Solution to “the ophtalmoscope”

A. Simple paraxial model of the eye

1. R_1=5.6mm P_1=60δ SF_1=–16,7mm

2. R_2=5.26mm P_2=64δ SF_2=–15,65mm SF'_2=20,9mm

3. θ=y/SA: angle under which the object y is seen if located at a distance SA from the eye
   Refracted angle θ'= θ/n'=y'/d
   Size of image y'=dθ/n' depends only on θ since the other parameters are fixed

B. Direct ophtalmoscopy

1. The retina of the patient is in the focal plane of the eye lens: its image is at infinity, it can be seen by the doctor as through a magnifying glass with a power of 60 δ. An object will be seen under a larger angle through a magnifying glass than if it was seen directly with the naked eye if y/f>y/25cm, or in other words if its power is larger than 4 δ,which is the case here. A circular burnt spot with a diameter of *0.1 mm* on the patient's retina is seen with an angular diameter of 0,1mm/16,7mm=6mrad.

2. A incident parallel ray converges in $F_p=F_o$, so it comes out parallel after the second eye lens: the whole system is afocal and its magnification is –1 (same focal length for the two eyes).

3. P_p=70δ $S_pF'_p$=19,1mm F'_pR_{etina}=3,2mm.

4. If the myopic patient does not accommodate, the image of its retina will be at point A such that:

$F_pA.F'_pR_{etina}$=–n/P.n'/P F_pA= –85mm

The doctor would have to see an object located at (–85+16,7) from its vertex, which is impossible (unless he is very hypermetropic!). To bring back the image at infinity, a negative lens with focal lens –85mm placed at F_p will do the job.