The Astronomical telescope

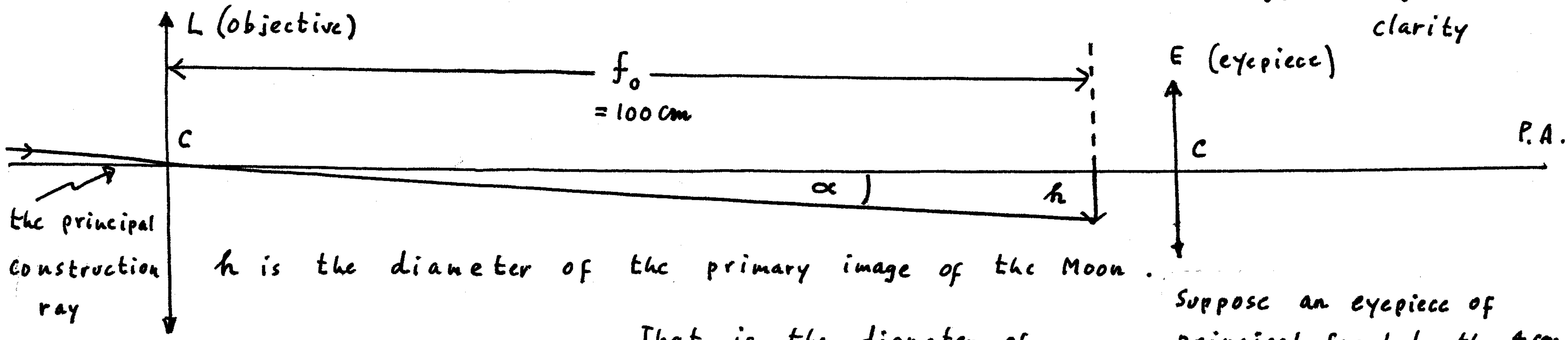
The function of this instrument is to produce an enlarged retinal image of a distant, inaccessible object.

The simple refractor trained on the Moon

[Remember: the Moon subtends an angle of 0·5° at the distance of the Earth]

α is exaggerated for clarity

This refractor could have a principal focal length of around 100 cm



h is the diameter of the primary image of the Moon.

Suppose an eyepiece of principal focal length 4 cm is employed.

From the above diagram,

$$\frac{h}{100\text{ cm}} = \tan\alpha$$

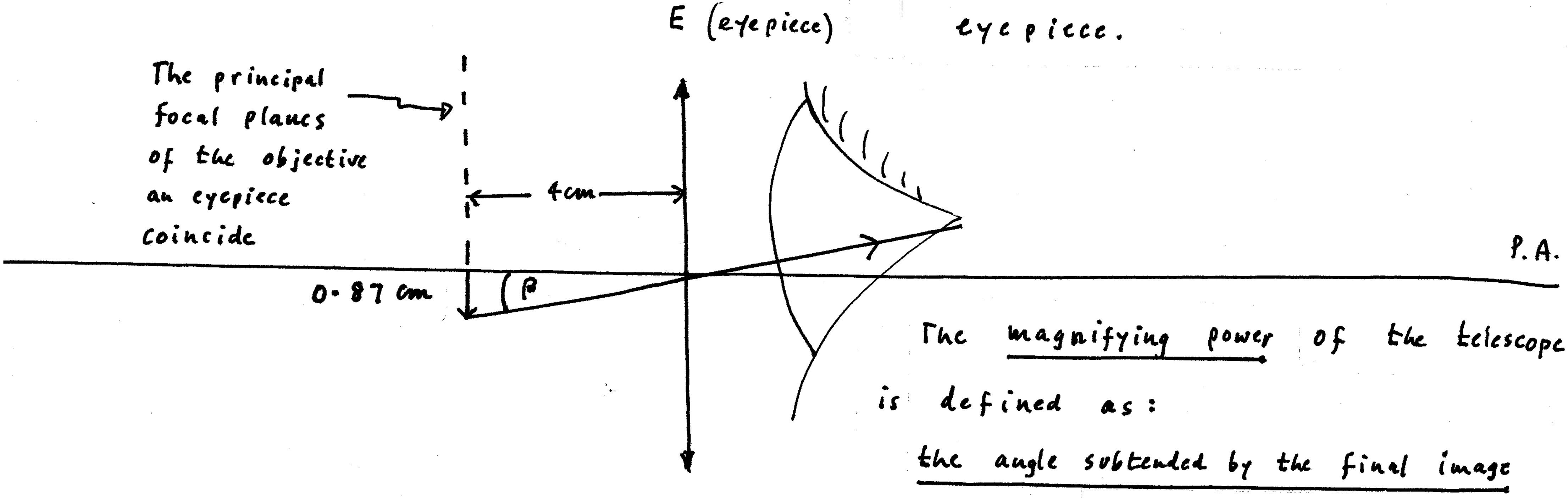
Substituting, and rearranging,

$$h = 100\text{ cm} \times \tan 0{\cdot}5^\circ$$
$$= 100\text{ cm} \times 0{\cdot}0087$$
$$= 0{\cdot}87\text{ cm}$$

That is, the diameter of the image of the Moon in the principal focal plane of the telescope is 0·87 cm.

This (real) image is treated by the eyepiece as an object.

Let β be the angle subtended by the primary image at the eyepiece.



The magnifying power of the telescope is defined as:

$$\frac{\text{the angle subtended by the final image}}{\text{the angle subtended by the object at the unaided eye}}$$

From the above diagram, drawn to scale,

$\angle\beta$ is measured to be 12·5°

$$\text{Magnifying Power} = \frac{12{\cdot}5^\circ}{0{\cdot}5^\circ} = 25$$

Clearly, an eyepiece with a shorter p.f.l. would increase $\angle\beta$, and produced an increased Magnifying Power

You now see that "magnification" is a nonsense when referring to the function of an astronomical telescope.

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2017, November 10