the paraoptic areas of the cortex. CHANG's[15] opinion is that the transmission of diffuse cortical photic responses beyond the primary visual area might start from the ventral part of the lateral geniculate body. Only continued investigations of this problem will reveal a definite answer.

Zusammenfassung. Die extraprimären optischen Potentiale, die in der somatosensorischen, akustischen und Assoziationsrinde der wachen Katzen mittels chronischer epiduraler Elektroden registriert wurden, zeigen fast dieselbe Latenz wie die primären Potentiale, unterscheiden sich aber von ihnen durch ihre Form.

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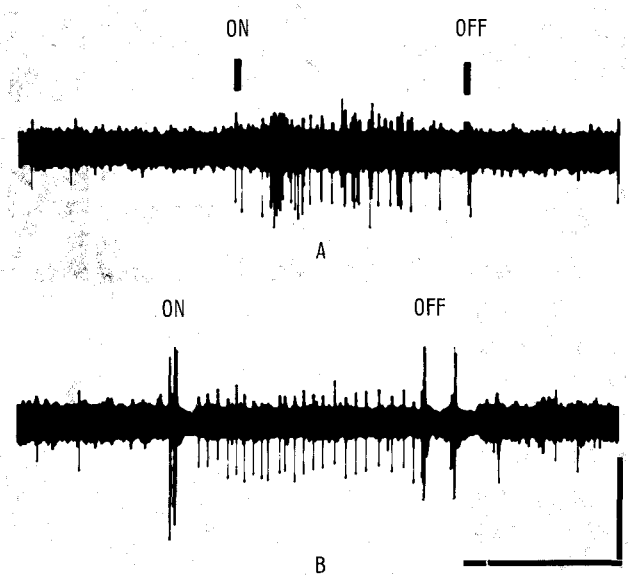
Actions of L-Glutamate, Acetylcholine and Dopamine on Single Neurones in the Nuclei cuneatus and gracilis of the Cat

The dorsal column nuclei (nucleus cuneatus and nucleus gracilis) are the major terminations of primary afferent fibres from body surface and joint receptors. Individual units in these nuclei are easily identified by means of electrophysiological techniques. It was tempting to examine this pool of secondary sensory neurones with respect to the action of microelectrophoretically applied drugs[1]. A similar study has been successfully completed on the vestibular nuclei[2].

The experiments were made on 21 adult cats under sodium pentobarbital anaesthesia. The medulla oblongata was exposed and the caudal parts of the cerebellum were removed. The activity of neurones in the dorsal column nuclei was recorded extracellularly with the central barrel (filled with 4 M NaCl) of a five-barrelled glass micropipette. The total tip diameter was 2–8 μ. One of the four remaining barrels was always filled with 1/6 M NaCl for current control and the other barrels contained strong solutions of acetylcholine-Cl (1–2 M), Na-L-glutamate (1 M), and dopamine HCl (1–2 M) respectively. Electrophoretic current of 20–120 nA for expelling the ions was used. For identification of neural elements, the following types of physiological stimulation were applied: hair movement, light skin touch, and joint movement.

Out of 250 cells 132 responded to adequate ipsilateral peripheral stimulation with an increase in the discharge rate and 6 with a decrease. *L-glutamate* activated 50% of the cells which had been influenced by ipsilateral stimulation



Response of a cell in the nucleus cuneatus to ipsilateral peripheral stimulation of the receptive field on the forearm (A) and to L-glutamate-microelectrophoresis [60 nA] (B). Time mark 1 sec Vertical calibration is 0.3 mV.

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