動物生理学 III　Handout No. 5

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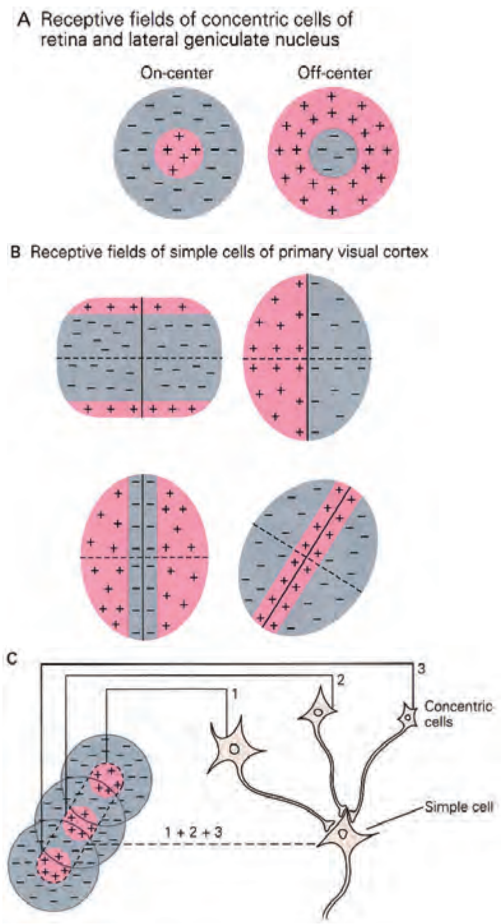

Figure 27-12 The receptive fields of simple cells in the primary visual cortex are different and more varied than those of the neurons in the retina and lateral geniculate nucleus.
A. Cells of the retina and lateral geniculate nucleus fall into two classes: on-center and off-center. The receptive fields of these neurons have a center-surround organization due to antagonistic excitatory 1+1 and inhibitory (-) regions.
B. The receptive fields of simple cells in the primary visual cortex have narrow elongated zones with either excitatory (+) or inhibitory (-)flanking areas. Despite the variety, the receptive fields of simple cells share three features: 11) specific retinal position, (2) discrete excitatory and inhibitory zones, and (3) a specific axis of orientation.
C. Model of the organization of inputs in the receptive field of simple cells proposed by Hubel and Wiesel. According to this model, a simple cortical neuron in the primary visual cortex receives convergent excitatory connections from three or more on-center cells that together represent light falling along a straight line in the retina. As a result, the receptive field of the simple cortical cell has an elongated excitatory region, indicated by the colored outline in the receptive field diagram. The inhibitory surround of the simple cortical cells is probably provided by oft-center cells whose receptive fields (not shown) are adjacent to those of the on-center cells. (Adapted from Hubel and Wiesel 1962)

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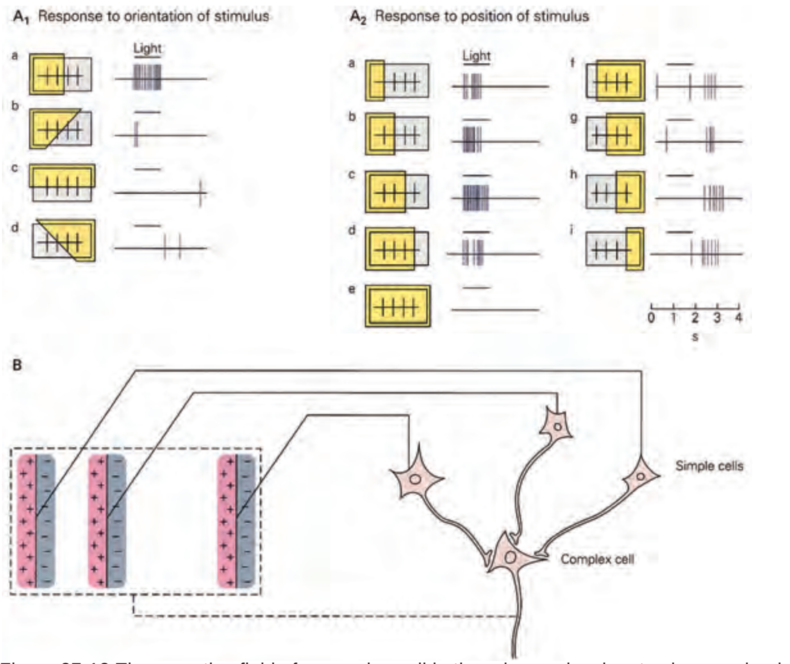

Figure 27-13 The receptive field of a complex cell in the primary visual cortex has no clearly excitatory or inhibitory zones. Orientation of the light stimulus is important, but position within the receptive field is not. (Adapted from Hubel and Wiesel 1962).
A. In this example the cell responds best to a vertical edge moving across the receptive field from left to right. This figure shows the patterns of action potentials fired by the cell in response to two types of variation in the stimulus: differences in orientation and differences in position. The line above each record indicates the period of illumination. 1. Different orientations of the light stimulus produce different rates of firing in the cell. A vertical bar of light on the left of the receptive field produces a strong excitatory response (a) Orientations other than vertical are less effective (b-d). 2. The position of the border of the light within the receptive field affects the type of response in the cell. If the edge of the light comes from any point on the right within the receptive field, the stimulus produces an excitatory response (a-d). If the edge comes from the left, the stimulus produces an inhibitory response (f-i). Illumination of the entire receptive field produces no response (e).
B. According to Hubel and Wiesel, the receptive fields of complex cells are determined by the pattern of inputs. Each complex cell receives convergent excitatory input from several simple cortical cells, each of which has a receptive field with the same organization: a central rectilinear excitation zone (+) and flanking inhibitory regions (-). In this way the receptive field of a complex cell is built up from the individual fields of the presynaptic cells.

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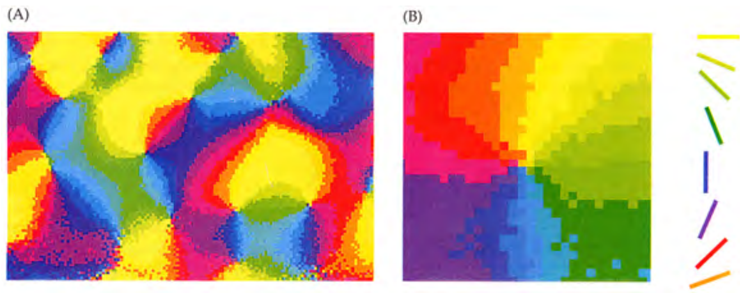

FIGURE 21.4 Detection of Orientation Columns (Pinwheels) by Optical Imaging. The activity-dependent reflectance of visual cortex was recorded by a sensitive camera while an eye was stimulated with oriented bars. (A) Each orientation caused maximal changes in different regions (an orientation "contour," encoded by a different color). Although the pattern seems at first disorderly, close inspection reveals centers at which all orientation contours come together in a pinwheel, as shown in (B). Note that each orientation is represented only once and that the sequence is beautifully precise. Such pinwheel centers occur at regular distances from each other. (After Bonhoeffer and Grinvald,1991.)

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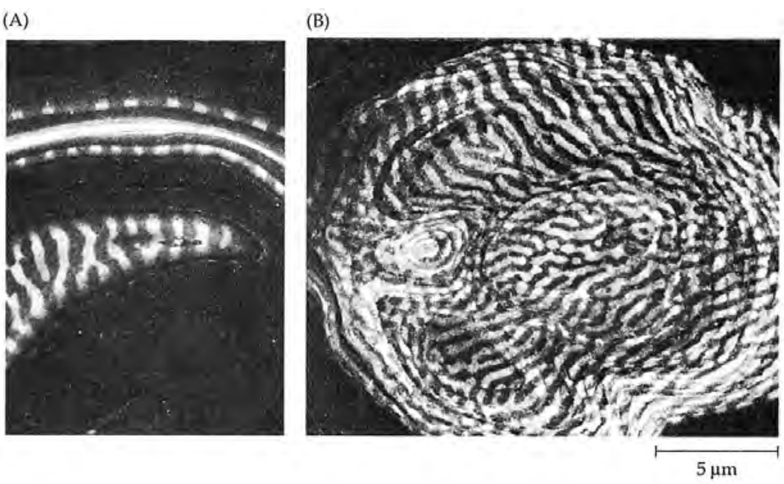

FIGURE 20.8 Ocular Dominance Columns in monkey cortex demonstrated by injection of radioactive proline into one eye. Autoradiographs photographed with dark-field illumination in which the silver grains appear white. (A) At the top of the picture the section passes through layer 4 of the visual cortex at right angles to the surface, displaying columns cut perpendicularly. In the center, layer 4 has been cut horizontally, showing that the columns consist of longer slabs. (B) Reconstruction made from numerous horizontal sections of layer 4C in another monkey in which the ipsilateral eye had been injected. (No single horizontal section can encompass more than a part of layer 4 because of the curvature of the cortex.) In both A and B, the ocular dominance columns appear as stripes of equal width supplied by one eye or the other. (Autoradiographs kindly provided by S. LeVay.)