Neuronal responses of an isolated slab of auditory cortex (area AI) to intracortical stimulation at the level IV were studied in curarized cats by extracellular recording 3 weeks after isolation. Dispersion of response latencies in the isolated slab was reduced (compared with that observed soon after isolation); the predominant responses were mono- and disynaptic, and the number of discharges consisting of bursts of spikes increased. However, despite simplification of the structural and functional organization of the chronically isolated slab of auditory cortex, the conditions for complex polysynaptic interaction between neurons of all layers were preserved in it, and in each layer the character of such interaction depended on the distance of the neuron from the focus of origin of the excitation. [In the chronically isolated slab of auditory cortex, just as in the acutely isolated slab, late responses of over 40 msec were absent.]

**INTRODUCTION**

The writers previously [4] studied neuronal responses of an isolated slab of auditory cortex (area AI) to intracortical stimulation under acute experimental conditions. Depending on the distance between the recording and stimulating electrodes, these responses had distinctive features. Under these conditions, despite rupture of all connections of the test area of cortex both with deep brain structures and with neighboring areas, the possibility of activation of geniculocortical and other fibers preserved in the slab was not ruled out. This greatly complicated the study of the character of intracortical interactions. Neuronal activity in chronically isolated slabs has been studied by several workers [5-8, 10]. It has been shown that at different times after isolation of the cortical slab (from a few days to a few months) it remained viable and its neurons were still capable of generating both spontaneous and evoked action potentials (APs). One investigation [6] showed that 2-2.5 weeks after isolation, degeneration of all afferent fibers from deep brain structures and other cortical areas is practically complete in isolated slabs with a normal pial circulation. In addition, 30 days after isolation changes due to regenerative processes are found in a cortical slab [3]. However, several problems concerned with the internal organization of the isolated slab have not been adequately studied. It was accordingly decided to investigate neuronal responses to intracortical stimulation 3 weeks after isolation of a slab of auditory cortex in cats.

**METHOD**

Experiments were carried out on cats. Initially under pentobarbital anesthesia (30 mg/kg, intraperitoneally) an operation was performed to isolate a slab of auditory cortex (area AI) by the method described in [4], with aseptic precautions.

Three weeks later the second stage of the experiment began, in which responses of neurons of the isolated slab to intracortical electrical stimulation (ICS) were studied. The preparatory operations (fixation of the animal's skull in the stereotaxic apparatus, tracheotomy, exposure of the brain surface, and introduction of a cannula into the femoral vein) were performed under pentobarbital anesthesia (30 mg/kg, intraperitoneally). Responses of single units to ICS were tested a few hours after injection of pentobarbital; the animal was first immobilized with tubocurarine. The wound edges were constantly infiltrated with 0.5% procaine solution. APs were recorded extracellularly from the neurons. Fuller details of the experimental method were described previously [4].
Neuronal responses of the chronically isolated slab of auditory cortex were recorded, just as previously [4], in three series of experiments at distances of 0.5, 1.0, and 2.0 mm from the site of ICS. Responses of 304 neurons were recorded in the first series of experiments, 450 in the second, and 290 in the third.

Most neuronal responses in the slab of auditory cortex 3 weeks after isolation, just as in the acutely isolated slab, were single APs (93%). Only 2% of responses consisted of two or three APs. The number of responses consisting of burst discharges, made up of four to eight APs, was a little greater than in the acutely isolated slab. Such responses were recorded in 5% of neurons, chiefly in layers III-V. The number of burst discharges usually increased after repeated stimulation of the slab, when paroxysmal slow-wave electrical activity, which could last for tens of minutes, was evoked in it. During these periods, all neurons found in layers III-V generated spontaneous discharges of bursting type, which appeared synchronously with the paroxysmal slow-wave discharge.

During the first few minutes after the onset of slow-wave paroxysmal activity, bursting discharges of the neurons, like "bursts" of slow-wave activity, were generated every 30-500 msec. Gradually their frequency decreased to a few discharges per minute, and later they disappeared, although they were easily provoked by fresh stimuli.

Application of a series of ICS led to modification of the rhythm of the previously provoked discharges, and later of spontaneous burst discharges also, and they began to bind the rhythm of stimulation. Often lengthening of the burst was observed after application of two to four stimuli. When stimulation ceased the original intrinsic rhythm of the burst discharges was quickly restored.

Three weeks after isolation of the slab of auditory cortex no neurons with spontaneous activity could be found in it for long periods of time, with the exception of units whose activity was provoked by frequent stimulation, as described above. Discharges of some neurons evidently arose in response to mechanical stimulation by the nearby microelectrode. As a rule these neuronal discharges were inhibited by ICS; the period of inhibition varied in duration from 30 to 200 msec. Three neurons which generated activity of this kind did not respond to ICS. No late responses with a latent period of 40-200 msec could be found in the chronically isolated slab of auditory cortex, just as in the acutely isolated slab.

Neuronal Responses of Slab of Auditory Cortex to ICS (interelectrode distance 0.5 mm). The distribution of latencies of neuronal responses in this series of experiments is illustrated in Fig. 1a. Clearly 6% of neurons responded with a latent period of under 1 msec and 37.7% responded with a latent period of 1.1-3 msec. Neuronal responses of the first group were evidently antidromic. During paired stimulation the refractory period of these responses did not exceed 3 msec. Responses of about 1% of neurons of the second group, with a latent period of 1.1-1.2 msec, could also be classed as antidromic. Responses of the remaining neurons of this group could be regarded as monosynaptic orthodromic responses [2, 9].

Neurons responding with a latent period of 3.1-5 msec accounted for 33.3% of the total. Most of these responses evidently were disynaptic in origin, although some of them could have been trisynaptic.

As the data in Fig. 1a show, the number of neurons responding to ICS with a latent period of over 5 msec was relatively small. Neurons responding with a latent period of 5.1 to 11 msec accounted for 20.3% of the total. Only five units responded with a latent period of over 11 msec, and the response of only one of them had a latent period of 18 msec. Neuronal responses with a longer latent period were not observed in the chronically isolated slab.

To discover into which layers of the isolated slab the excitation wave evoked by ICS at the level of layer IV spread, the depth of the responding neurons was determined. The distribution of responding neurons of the first series by depth in the isolated slab is shown in Fig. 2a. Responses to ICS when the electrodes were 0.5 mm apart, just as in the remaining series of experiments (Fig. 2b, c) appeared in neurons in all layers of the slab. A small proportion of responding cells lay at a depth of 0.4-1.6 mm. Responses were recorded in only four neurons (1.3%) in layer I in this series. Most responding cells were found in layers IV and V, i.e., at the level of the stimulating electrode. They were also quite numerous in adjacent layers III and VI.

Neuronal Responses in Slab of Auditory Cortex to ICS (distance between electrodes 1 mm). The ratio between the numbers of neurons which responded to ICS with different latent periods differed significantly in this series of experiments from the corresponding figure in the previous series (Fig. 1b). A latent period of under 1 msec was found in only one neuron; another 1.6% of cells responded with a latent period of 1.1-1.3 msec. This group of responses could be classed as antidromically activated. A latent period of 1.3-3 msec was a