

Sense Organs

Interfaces between Environment and Behaviour

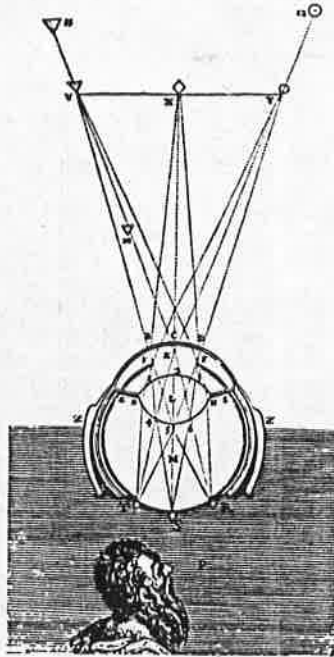
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Zwischen Umwelt und Verhalten

Proceedings of the 16th Göttingen Neurobiology
Conference

Beiträge zur 16. Göttinger Neurobiologentagung MAY 27-29, 1988

Edited by
Norbert Elsner and Friedrich G. Barth



1988

Georg Thieme Verlag Stuttgart · New York

266

CELLULAR ORGANIZATION AND PHYSIOLOGY OF SLICE CULTURES FROM RAT VISUAL CORTEX

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Brain slices provide a useful experimental approach to study cortical structure and connectivity at the cellular level. This technique permits a variety of physiological, anatomical and biochemical experiments which might not be possible *in vivo*. One of the limitations of such preparations is the limited survival *in vitro*, which is usually less than 16 hours. However, Gähwiler showed recently that slices from hippocampus can be cultivated for several weeks by means of the roller-culture technique (Gähwiler, *J. Neurosci. Methods* 4, 329, 1981). The hippocampal slice cultures were organotypically organized and many features of the normal cell morphology and intrinsic connectivity remained stable under culture conditions (Zimmer and Gähwiler, *J. Comp. Neurol.* 228, 432, 1984).

We applied the Gähwiler technique to the visual cortex, an area of the brain whose development and functional architecture is extensively investigated *in vivo*. About 350 μm thick slices of the visual cortex were prepared from 2 - 10 days old rats. The slices were placed on glass coverslips, embedded in chicken plasma and cultivated in a roller tube. After 10 days in culture the cortical cultures flattened to 2 - 3 cell layers and often monolayers were obtained. The slice cultures survived for up to 6 weeks.

Nissl staining showed that the typical layered structure of the cortex was preserved after several weeks in culture. To study the morphology of individual neurons single cells were injected using Lucifer Yellow filled microelectrodes. Most of the injected cells were pyramidal cells which had the characteristic morphological features of their *in vivo* counterparts. The cells possessed a long apical dendrite directed towards the pial surface and several branched basal dendrites. All dendrites were heavily covered with spines.

Nonpyramidal cells in the cortex form a morphological diverse class of neurons. Many of these nonpyramidal cells are inhibitory and utilize the neurotransmitter GABA. We therefore used antibodies directed against GABA to characterize the morphology and distribution of these cells in cortical slice cultures. GABA positive neurons were found in all layers and in our best slice cultures about 20 % of the neurons were labeled. GABA immunoreactive neurons in slice cultures were spine-free and showed a variety of dendritic branching patterns as described *in situ*.

Using intracellular recording we found that basic biophysical properties of neurons in slice cultures were similar to those reported from acute slice preparations. Depolarizing a neuron close to firing threshold (about 10 mV above resting potential) usually triggered a single spike, but in a few cells burst potentials were generated. In many neurons we observed large postsynaptic potentials and a high spontaneous activity. The spontaneous activity was decreased by bath application of GABA and increased by bicuculline, a GABA antagonist. Taken together with our immunohistochemical studies this suggests that GABAergic inhibition is present in cortical slice cultures.