are valueless. There are many non-astronomical cases in which long exposures can be given without detriment, or in which the focal length cannot be varied at will, when the high resolution afforded by such emulsions is extremely valuable. Unfortunately, in astronomical photography, and in planet photography particularly, the exposure time is a factor equal in importance to sensitivity and graininess.

A Spurious Aberration in Reflecting Telescopes

By F. J. Hargreaves, F.R.A.S.

H. Dennis Taylor in his book "The Adjustment and Testing of Telescope Objectives", described in great detail the testing of object-glasses by examining the out-of-focus images of stars. When there are no aberrations, the image inside focus is exactly the same as the image the same distance outside focus. If there are differences, the character of these differences gives valuable information about the aberrations. He mentioned that when the test is applied to a parabolic mirror, the diagonal causes a circular central dark spot in the out-of-focus images.

In a paper published in the *Journal*, **46**, 193, (1936 March), I mentioned that this central dark spot is bordered by a bright ring with a "hairy" or spiky fringe on its inner edge and that if spherical aberration is present this ring is absent on one side of the focus. I also remarked that this appearance is misleading as it might be taken to indicate a narrow defective zone just outside the area of the shadow of the diagonal.

Since 1936 I have been much puzzled by this bright ring and its vagaries. During the thirteen years that have elapsed I have subjected a great many mirrors to this test in my telescope, and my notes are full of references to difficulties in interpreting the out-of-focus images and of reconciling inferences from them with the results of other tests.

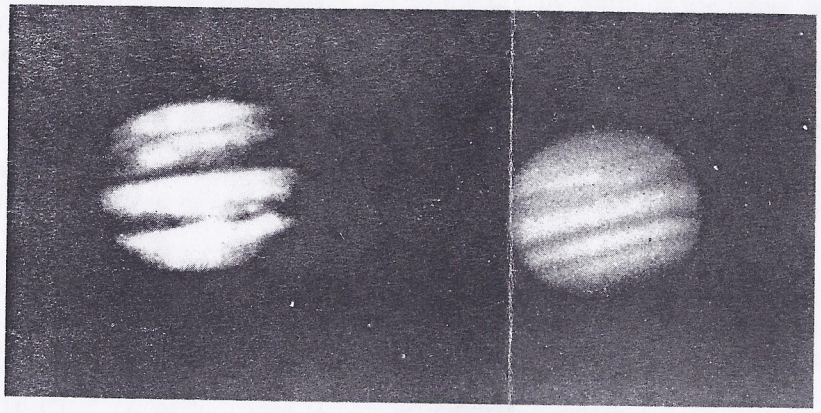
Recently I reviewed the whole problem carefully and was struck by the fact that in every case, when other tests have shown that a mirror is free from aberration, the inner bright ring has been absent from the image *inside* focus and abnormally bright in the image *outside* focus, never the other way round. Moreover, this appearance was more marked on some occasions than others, although in other respects there was no difference. The appearance is shown in Plate III, Fig. 3.

I should make it clear that I am referring to a mirror that has been exposed for some time at night so that it has attained a more or less steady state.

This led me to suspect that the cause must be sought elsewhere than in the mirror. One very windy night a clue presented itself. Every time a strong gust struck the telescope the bright ring became temporarily one-sided—weaker on the windward side and stronger on the leeward side.

The explanation is simple; the cell and mounting of the diagonal became colder than the atmosphere and chill the air immediately surrounding them. There is therefore a sheath or "tube" of dense air, densest at the surface of the mounting and becoming progressively less dense radially outwardly, which acts as a weak collective lens.

The effect of this air lens on the image is precisely the same as that of a zone surface of the mirror, of shorter focal length than the rest of the surface,



PRETORIA
FIG. 1

HEADLEY
FIG. 2

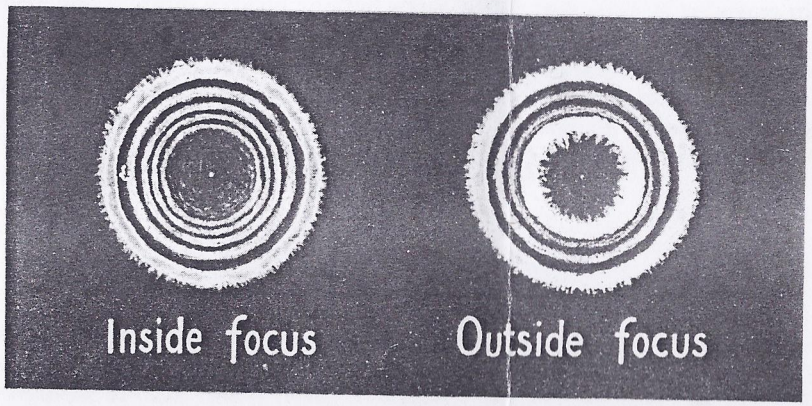
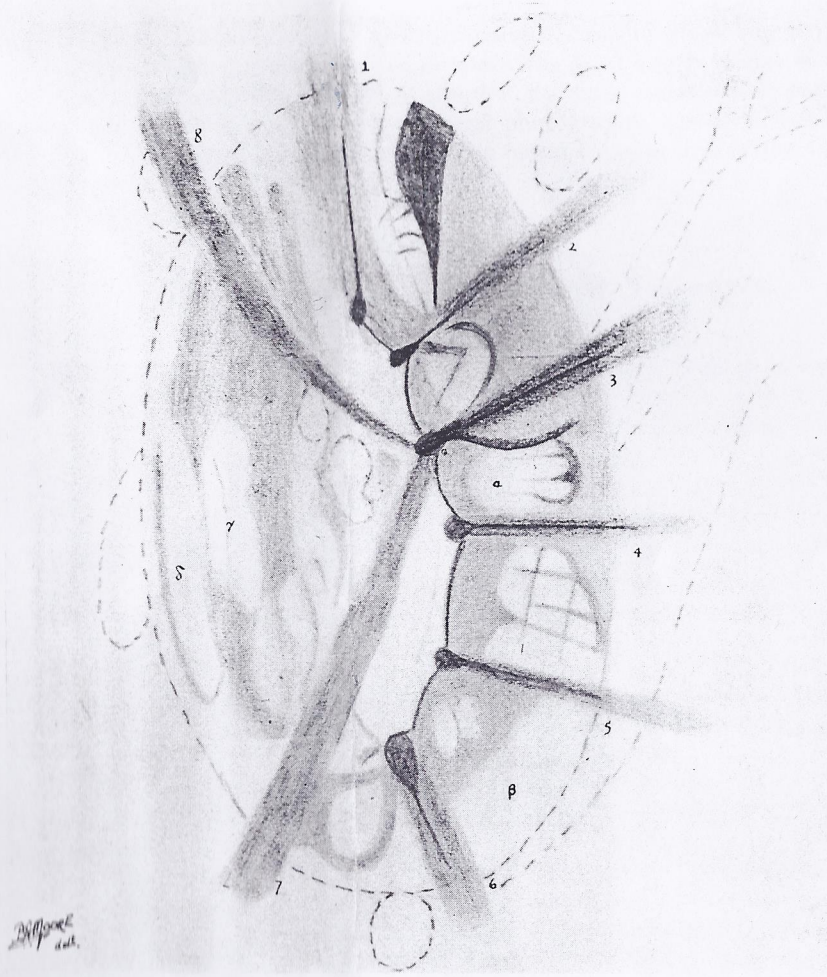


FIG. 3

A Spurious Aberration in Reflecting Telescopes



ARISTARCHUS

Constructed by P. A. Moore and R. M. Baum from observations with 3-inch O.G.s during period April—December 1948. (2 observations made by P.A.M. with a 6-inch O.G., December 1948.)

Bands in order of darkness: 3, 4, 5, 2, 6, 7, 8, 1.

α = brilliant white patch. β, γ, δ = other bright areas.

Much of this detail is highly elusive, particularly the "filaments", but the main bands and bright areas are glaringly obvious and could not possibly be missed now. On several occasions bands 2, 3, 4, 5, (particularly 3 and 4) have shown a brownish or brownish-green colour. Band 8 was usully curved, but once or twice was drawn more or less straight, this band seems to us to vary in intensity from lunation to lunation.

Powers generally used: Baum 100–200, Moore 50–260 (Moore 100–325 with the 6-inch O.G).

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and just outside the area of the shadow of the diagonal. I had been looking for such zones for years, and failing to find them. It had not occurred to me until the other day to look for them in the air in the tube. It is depressing to think of the time that has been wasted in this way.

This diagnosis was immediately put to the test by warming the upper part of the diagonal mounting (taking care not to warm the diagonal itself) with an electric hair drier which I normally use for dispelling dew on the mirrors. The immediate effect was to reverse the appearance, the bright ring being transferred to the inside-focus image. After a few minutes the two images were exactly the same for a short time, after which the original appearance returned. This has been done many times since, always with the same result. Sufficient heat can be imparted by holding the hand on the diagonal mounting for a few seconds.

It must be borne in mind that the abnormally bright ring *may* be due to spherical aberration or to a real defective zone on the mirror. I draw attention to this effect because other users of reflectors may have noticed it and have concluded that their mirrors were in need of re-figuring when in fact there was nothing wrong with them.

The effect on performance is trifling unless the diagonal is unduly large. As regards a remedy, it is possible that a pocket-lamp bulb, inside the cell of the diagonal, might supply the very small amount of heat required. Many years ago Dr. Steavenson advocated this as a remedy for dewing of the diagonal and for some years I (and no doubt many others) used it with success for this purpose. My present telescope is not provided with this device and I have not yet had an opportunity of trying it as a cure for this other effect. It would be interesting to hear from any observers who use this "central heating"; it would be a simple matter to compare the extra-focal appearances with and without heat.

These observations explain another effect with which users of reflectors must be familiar. In warm weather, when the telescope is first opened up in the evening, the inside-focus image invariably shows a very strong bright ring round the central shadow. I now have no doubt that this effect is due to the diagonal mount being temporarily warmer than the surrounding air. I have never been able to associate it convincingly with any temperature effect on the figure of the mirror.

A Lunar Physical Change

By Robert Barker, F.R.A.S.

At the B.A.A. meeting in January 1948, the writer gave a paper, "The Bands of Aristarchus" (*J.B.A.A.*, **58**, No. 3), in which he traced the evolutionary development of dark radial bands and dusky markings in this massive walled lunar plain. Since then, Wilkins has noted dark radial bands extending across the upper slope of the innermost side of the W. wall. All previous markings had been detected under a rising or meridional Sun on the E. wall, and our Director's discovery of bands on the opposing wall under a setting Sun is a further parallel development. Two extensions of bands, running S.E. across the dark rough terrain to Herodotus, had already been discovered by Goodacre and Barker, and I suspected a further band S., also heading to Herodotus, which has been seen and confirmed by Wilkins.