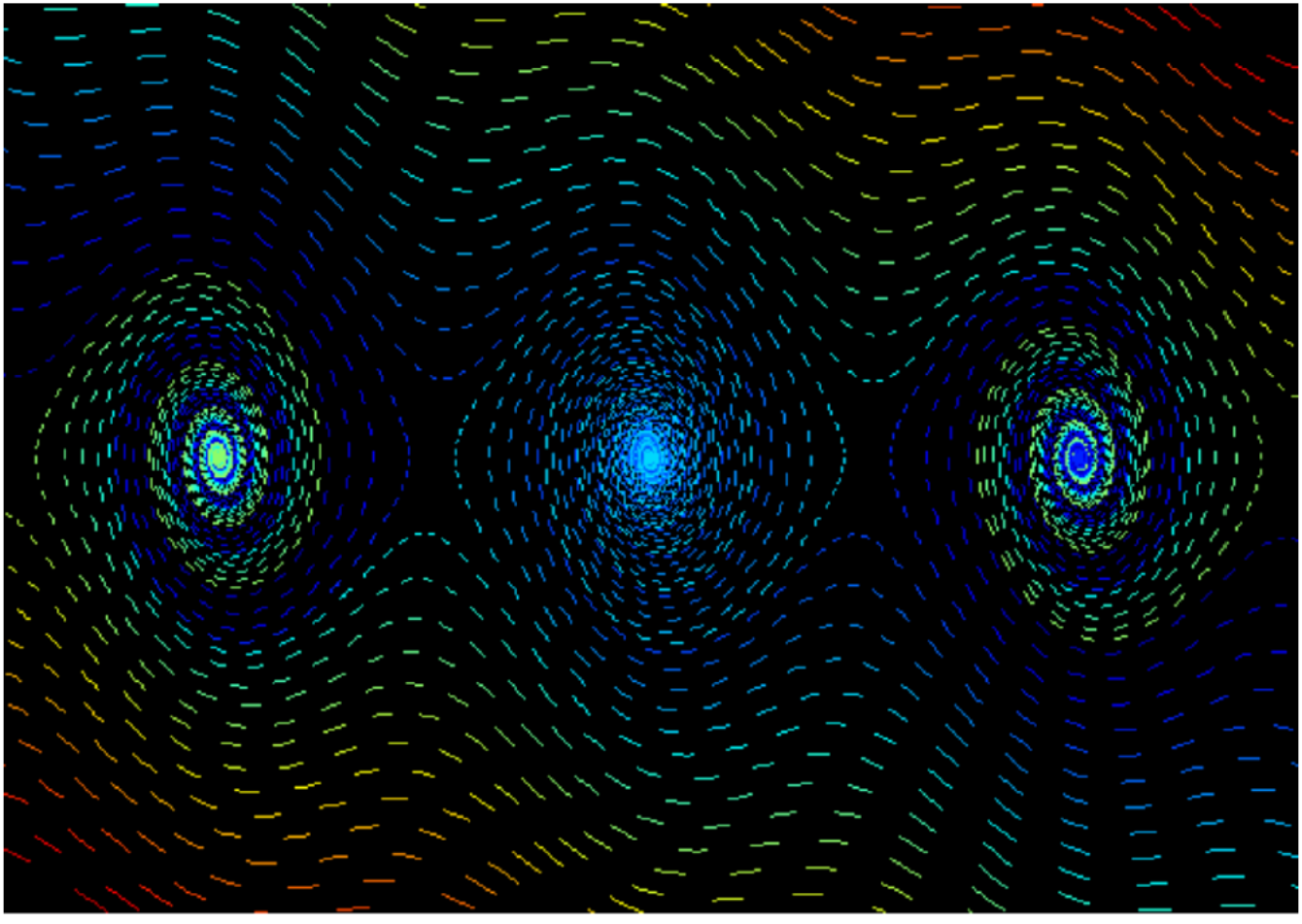
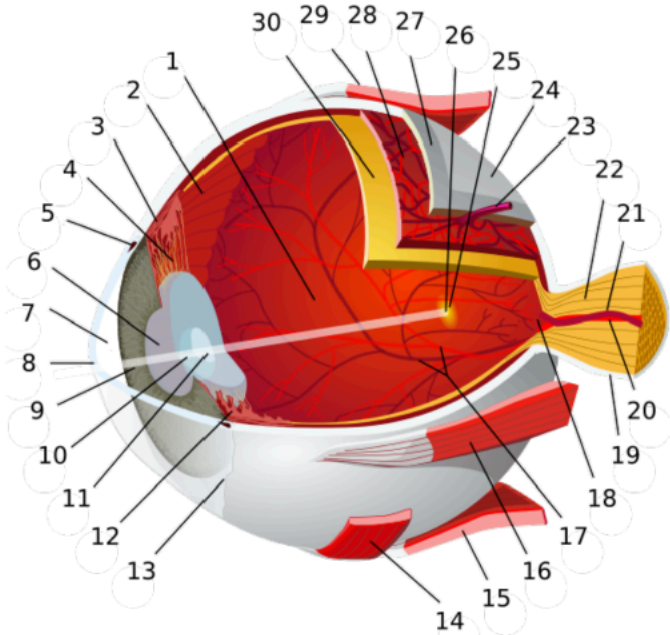
WHAT IS A VECTOR FIELD?





The human eye with the retina containing the sensitive ganglion cells and the optic nerv exiting to the right.

Some Terminology

Retina

Retinal ganglion cells

Lateral geniculate nucleus

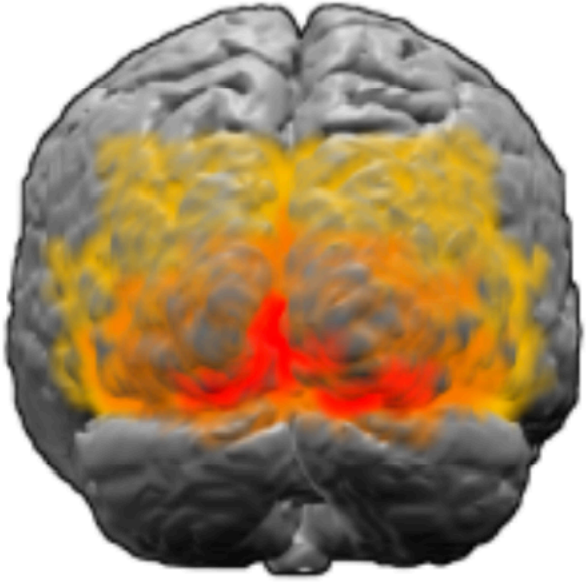
Visual cortex

Primary visual cortex / striate cortex

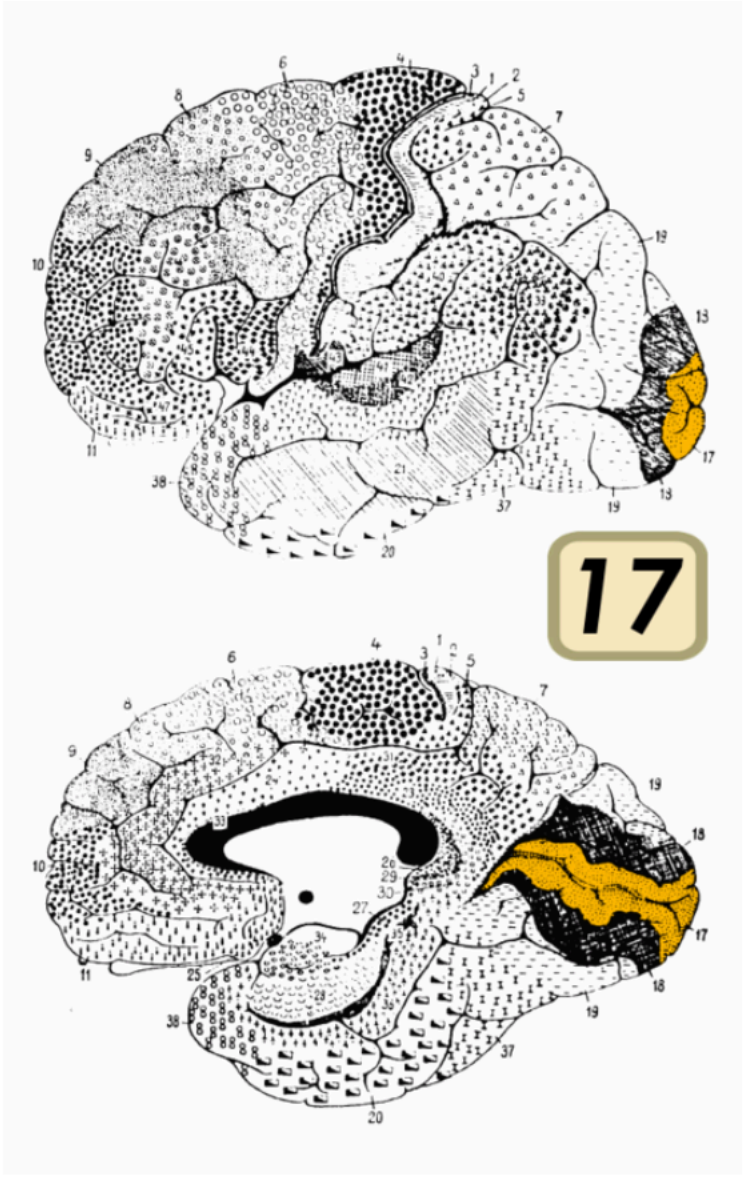
Neuronal cells

Receptive field

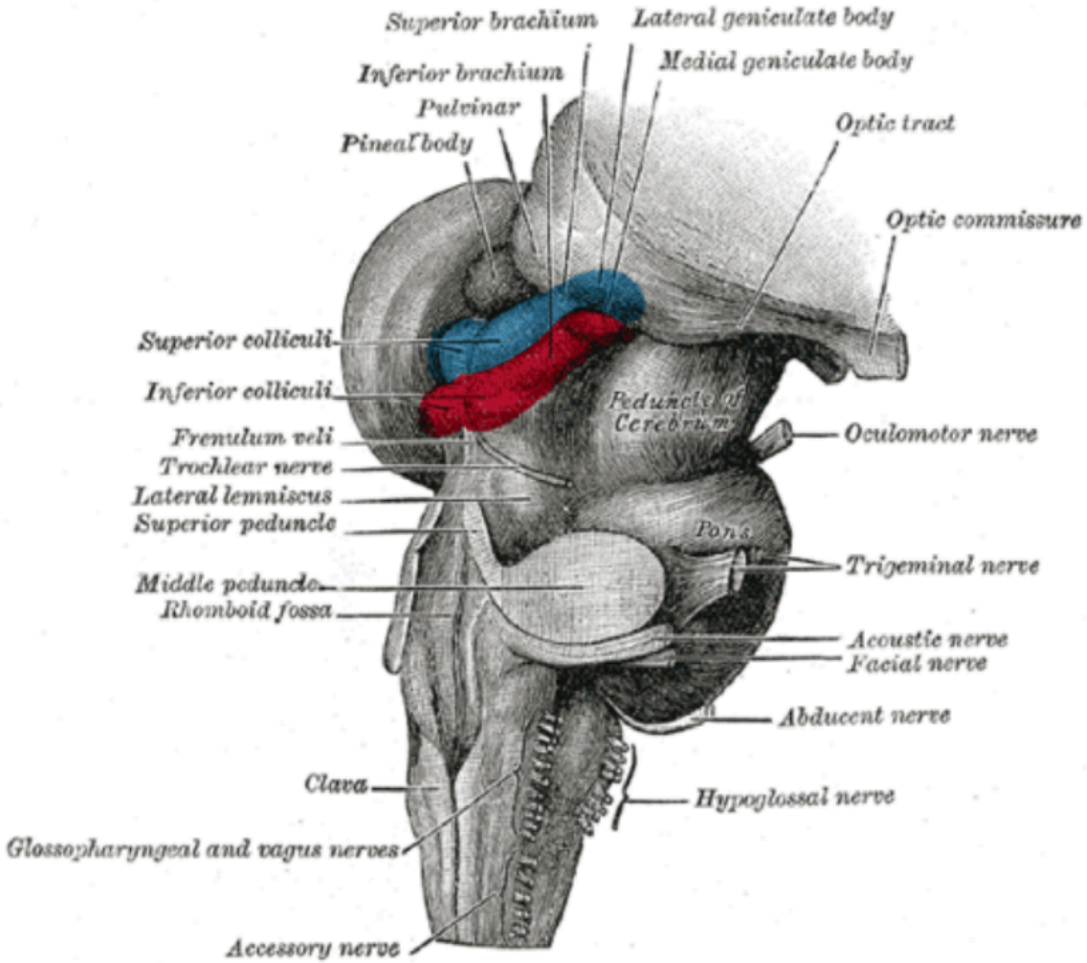
Firing



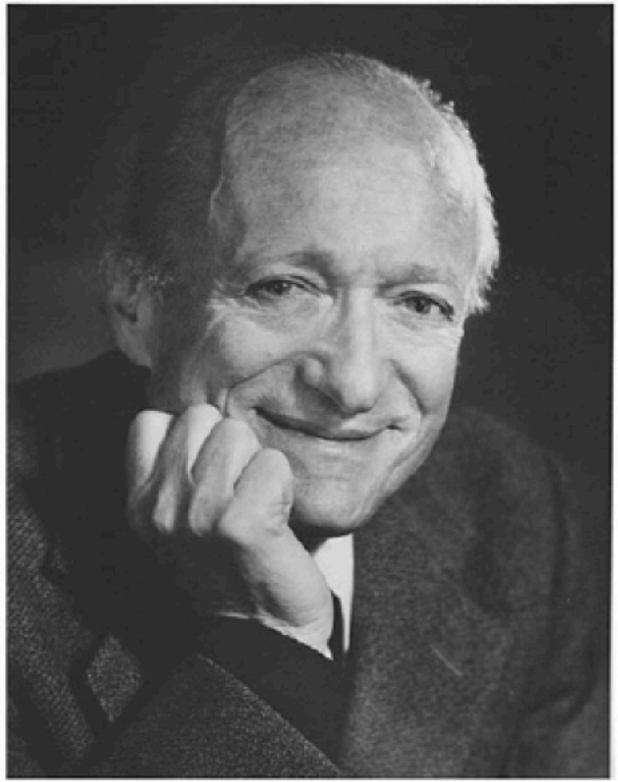
Back view of the visual cortex. Simple, complex and hypercomplex cells are coloured yellow, orange and red, the last ones forming the primary visual cortex.



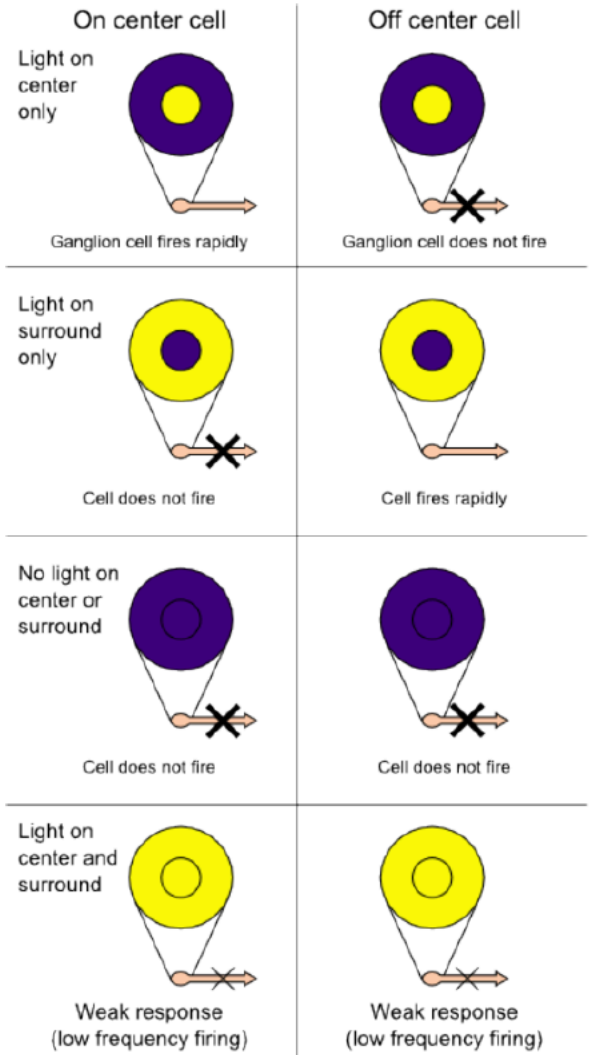
Side view and section of the visual cortex. Primary visual cortex in yellow.



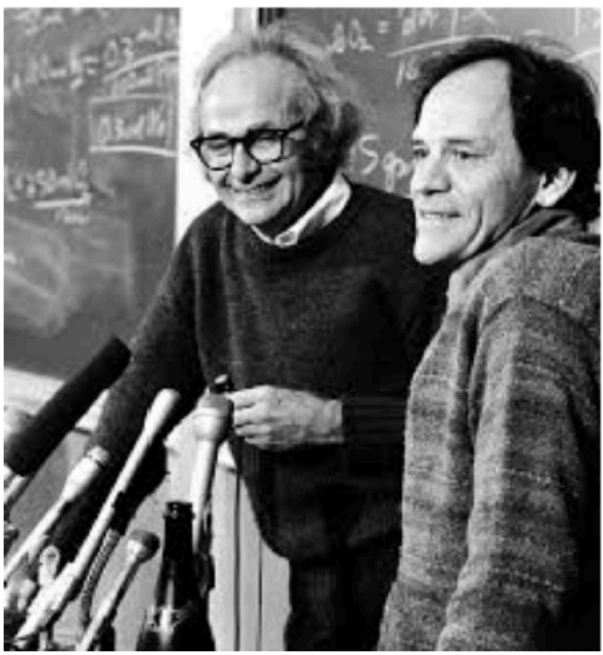
Lateral geniculate nucleus.



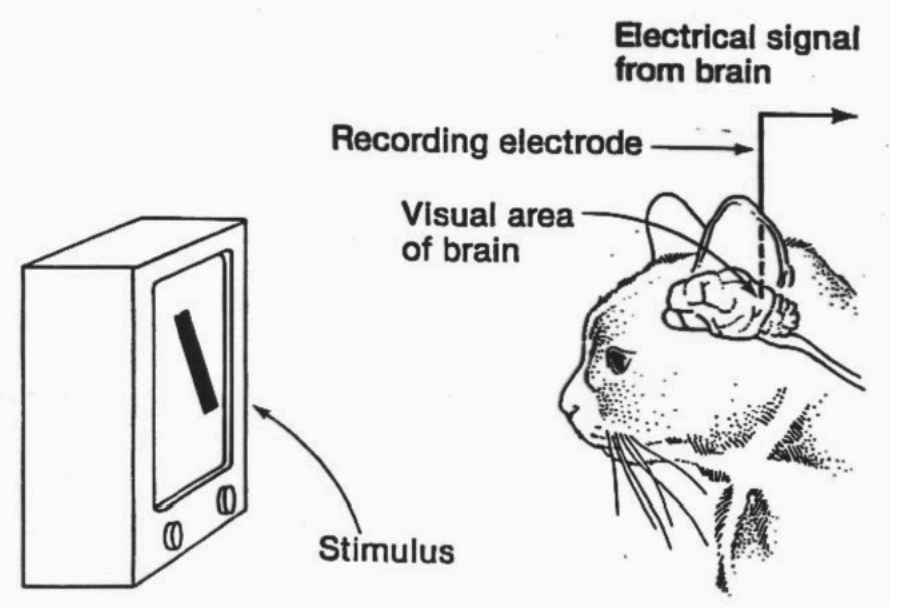
Stephen Wilhelm Kuffler, 1913 - 1980.



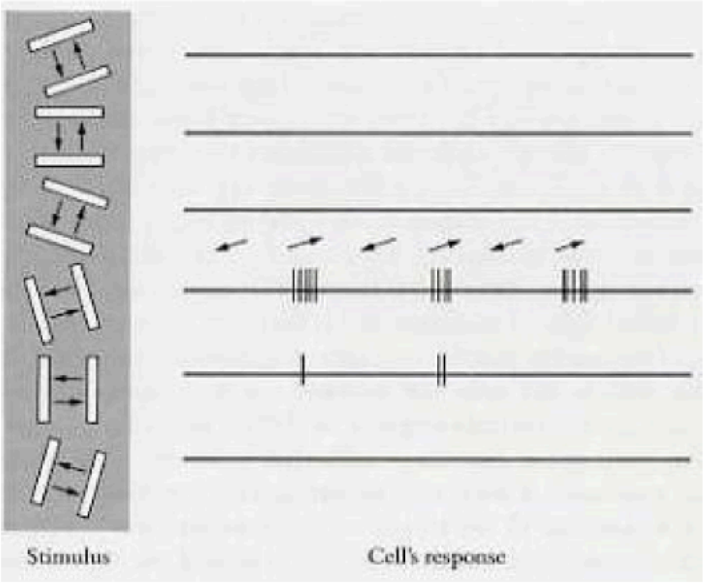
Kuffler's on- and off-cells, with the respective receptive fields in form of a disk surrounded by an annulus.



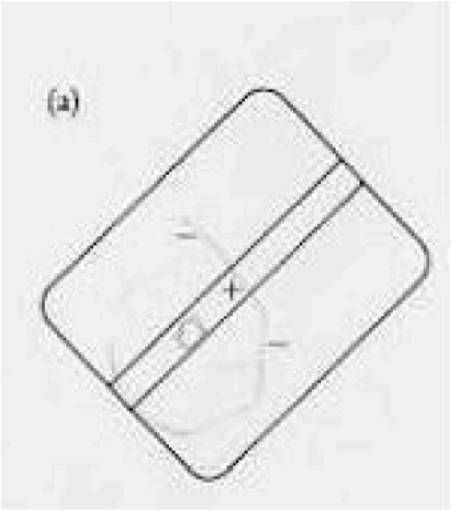
David Hubel, 1926 - 2013, and Torsten Wiesel, 1924.



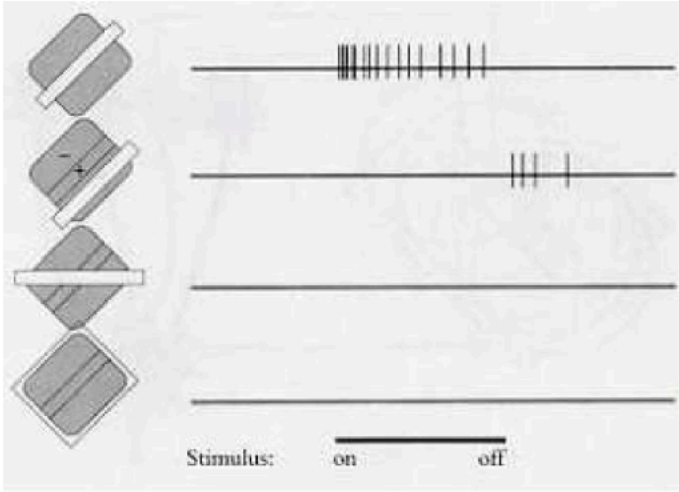
An illustration of Hubel & Wiesel's cat experiment.



One of the first reactions of a neuronal cell to bar-like stimuli sent to the retina. The response depends crucially on the angle of inclination of the bar, the so called *orientation preference* of the cell.

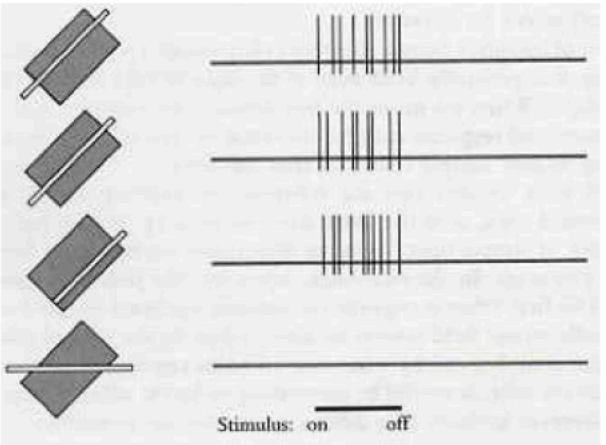


Geometry of the receptive field in the retina of a *simple* neuronal cell. The signs ± indicate the regions where the field causes an excitatory, respectively inhibitory reaction in the neuronal cell.

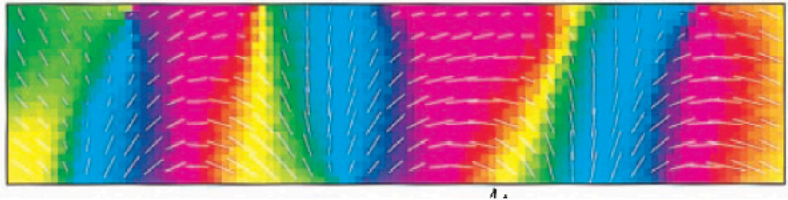


Moving a rectangular bar over the receptive field of a *simple* neuronal cell causes responses of the cell according to the actual position along the movement as well as the inclination of the bar.

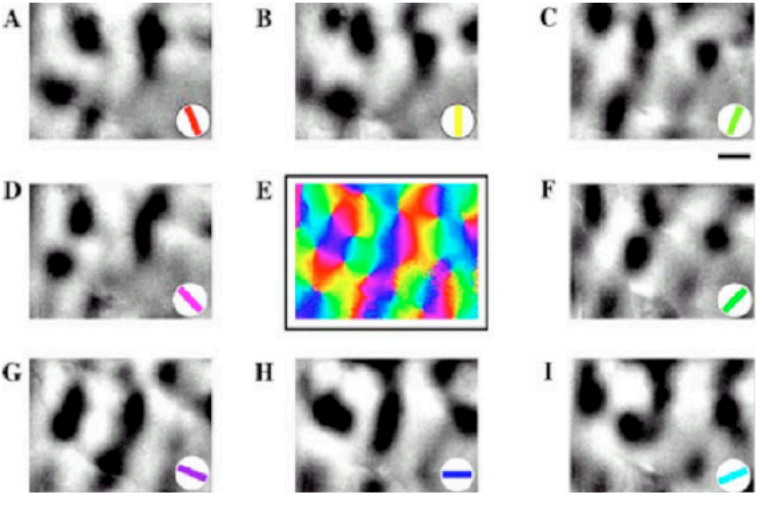
Diffuse light mapped onto the whole receptive field gives no response, as shown in the last row.



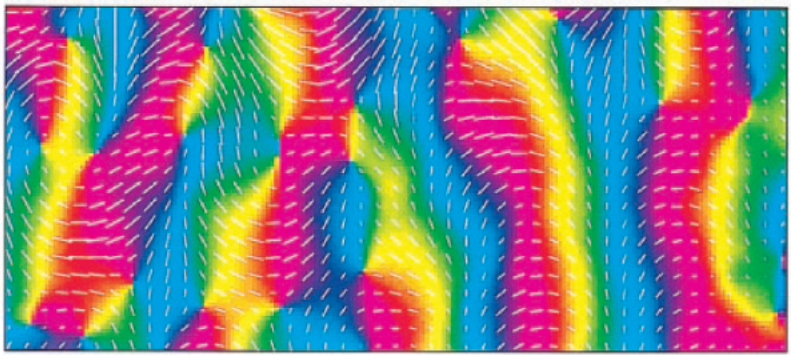
The location of a correctly oriented rectangular bar in the receptive field of a *complex* neuronal cell is irrelevant for the response of the cell.



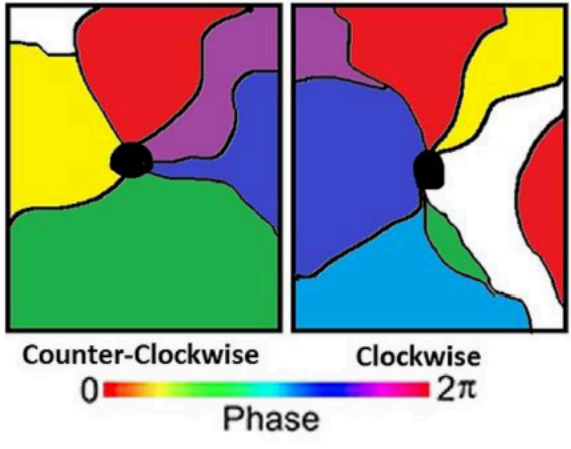
Orientation preferences in the striate cortex.



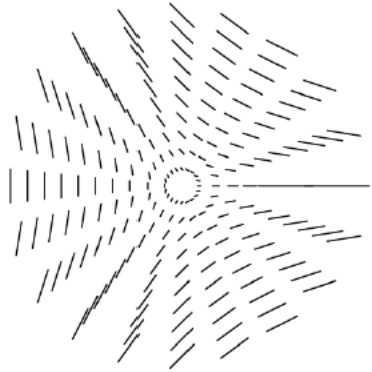
Experiments for the partition of the striate cortex according to the orientation preferences of the cells.



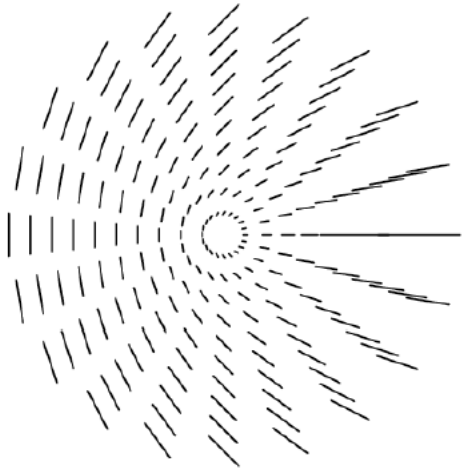
Colouring of the striate cortex by orientation preference. Points where various colours meet are called *pinwheels*.



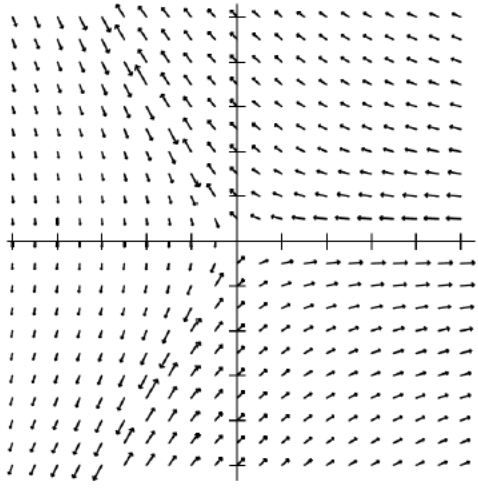
Schematic description of pinwheel of first type with its chirality (= clockwise or counterclockwise arrangement of colours). The colours correspond to orientation preferences of the cells.



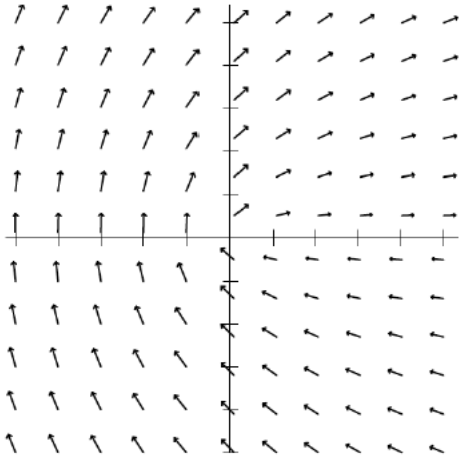
Pinwheel singularity of the first type, a *triple point*.



Pinwheel singularity of the second type, a *bifurcation point*.



Phase portrait of the triple point.



Phase portrait of the bifurcation point.

Complex form of vector fields

Triple point: $$z'(t) = \frac{1}{\sqrt{z(t)}}$$

Bifurcation point: $$z'(t) = \sqrt{z(t)}$$