The difference of length of the paths A_1, B_1, A_2, B_2 of rays making an angle i with the principal axis is $\alpha \sin(i+\beta)$, and unless the average of this for all values of i exceeds $\lambda/4$, the images B_1, B_2 will appear connected, and will not be clearly separated until the average is about $\lambda/2$. From this it may be seen that not only is it impossible to separate the images of objects in the focal plane which are much closer together than $\lambda/2$, but also that the same limit defines the distance out of focus at which objects may be placed without altering the character of their images. This is a point which is well brought out by the lines on the aniline films.

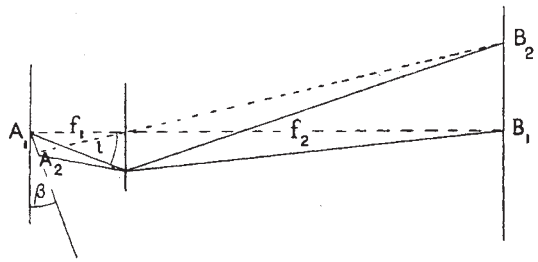

FIG. 3.

It may be asked what is the greatest magnifying power which can be usefully given to microscopes? Since objects closer together than $\lambda/2$ cannot form separate images, the greatest useful magnification is that which makes $\lambda/2$ visible to the eye.

A very good eye can just distinguish minutes of arc, or say objects separated by 1/350 in. at the distance of the eye from the stage. Then, taking the half-wave-length as the 1/100,000 of an inch, all details would be visible with a magnification of 100,000/350, or a little more than 280. Not all eyes, however, are capable of distinguishing minutes, and for convenience of observation, magnifications of twice this amount or more are used in practice, but the extra power reveals no new detail.

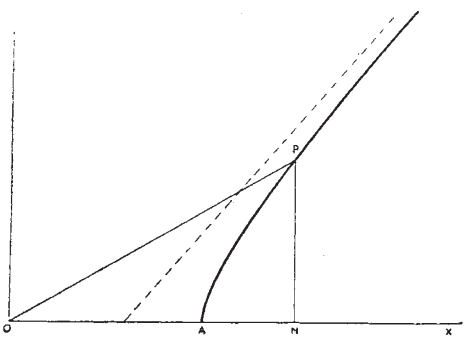

FIG. 4.—Form of plano-convex lens for the conversion of divergent rays into a parallel beam. O, Radiant point; OX, principal axis; PA, section of lens surface.

An idealised lens is merely a means of changing the radius of curvature of a wave-surface from f_1 to f_2 while preserving the constancy of the optical length of all the rays from focus to focus.

From these conditions the form of the lens which will achieve the result may be deduced. As a simple example, find the form of a plano-convex lens which will convert spherical waves originating at O (Fig. 4) into a parallel beam.

Let the convex surface of the lens cut the principal axis OX at A, and let the refractive index of the material be μ. The form of the surface is determined by the relation $OA+\mu AN=OP$. Elementary algebra shows that the curve PA is a hyperbola the asymptotes of which make an angle $\tan^{-1}\sqrt{\mu^2-1}$ with the axis of the lens. The complexity of actual objectives arises from the necessity of effecting the change of radius of curvature by means of spherical surfaces.

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The Antitrades.

I AM glad to support the appeal for observations of the motion of cirrus-clouds in the inter-tropical region and elsewhere made by Prof. van Bemmelen in his letter on the Antitrades (NATURE, February 9, p. 172). It is very interesting that the results which he has obtained by direct observation, with only such additional information from dynamics as may be got from a consideration of the general character of the Australian pressure, should coincide so excellently with results which we obtained here from the calculation of the distribution of pressure at various levels, and the assumption that the wind flows along the isobars.

There are some details in Prof. van Bemmelen's maps which indicate a flow of air *across the equator* which I should be disposed to modify in view of the peculiar conditions under which such a transference of air must take place. I hope to give the details of the information that we have compiled about this subject at some future time, and confine myself for the present to saying that the atmosphere seems to be able to use the circulation of air round a strip of doldrum region as a means of providing for currents which flow westward on the south side, and eastward on the north side, of the equator in a general slope of pressure from south to north across the equator. Thus the doldrum region becomes a sort of elongated clockwise "centre" for the winds of the monsoon north and south of the equator.

I would add also to Prof. van Bemmelen's appeal for observations of cirrus a plea for the extension of observations with pilot balloons. Methods are now so well understood that the authorities could easily provide a *technique* which could be followed by those accustomed to surveying and others, and would provide invaluable information The committee of the British Association which concerns itself about the upper air has already taken up the question, and if anyone who is in a position to help in this matter would communicate with me or with the secretary of the committee, Capt. C. J. P. Cave, of Stoner Hill, Petersfield, we shall be greatly obliged.

NAPIER SHAW.

School of Meteorology, Roval College of Science, South Kensington, S.W.7, January 12.

The Isotopes of Mercury.

IT appeared to be so definitely one of the fundamental assumptions of physics that pure mercury has a constant density under given physical conditions that when Brönsted and Hevesy announced that they had separated it into fractions of different density (see NATURE, September 30, 1920, p. 144) it appeared desirable that the separation should be confirmed by other observers. One of us finds that when mercury (purified chemically and by distillation in a vacuum) is distilled in a very high vacuum the first sixth of the original mercury condensed is of lower density than the last sixth. The difference in density found for these fractions was 44 parts in 1,000,000. This