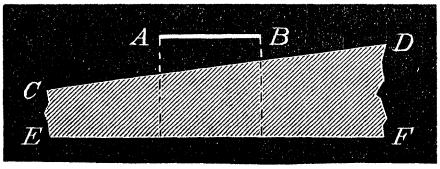
IV. "A Compound Wedge Photometer." By E. J. SPITTA, L.R.C. Phys. Lond. Communicated by Capt. W. DE W. ABNEY, C.B., F.R.S. Received November 8, 1889.

The idea of employing a wedge of neutral-tinted glass as a photometer has occurred to many observers—Dawes, Captain Abney, and others—and notably of late years to Professor Pritchard, of Oxford, who has produced with such an instrument his well known 'Uranometria Nova Oxoniensis,' a catalogue of the relative brightness of the brighter stars north of the equator. But the use of such an instrument has always been limited hitherto to the comparison of the relative intensities of such points of light as the stars present, its employment upon objects of sensible area being foreign to the ideas and requirements proposed in its construction. Having, however, attempted to use a photometer of this description upon disks of small but of various areas illuminated by a known amount of light, the discordances of the results forced upon me the necessity of modifying the construction of the photometer in a way which I believe will extend its sphere of usefulness. It is not within the scope of this paper to give any detailed account of the many experiments I have made with several wedges, but it is sufficient to say that the wedge-form itself has been fully proved to be an important factor in the production of the discordances to which reference has been made, for the following reasons :—

A point of light from its very definition implies that no sensible portion of the wedge is occupied in its passage, but it requires very little thought to perceive that when an area of sensible dimensions is being dealt with this is by no means the case. Moreover, an elementary inquiry suffices to point out that if the area possess a considerable diameter the light emanating from its lateral portions will impinge on different thicknesses of the wedge, as shown to an exaggerated degree in fig. 1, where AB is the transverse diameter of

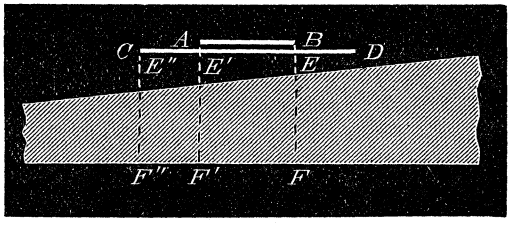
FIG. 1.



the area, and CDEF the portion of the wedge employed. It is evident if the differences in intensity be required between two disks

of the same diameter this condition of things would not affect the validity of the final results, but it is equally apparent that were the disks of differing diameter the values obtained could not but be seriously affected. Let it be presumed that two such different-sized disks were under consecutive examination, as shown in fig. 2, AB

FIG. 2.



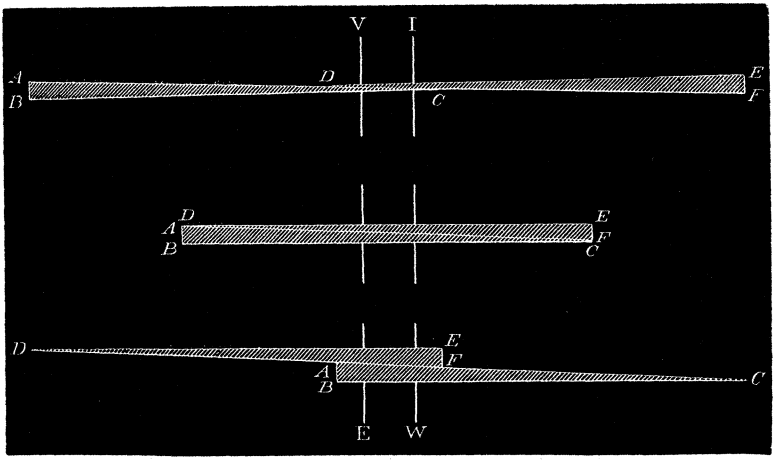
representing the diameter of one and CD that of the other. In the case of AB it is manifest that the extreme limb B would be fainter to all appearance than the opposite edge A, because the light issuing from it has to traverse a portion of the wedge EF, thicker and so more dense than E'F'. On consideration, it is equally obvious that the limiting margin A will be the last to appear as the wedge is made to move from right to left till disappearance takes place, the position technically spoken of as "the point of wedge extinction." But if CD, the larger disk, be illuminated with light of the same initial intensity as fell on AB, it is evident that the point of wedge extinction (technically so-called) for CD at the limb C will not be at the same wedge-reading as in the previous case; in fact, disappearance would not occur until the portion of the wedge corresponding to the line E'F' had been moved to occupy the position shown by the line E''F''. Hence, when ascertaining what is termed the wedge-interval in the direct comparison, say, of the relative intensities of a large and small disk, it is very obvious an error entirely due to the physical nature of a wedge must inevitably result, such error being in direct proportion to the amount of shift required, which depends upon the relative differences in diameter of the disks under observation. Nothing is here said of the difficulties of observation, which are enormously increased by the different apparent intensities of the light at the extremities of the diameter parallel to the length of the wedge, because I merely wish to call attention to the error resulting from the employment of the wedge-form itself.

To apply a correction under these circumstances was not deemed expedient, even if found to be practically possible; hence the removal of the source of error has been arrived at by devising an instrument of

different construction, to which the term Compound Wedge Photometer has been applied, and of which the following is a brief description :—

Two very thin wedges of neutral-tinted glass are made to slide past one another with a uniform rate of motion by the turning of a single milled-headed screw, the idea of the arrangement being diagrammatically set forth, so far as the wedges themselves are concerned, in fig. 3, where it will be seen that any amount of density, within

FIG. 3.



certain limits, can be obtained by equal movement of the two wedges, although a uniformly absorptive area in all parts of the field is rigidly maintained. In the figure, ABC is shown as one wedge, DEF the other, and VIEW the field of view. A cursory inspection of the arrangement at once reveals its most salient advantages, and the fact that any sized disk within the limits of the field of vision will be obscured by the same density of neutral-tinted glass at any and all parts of its image, and hence that the cause of error spoken of as arising from the use of a single wedge is at once removed.

An instrument so constructed has been subjected to several months' crucial testing, and I have no grounds for thinking it does not fulfil the requirement for which it was devised. In its final form the arrangement differs from that usually met with as suggested by Professor Pritchard, for it is supplied with a rotating disk of metal, perforated at intervals to allow the permanent insertion of pieces of neutral-tinted glass of different thickness, each of which can be evaluated for magnitude and used as a constant. Besides, it is

fixed upon the occulting eye-piece, a device for limiting the aperture at the eye-end of a telescope, or for occulting any portion or portions of the field of view, and which I have fully described in vol. 45 of the 'Monthly Notices of the Royal Astronomical Society.'

Presents, December 5, 1889.

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FIG. 1.

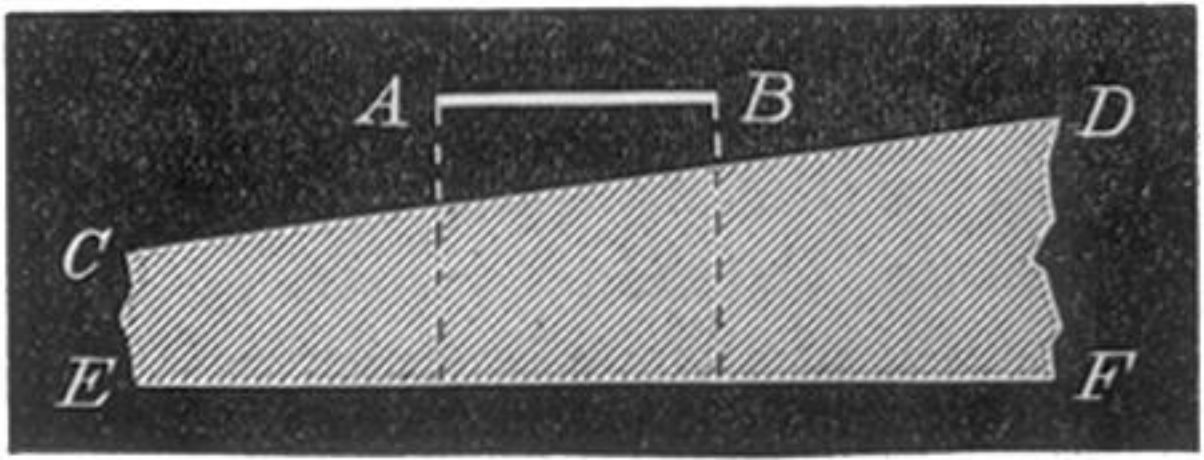

FIG. 2.

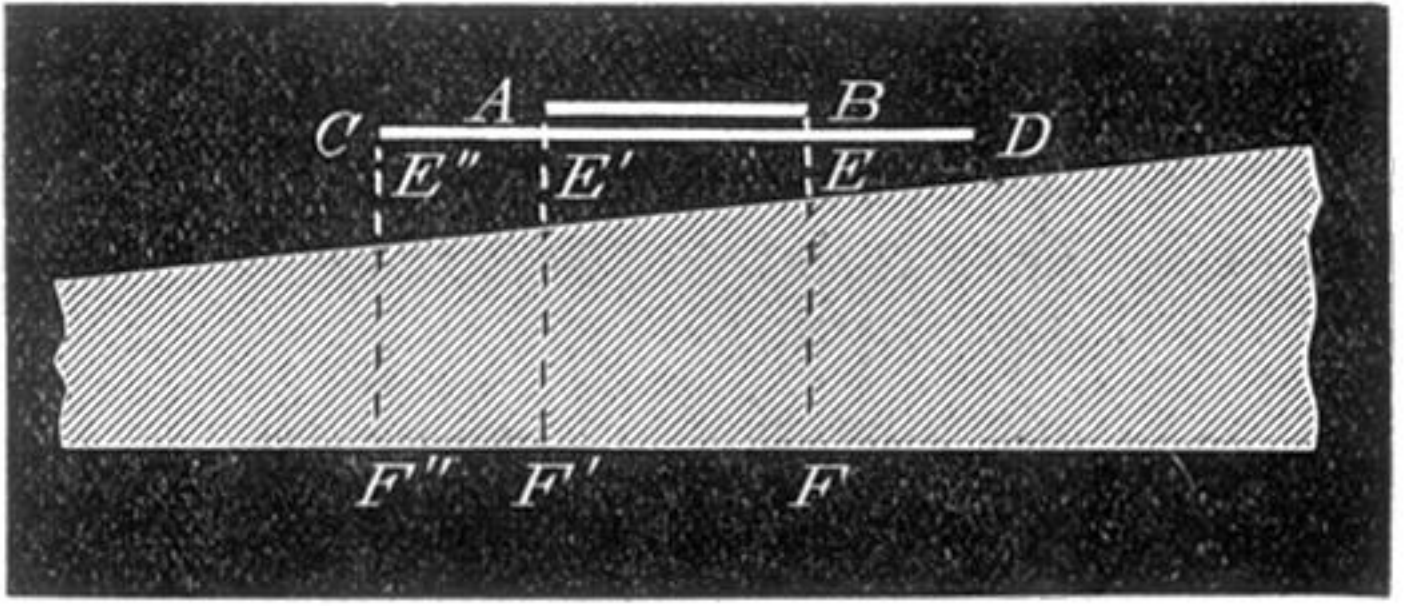

FIG. 3.