

Vision –4th note

Adaptations

Adaptations

- Adaptation means accustomed to or used to new conditions.
- Human eye has the ability to adapt to both light and dark environments.
- Adaptation to light environment – light adaptation
- “ “ dark - dark adaptation

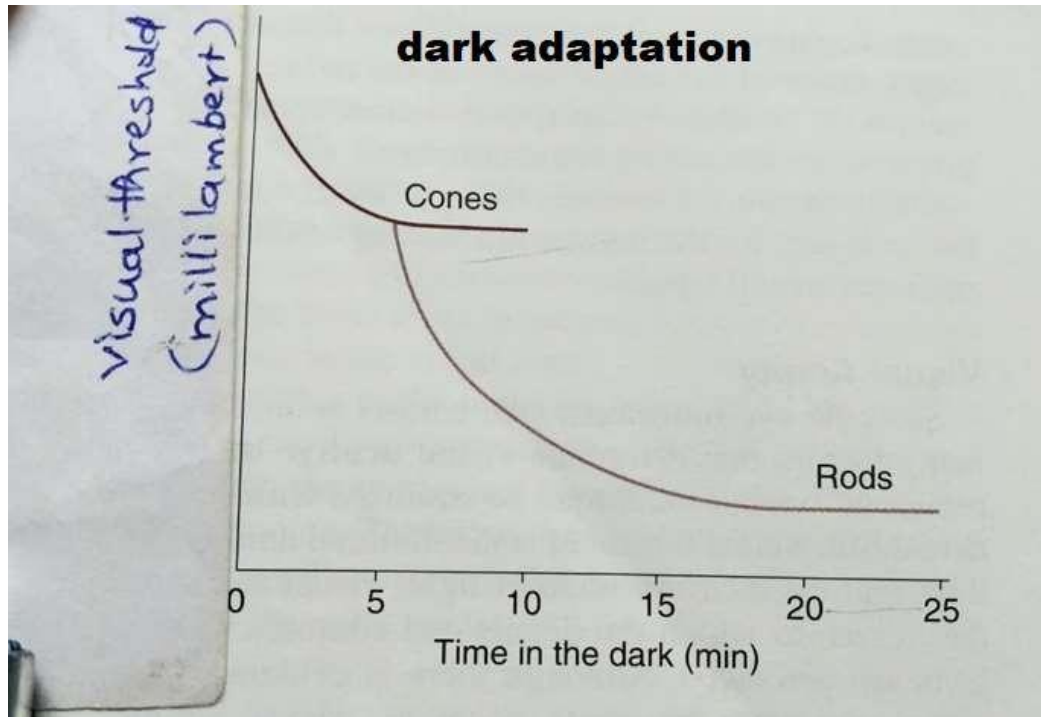
Dark adaptation

- When a person enters a dim light area after spending a long time in bright light area, initially he cannot see anything clearly. But gradually visual threshold decreases and vision becomes clearer.
- As visual threshold decreases, the sensitivity of retina is increasing and at a particular point we can see
- The decrease in visual threshold or increase in sensitivity of eye to light is called dark adaptation

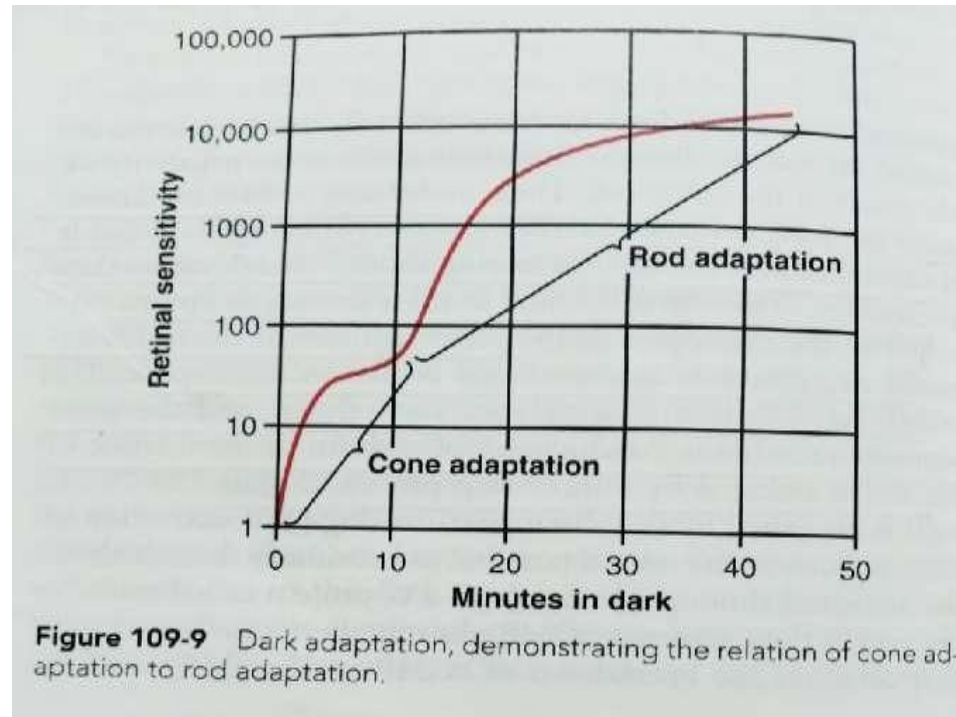
- The process by which the person is able to see the objects in dim light is called is dark adaptation
- Dark adaptation time = 20 minutes.
- **Reason**
- In bright light all the pigments of both rods and cones are bleached and decomposed into retinal and opsin and much of the retinal will be converted to vit A. So amount of rhodopsin for dim light vision is not sufficient.
- To see in dimlight , it has to be resynthesised. Resynthesis takes more time than its degradation. And it is about 20 minutes.
- In vit A deficiency the dark adaptation time will be prolonged.

Dark adaptation graphs

- 1 visual threshold versus time
 - 2 sensitivity versus time
-
- visual threshold versus time

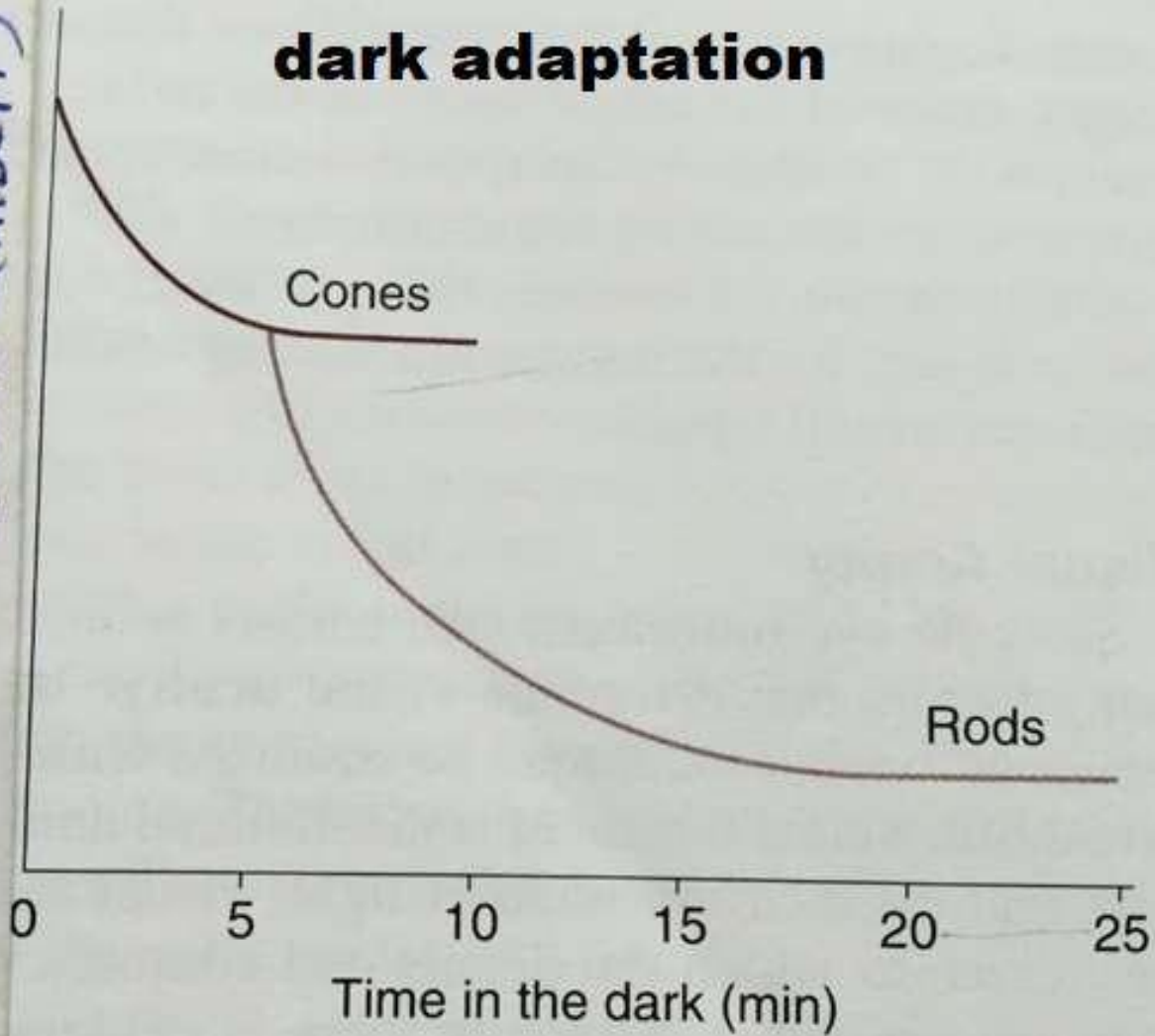


- sensitivity versus time



Visual threshold
(millilambert)

dark adaptation



- Dark adaptation curve has two parts – fast response and slow response.
- **First part (fast response) is due to cone adaptation.**
- It occurs for 4-5 minutes.
- **Proof**---when the visual threshold stimulus is tested over **fovea centralis** (rod free area) the first part is obtained and when peripheral part of retinal surface is illuminated, the second part of graph is obtained.
- Therefore **second part is due to rods adaptation.**
- Initially there is less rhodopsin stores and time is required for synthesis of rhodopsin.
- **Dark adaptation time = time required for rhodopsin synthesis.**
- 20 minutes

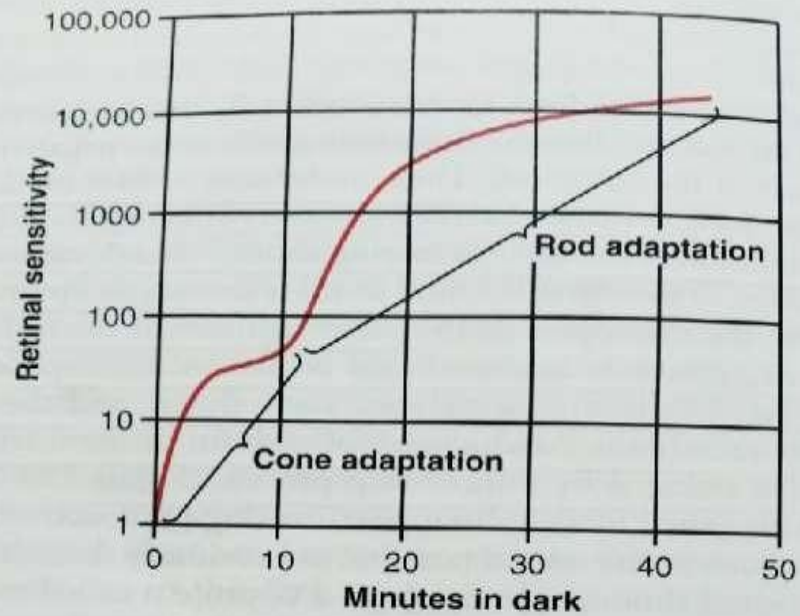


Figure 109-9 Dark adaptation, demonstrating the relation of cone adaptation to rod adaptation.

- In dark adaptation first the sensitivity of retina is very low
- But within 1 minute sensitivity is increased 10 fold
- At the end of 20 minutes the sensitivity has increased 6000 times and at the end of 40 minutes it has increased 25000 fold

- Changes occur during dark adaptation

- Resynthesis of rhodopsin
- Dilation of pupil to get maximum amount of light
- Vision changes from cones to rods
- Sensitivity of receptors to light increases

Physiological significance

- Radiologists and aircraft pilots who need maximum visual sensitivity in dim light **wear red goggles** before entering dim light area
- This is because red stimulates rods to only a slight degree (but it stimulates cones well) . **So minimum bleaching of rods occur in bright light with red goggles.**
- Therefore in dimlight sufficient amount of rhodopsin will be there and they need not wait for dark adaptation time.

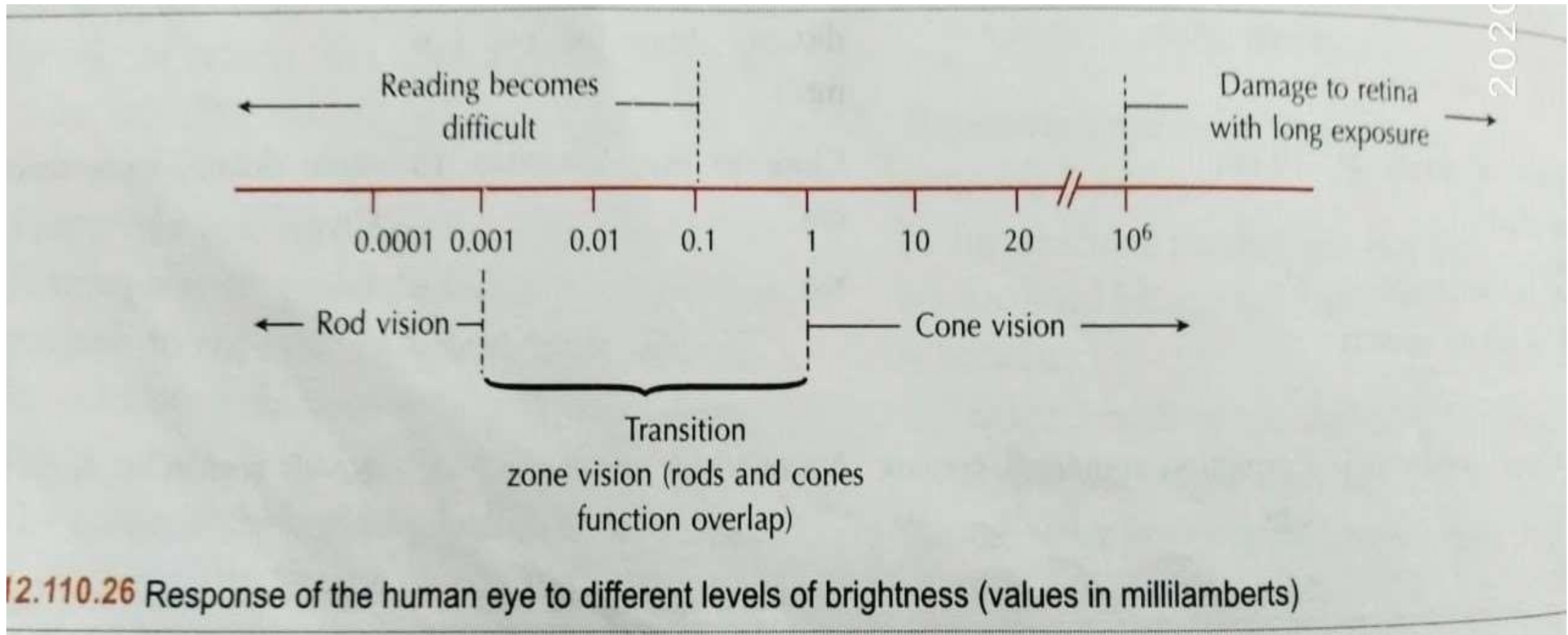
Light adaptation

- When a person suddenly enters a bright light area from a dimlight, the subject feels the light as intense and uncomfortably bright. This persists until the eyes adapt to this increased illumination and visual threshold increases. This is called light adaptation and occurs for 5 minutes.
- Changes occur during light adaptation
- pupils constrict to reduce the amount of light entering the eye
- Reduced sensitivity of rods --due to breakdown of rhodopsin

Duplicity theory of vision

- Rods aid in dim light vision ie, scotopic vision
- Cones aid in bright light vision, ie, photopic vision
- Shades of colour are not appreciated in dim light. This division of labour by the two receptors is called duplicity of vision.
- There are 2 kinds of inputs to the brain from the eye
 - inputs from rods
 - inputs from cones
- The existence of 2 kinds of inputs, each working under different conditions of illumination is called **duplicity theory of vision**

Response of human eye to different levels of brightness



- Scotopic vision

- Dim light vision due to rods
- Operates below .001 millilambert
-
- Rods have lower threshold
- .001mA ----- 1 mA

- photopic vision

- day light vision due to cones
- operates at higher intensities
ie, brightness > 1mA
- cones have high threshold
- transition zone

- Purkinje shift

- The shifting of sensitivity of eye from photopic vision to scotopic vision ie, from cone vision to rod vision.

- Occurs in evening

- eg, red becomes black

- end end end end end