



物質機能科学 **IIb**

物理博士 ミケレット・ルジェロ

知覚情報科学

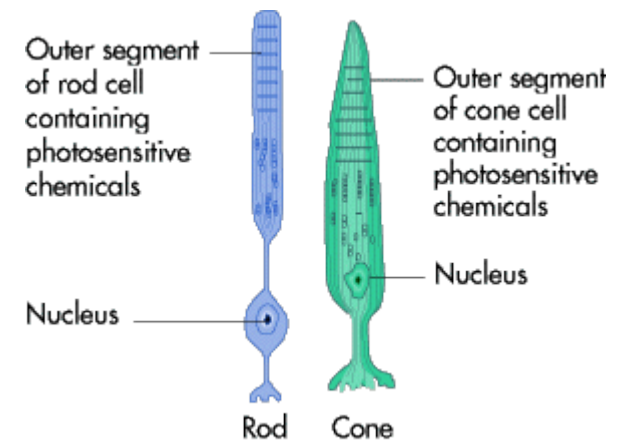
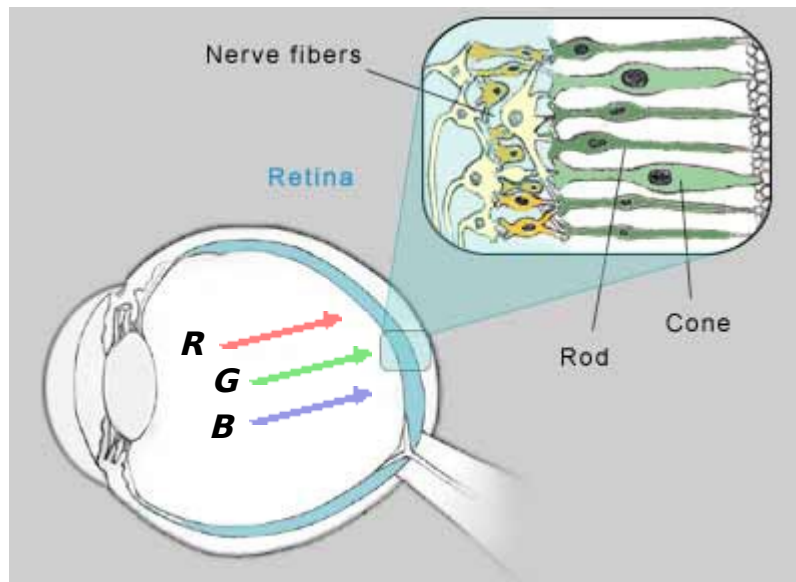
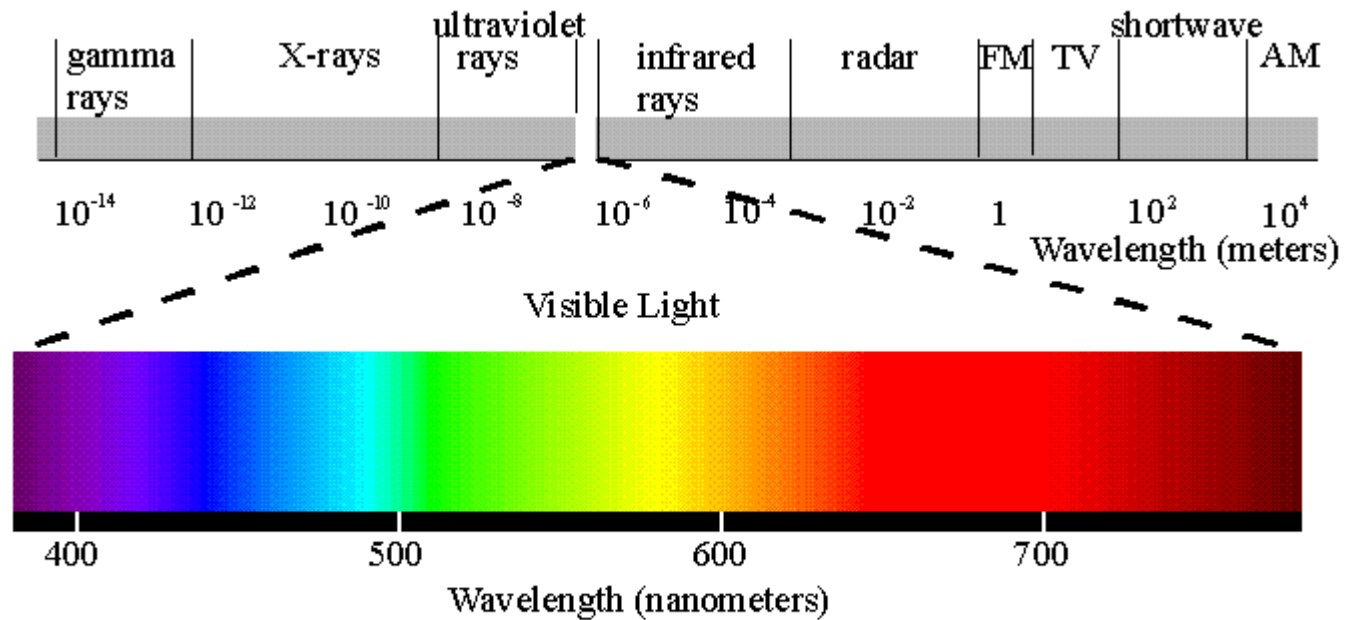
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THE VISION, How does it work ?





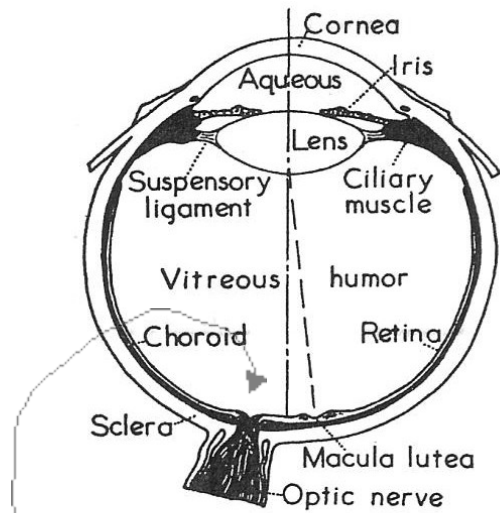


Fig. 35-1. The eye.

Blind Spot !

Neurons

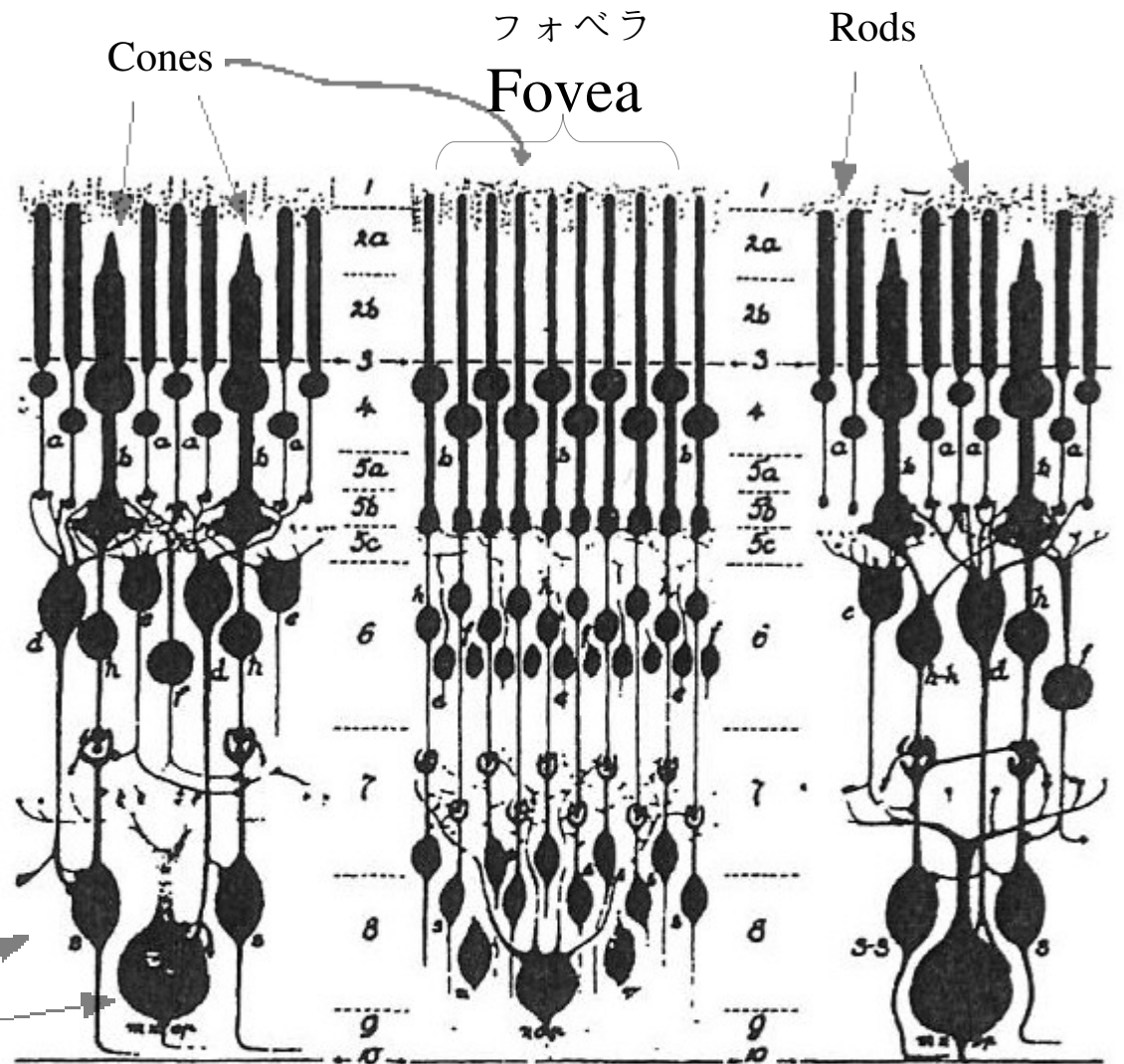
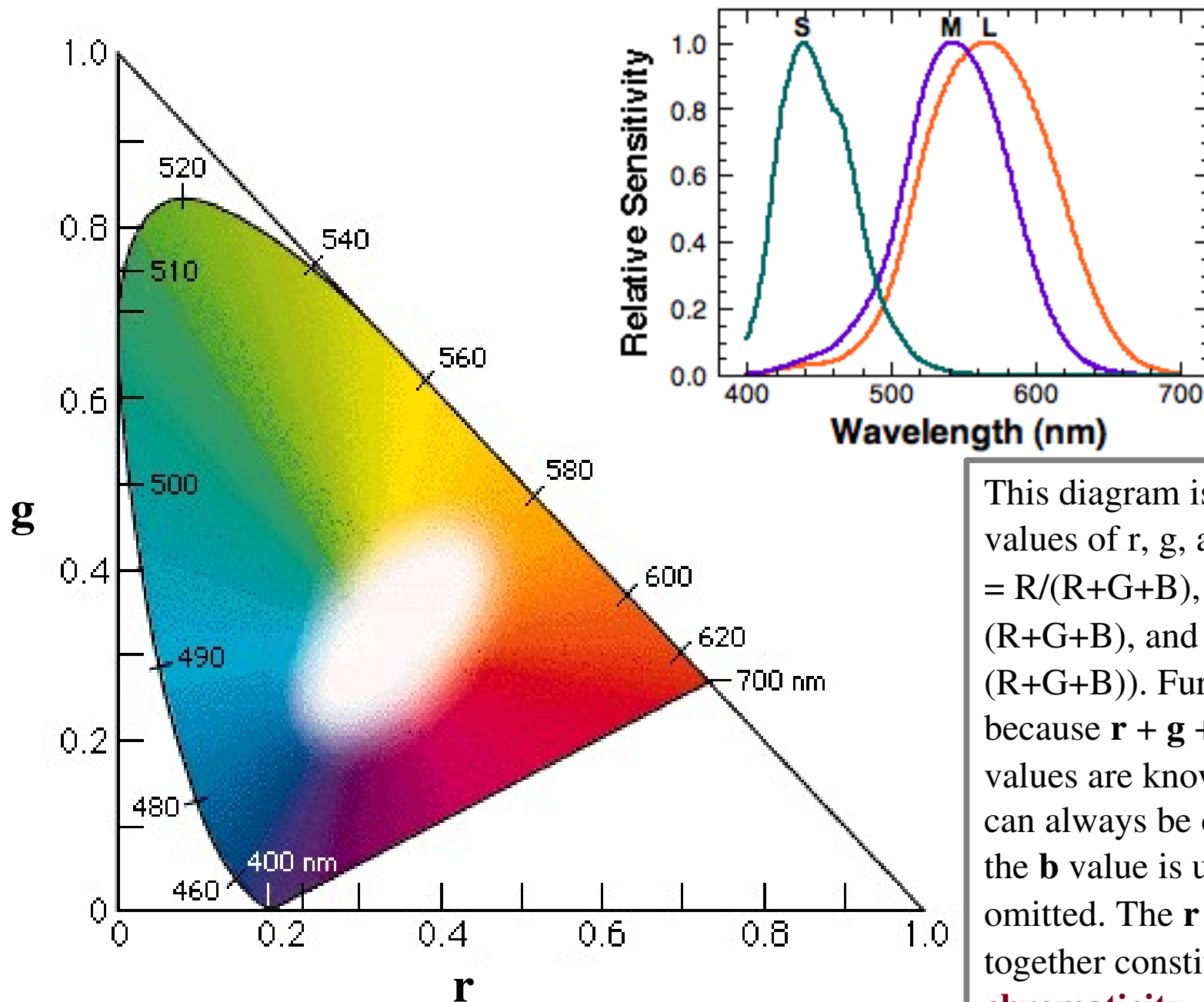


Fig. 35-2. The structure of the retina.
(Light enters from below.)



This diagram is based on the values of r , g , and b (where $\mathbf{r} = R/(R+G+B)$, $\mathbf{g} = G/(R+G+B)$, and $\mathbf{b} = B/(R+G+B)$). Furthermore, because $\mathbf{r} + \mathbf{g} + \mathbf{b} = 1$, if two values are known, the third can always be calculated and the \mathbf{b} value is usually omitted. The \mathbf{r} and \mathbf{g} values together constitute the **chromaticity** of a sample.

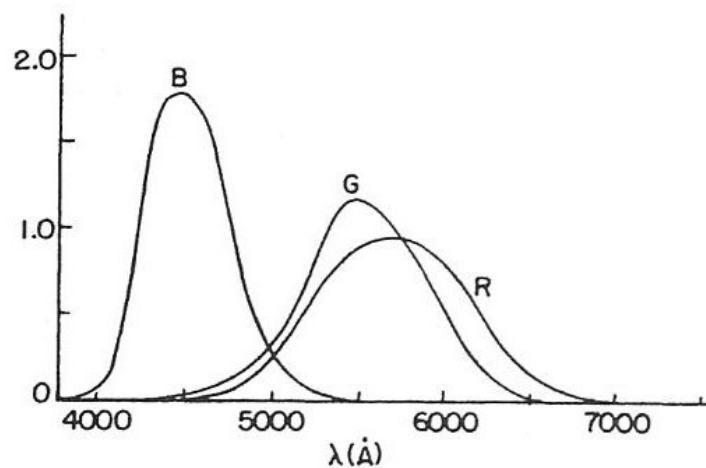


Fig. 35-8. The spectral sensitivity curves of a normal trichromat's receptors.

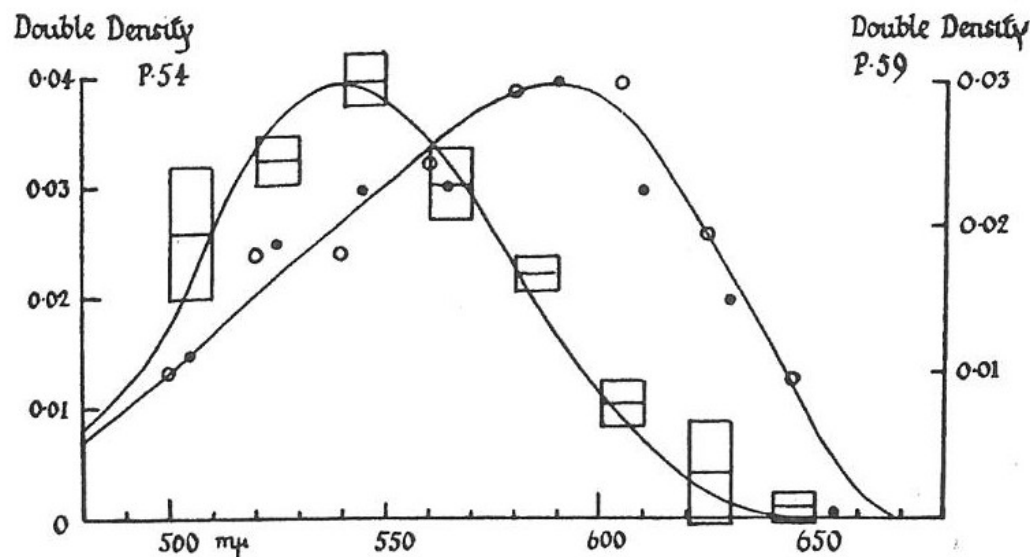
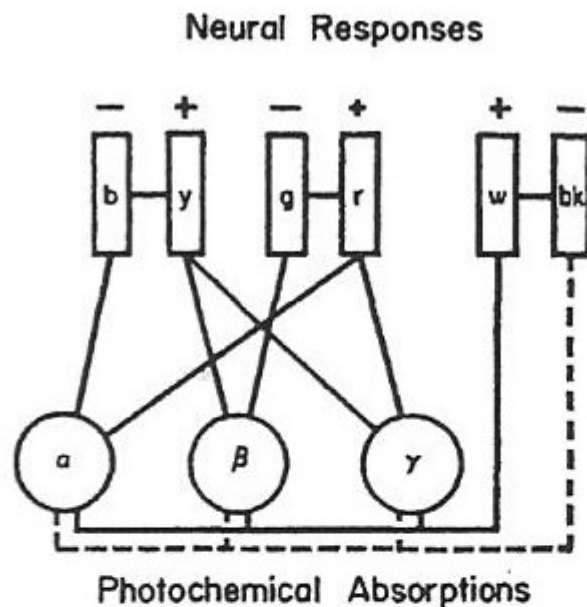
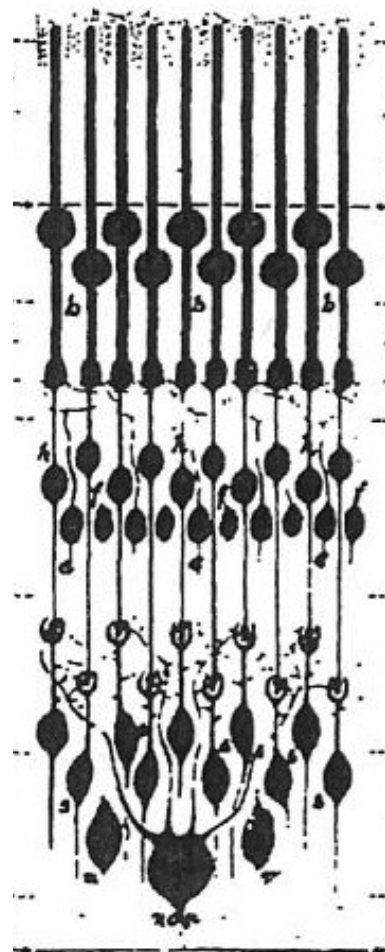


Fig. 35-10. Absorption spectrum of the color pigment of a protanope color-blind eye (squares) and a normal eye (dots).



$$\begin{aligned}
 y-b &= k_1(\beta+\gamma-2\alpha) \\
 r-g &= k_2(\alpha+\gamma-2\beta) \\
 w-bk &= k_3(\alpha+\gamma+\beta)-k_4(\alpha+\beta+\gamma)
 \end{aligned}$$

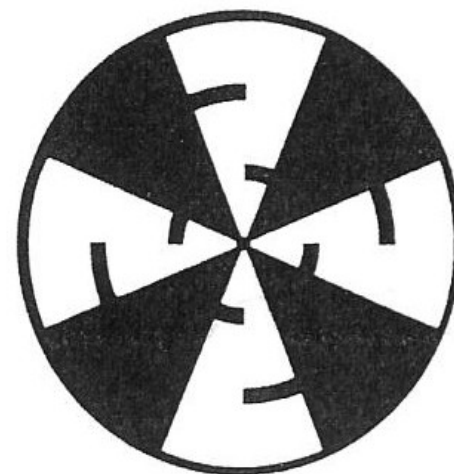


Fig. 36-1: When a disc like the above is spun, colors appear in only one of the two darker "rings." If the spin direction is reversed, the colors appear in the other ring.

Fig. 36-2. Neural connections according to an "opponent" theory of color vision.

Are we **pre-wired**, or we **learn** ?!?

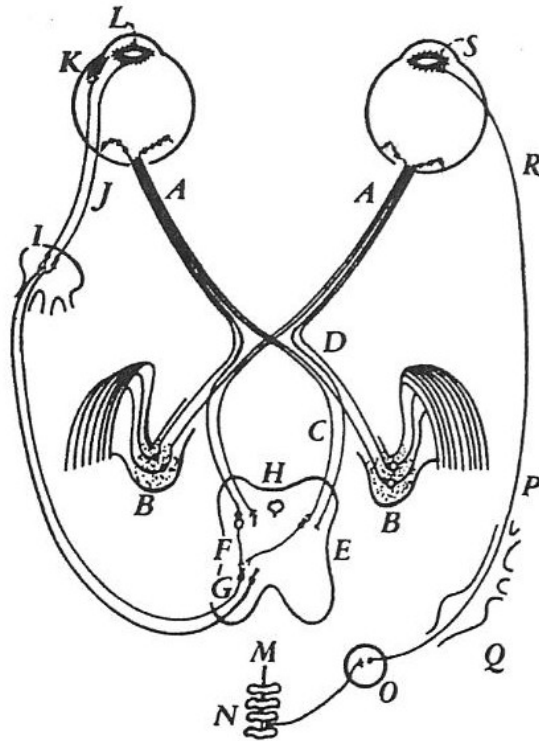


Fig. 36-3. The neural interconnections for the mechanical operation of the eyes.

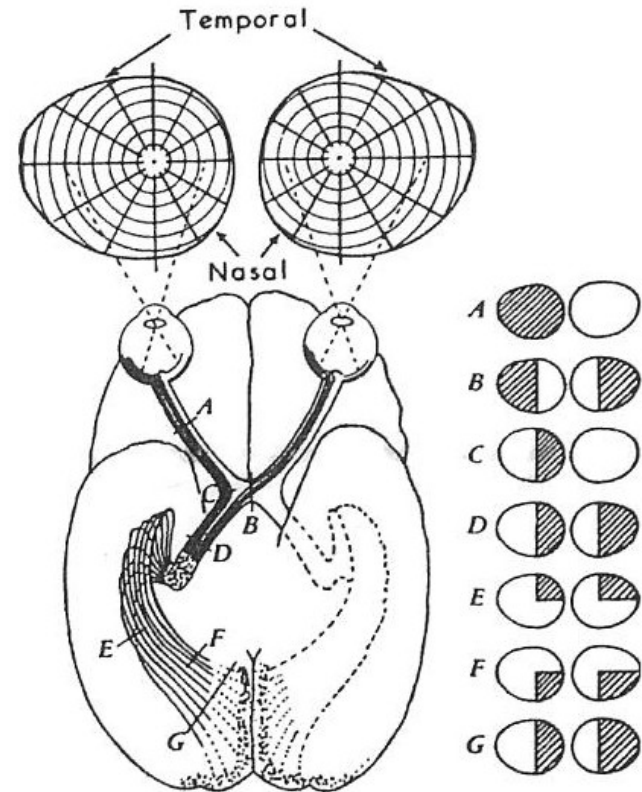
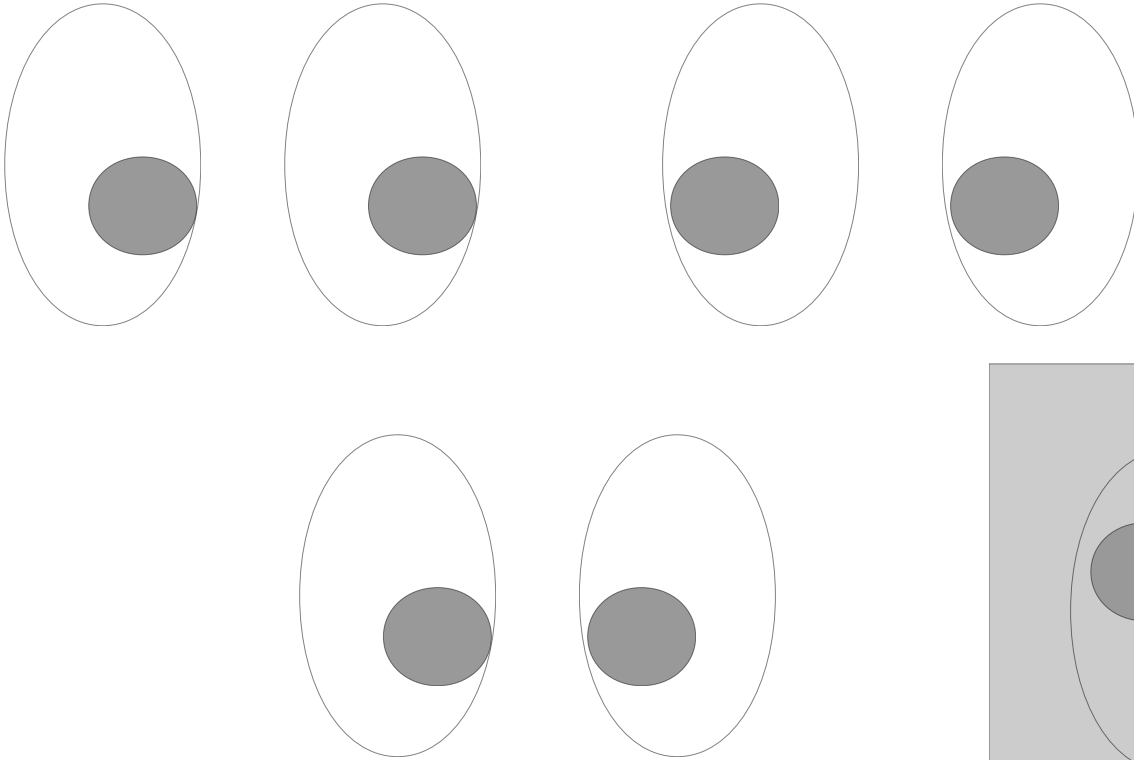
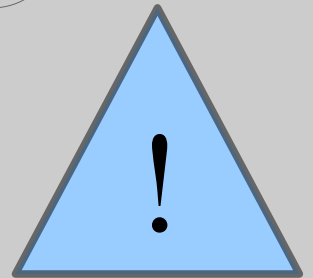


Fig. 36-4. The neural connections from the eyes to the visual cortex.

Possible



Impossible



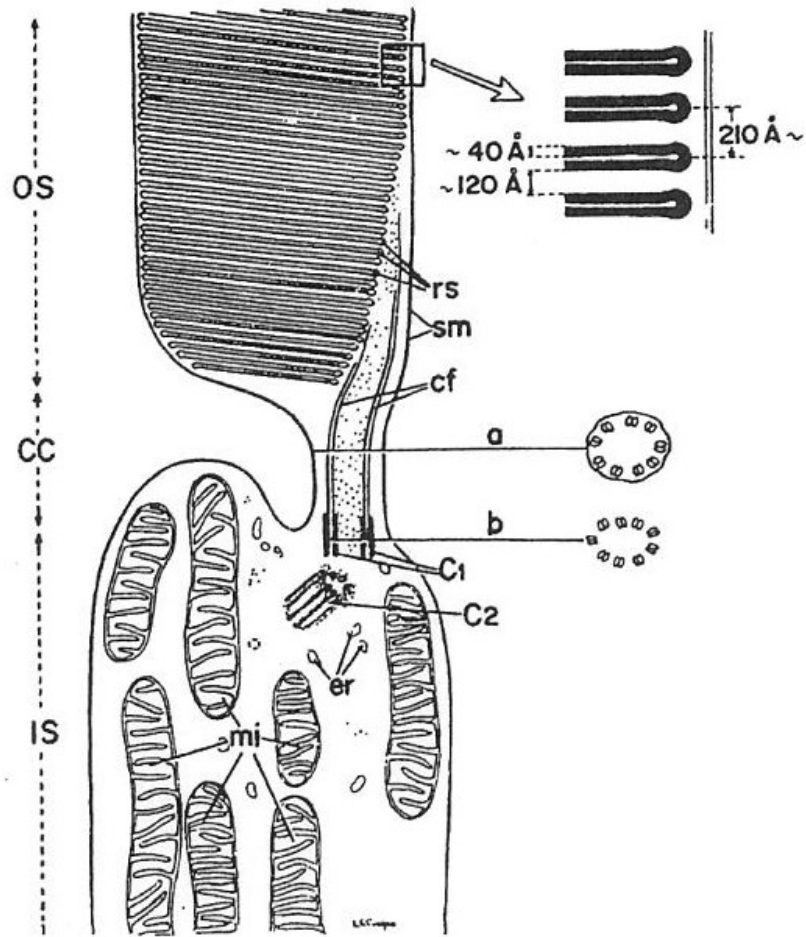


Fig. 36-5. Electron micrograph of a rod cell.

We have to eat this!
(vitamin A)

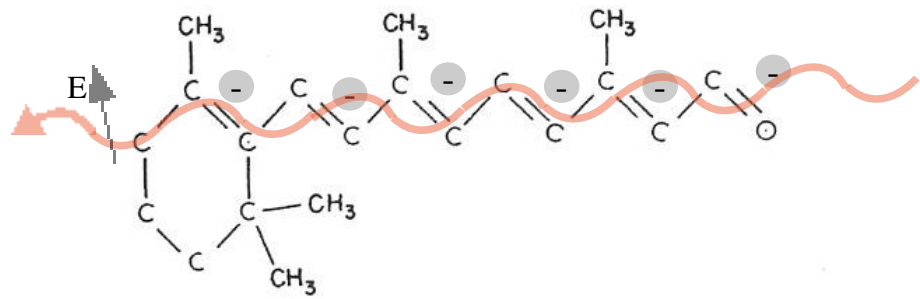
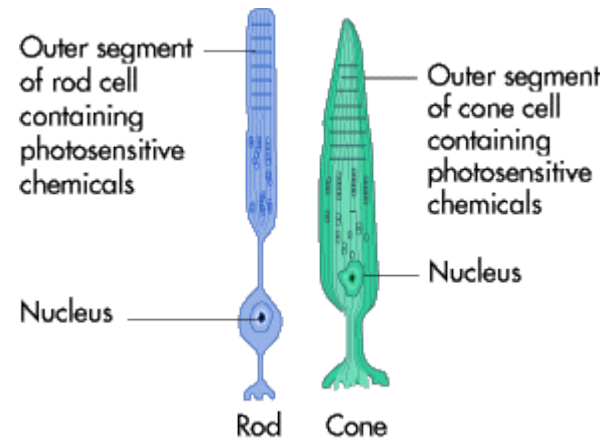


Fig. 36-6. The structure of retinene.



$$r=3\text{mm}$$

$$\lambda=400\text{nm}$$

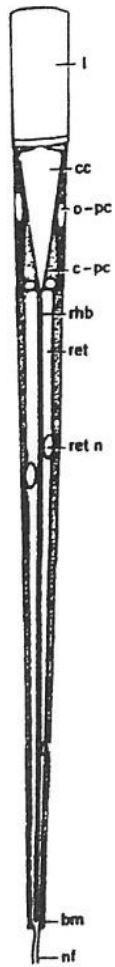


Fig. 36-7. The structure of an ommatidium (a single cell of a compound eye).

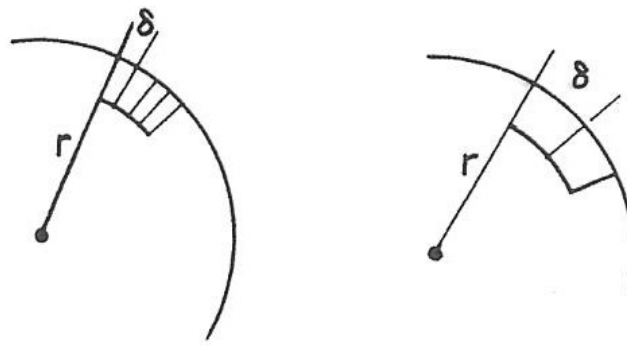


Fig. 36-8. Schematic view of packing of ommatidia in the eye of a bee.

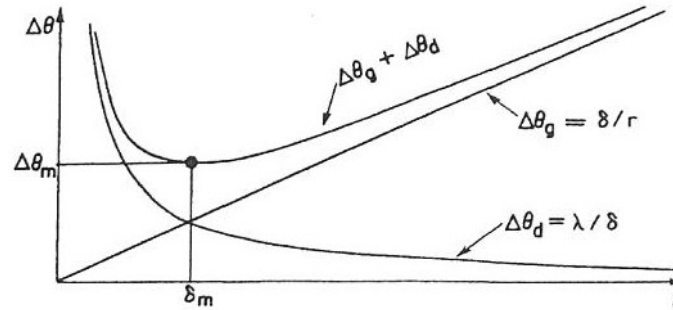


Fig. 36-9. The optimum size for an ommatidium is δ_m .

$$\Delta\theta_g = \delta/r.$$

$$\Delta\theta_d = \lambda/\delta.$$



$$\delta = \sqrt{\lambda r}.$$

$$\frac{d(\Delta\theta_g + \Delta\theta_d)}{d\delta} = 0 = \frac{1}{r} - \frac{\lambda}{\delta^2},$$

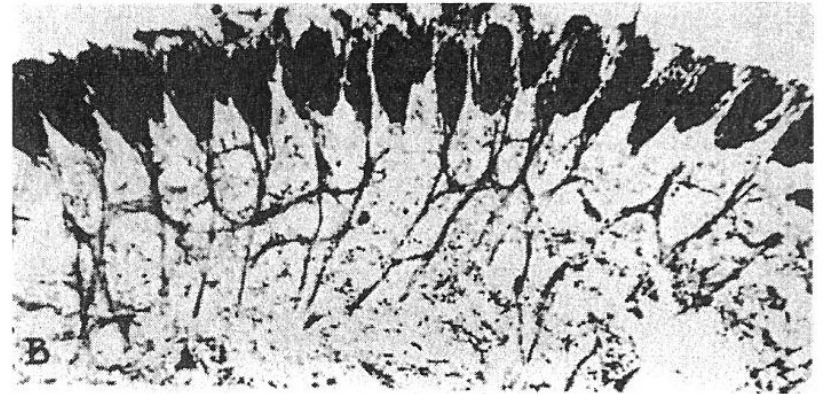
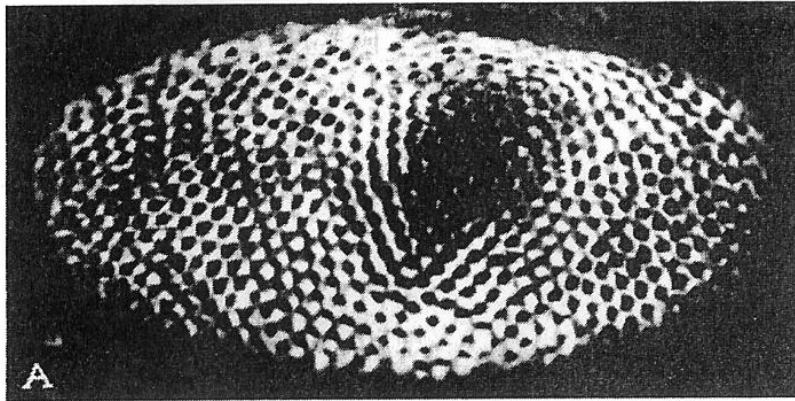
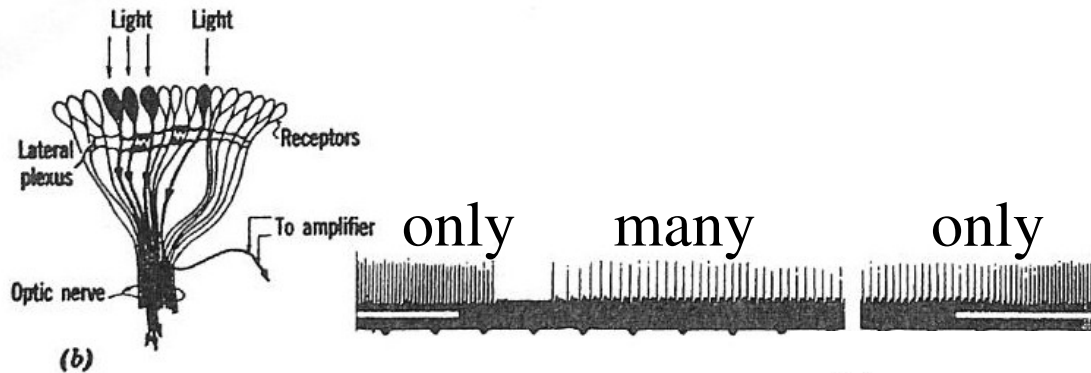
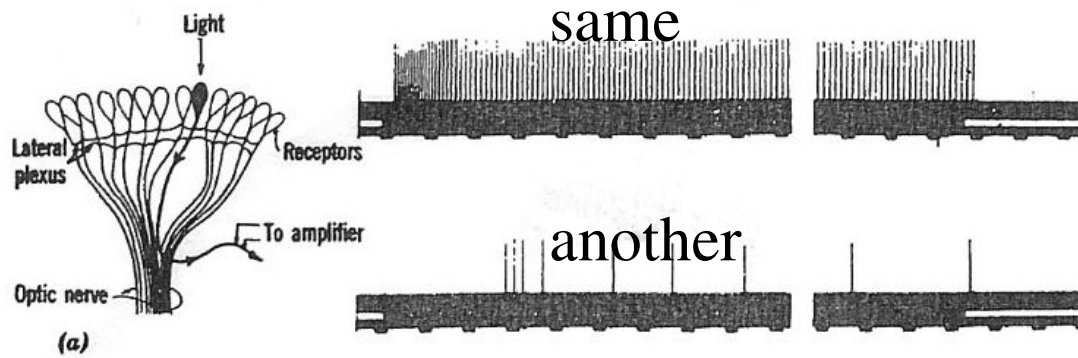


Fig. 36-11. The compound eye of the horseshoe crab. (a) Normal view. (b) Cross section.

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Edge
enhancement!

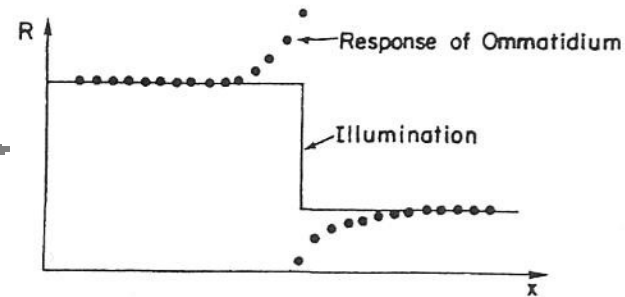


Fig. 36-13. The net response of horseshoe crab ommatidia near a sharp change in illumination.

Types of response in optic nerve fibers of a frog

Type	Speed	Angular field
1. Sustained edge detection (nonerasable)	0.2–0.5 m/sec	1°
2. Convex edge detection (erasable)	0.5 m/sec	2°–3°
3. Changing contrast detection	1–2 m/sec	7°–10°
4. Dimming detection	Up to $\frac{1}{2}$ m/sec	Up to 15°
5. Darkness detection	?	Very large

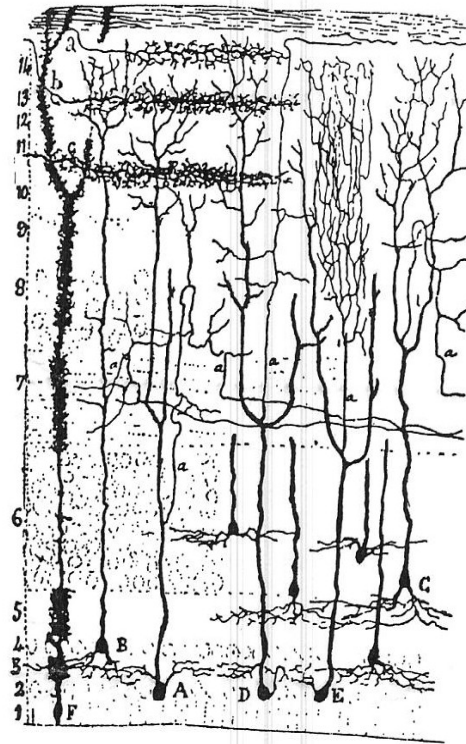
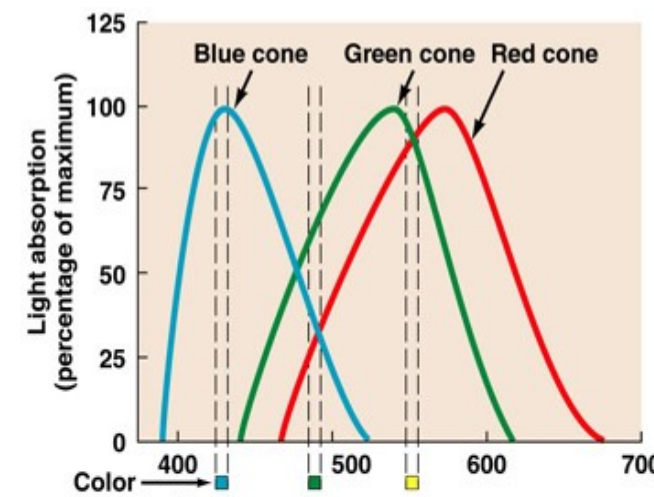
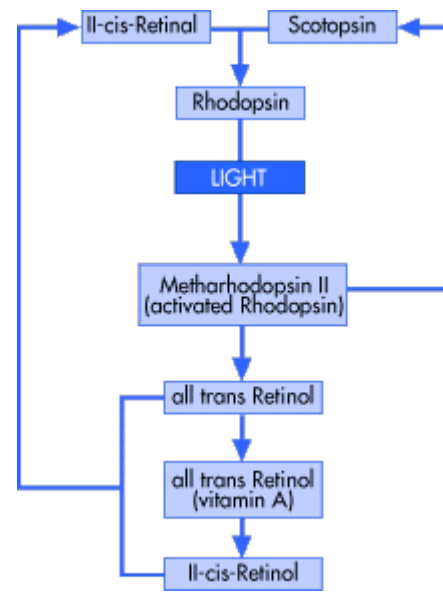
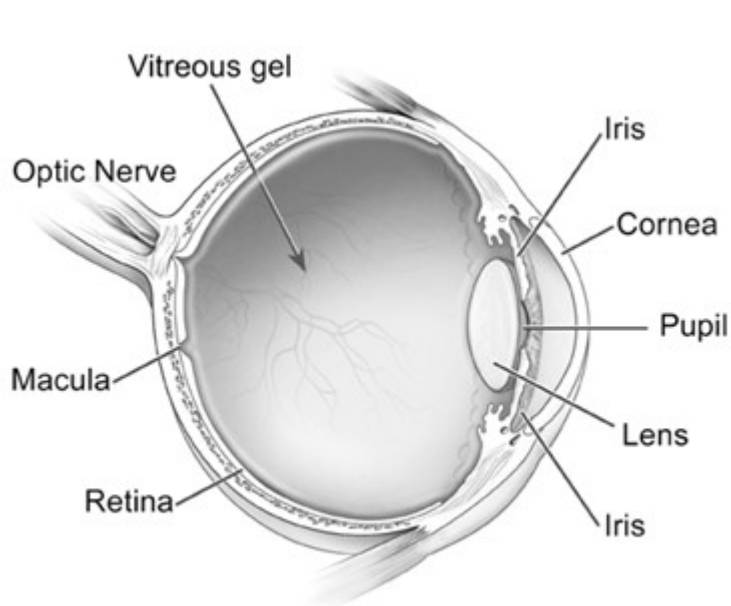


Fig. 36-14. The tectum of a frog.



“RGB”の色で全部の色を作る。この事は光の特性ではない、人間の目の特性です（！）

人間は「Trichromatic Vision」

動物の世界の中に「Tetrachromacy」「Pentachromats」などがあります