Experiment to examine the properties of a simple, refracting astronomical telescope

DF
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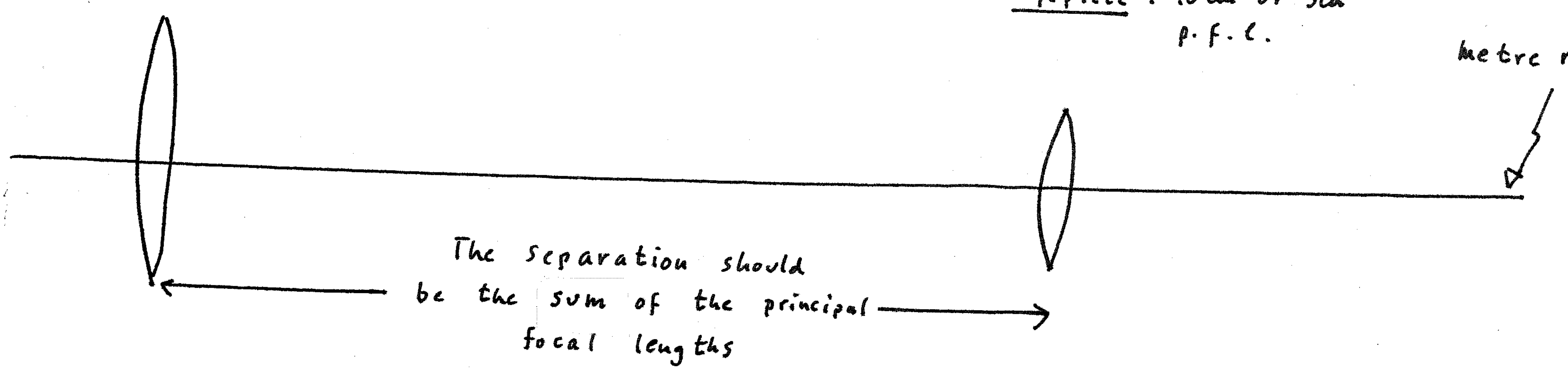
Apparatus

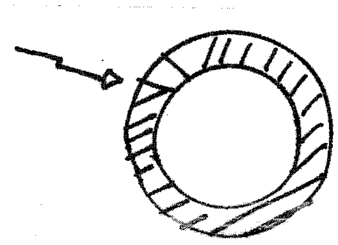
Metre rule, plasticine, lenses (100 cm or 50 cm principal focal length lens for the objective and a 5 cm or 10 cm principal focal length lens for the eyepiece)

Objective: 100 cm or 50 cm p.f.l.

Eyepiece: 10 cm or 5cm p.f.l.

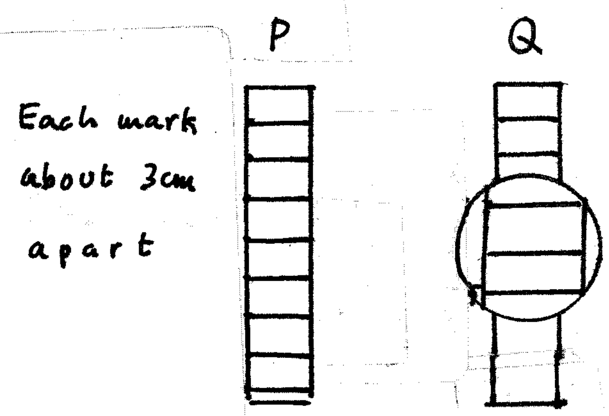


Fix the two convex lenses onto the rule, with plastice, so that the distance between them is as specified above. Look at distant objects through the arrangement, and verify that it does act as a telescope. The image can be rendered "sharper" by attaching, with plasticine, a circular "stop" of paper.



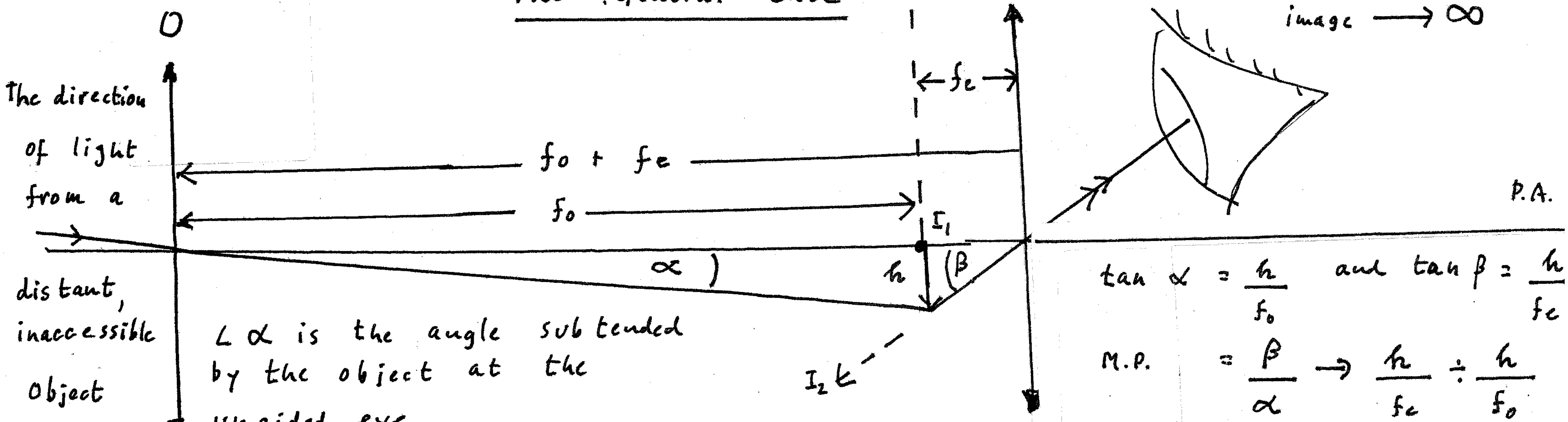
A development will be to measure the magnifying power (or angular magnification) of the instrument as follows.

Construct two similar scales, P and Q, with divisions about 3 cm apart (or similar scales on the whiteboard). Observe them from as far as possible, and hold the telescope to your right eye. Look through the telescope at the scale Q, and at the same time with your left eye at P. Try to count the number of divisions on P which will "fit" into the same number of divisions on Q.



The General Case

The primary image, I_1 is treated as an object for the eyepiece, leading to I_2, the virtual image $\longrightarrow \infty$



$\angle\alpha$ is the angle subtended by the object at the unaided eye.

$\angle\beta$ is the angle subtended by the image seen through the telescope. We can work with the tangen for small angles.

$\tan\alpha = \frac{h}{f_o}$ and $\tan\beta = \frac{h}{f_e}$

$$\text{M.P.} = \frac{\beta}{\alpha} \rightarrow \frac{h}{f_e} \div \frac{h}{f_o}$$

$$\therefore \text{M.P.} = \frac{h}{f_e} \times \frac{f_o}{h} \boxed{= \frac{f_o}{f_e}}$$