



XL. On a simple geometrical construction for finding the intensity of illumination at any point of a plane due to a small source of light symmetrical about an axis perpendicular to that plane

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To cite this article: Charles H. Lees D.Sc. (1895) XL. On a simple geometrical construction for finding the intensity of illumination at any point of a plane due to a small source of light symmetrical about an axis perpendicular to that plane , Philosophical Magazine Series 5, 40:246, 463-466, DOI: [10.1080/14786449508620792](https://doi.org/10.1080/14786449508620792)

To link to this article: <http://dx.doi.org/10.1080/14786449508620792>



Published online: 08 May 2009.



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From the foregoing numbers we see that the value of f always decreases with increase of temperature, both for associating and non-associating bodies. The only exception is the value of f for carbon bisulphide at -10° . The oscillations of f for oxygen and ethylene are simply due to difficulties in executing the experiments at such low temperatures. The difference between the highest and the lowest value for oxygen is, however, not so great—it does not reach 2 per cent. ; whilst the mean values for ether, from Prof. Battelli's and Profs. Ramsay and Young's determinations, differ by 3.3 per cent.*

From the numbers above and the equations (2) and (3) it follows that the disagreement of f with its normal value is a measure of the disagreement of specific pressures π at corresponding temperatures, and *vice versa*. The association of the molecules of the liquid has an influence on f , but is not the only reason of its increasing. In such a case f would, for instance, become smaller with the increase of the molecular weight in the series of alcohols, for Messrs. Ramsay and Shields have proved that the association decreases with the increase of the molecular weight. Besides, of ten esters for which Prof. Guye has calculated f , six have f much higher than 3.06, so that they would appear to be associated ; from the paper of Messrs. Ramsay and Shields it follows that they are not associated. That shows that the association, but not it *alone*, exerts an influence on f . It would therefore be necessary to find out the relation between f and the nature of the substance ; perhaps there is some relation with the molecular weight, for we see that the heaviest of the alcohols examined, isobutyl alcohol, has the highest f ; but to get more knowledge on this point we shall have to obtain more information on the critical constants and vapour-pressures of different bodies, those of homologous chemical structure being best for the purpose.

XL. On a Simple Geometrical Construction for finding the Intensity of Illumination at any Point of a Plane due to a Small Source of Light symmetrical about an Axis perpendicular to that Plane. By CHARLES H. LEES, *D.Sc.*†

THE following geometrical construction for finding the illumination of a plane due to a given source of light of

* Cf. Guye, *Arch. d. Sc. ph. et nat. Genève*, xxxi. p. 471.

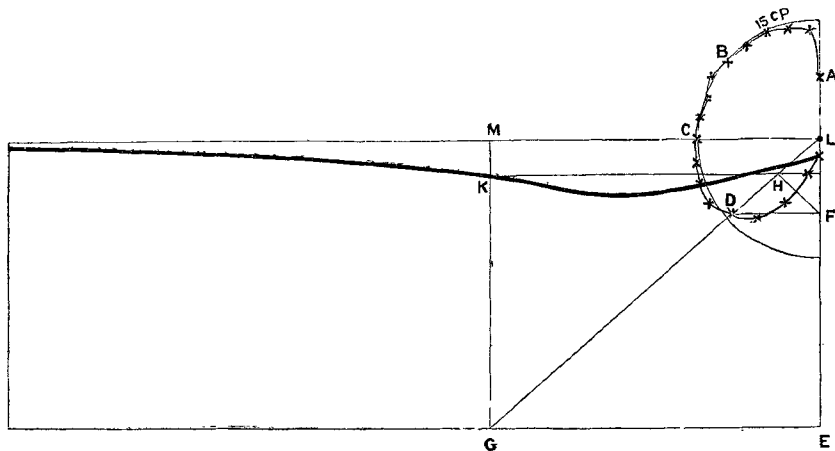
† Communicated by the Author.

small area, as, for example, an Argand gas-flame or an arc-light, symmetrical about an axis perpendicular to the plane, will, I trust, be found simpler to understand and easier to carry out in practice than that proposed by Loppe, and quoted by Palaz, in his *Photométrie Industrielle*, p. 253.

The source of light is supposed to be at a distance from walls &c. producing diffuse reflexion, but it may be provided itself with reflectors, if the photometer-curves for the source are taken with the reflectors in position. The most important cases in practice are those in which the illuminated plane is horizontal—in general the ground; and the source of light is symmetrical about a vertical axis.

Let A, B, C, D be the photometer-curve of the given source of light at L, the distances LA and LB &c. being equal, on some convenient scale indicated by the figures 15 or 700 on the circles, to the intensity of light sent out by the source in the directions LA, LB, &c.

Fig. 1.



Let the illumination of the horizontal plane GE through E, produced by the source L, be required.

Draw a line ML through the source L parallel to the plane GE.

Through any point D, say, of the photometer-curve, draw DF parallel to the horizontal plane GE.

Join DL and produce to meet the horizontal plane in G.

Through F draw FH perpendicular to DL, and through H draw HK parallel to GE, meeting the vertical line GM in K.

The illumination at G is then equal to $MK/(MG)^2$, MK being measured on the same scale as the radii of the photometer-curve.

For the illumination at G = $\frac{DL \cdot \cos \widehat{MGL}}{GL^2}$. Multiply both sides by $(LE)^2$,

$$\begin{aligned} \therefore (LE)^2 (\text{illumination at G}) &= DL \cdot \left(\frac{LE}{GL}\right)^2 \cos \widehat{MGL} \\ &= DL \cos^3 \widehat{MGL} \\ &= MK \text{ by the construction.} \end{aligned}$$

Fig. 2.

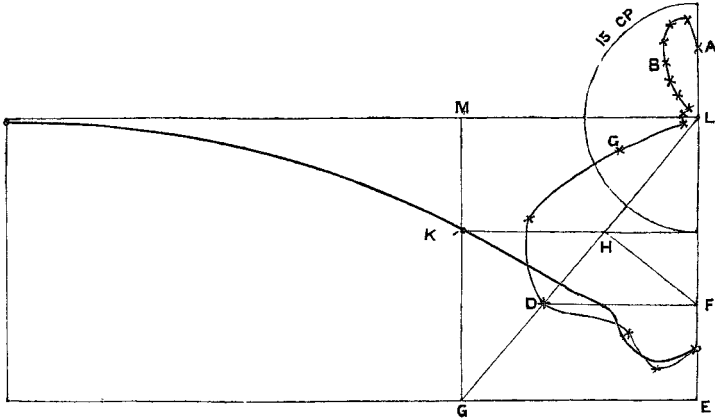
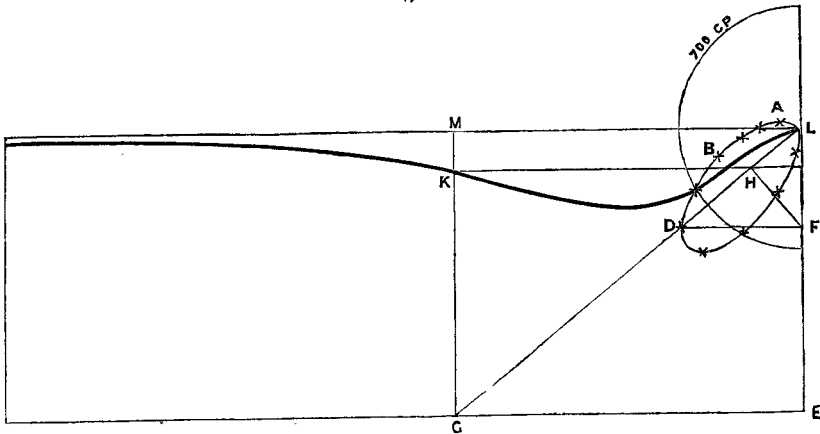


Fig. 3.



Hence the illumination at G due to the source L is proportional to the length intercepted between the horizontal line ML, and the curve passing through the points obtained at K is obtained.

The absolute value of the illumination at the point G due to the source L is equal to the illumination which would be produced if L were removed and a source of candle-power represented by MK on the same scale as LD were placed at M.

In order to show the applicability of the method, three photometer-curves are shown in figures 1, 2, and 3; the first being due to an Argand burner without shade, the second the same burner with a conical paper shade (from Dibdin's 'Photometry'), the third to an arc lamp (from Trotter's paper in the *Journal Inst. Elect.* vol. xxi. p. 365, 1892), and the illumination produced by each source on a horizontal plane is found*.

It is interesting to notice the great increase of illumination in the case of the Argand burner when the shade is introduced. In the case of the arc, the point on the horizontal when the illumination is a maximum is evidently at about 60° below the horizontal plane through the lamp.

XLI. *On Helium and its place in the Natural Classification of Elementary Substances.* By HENRY WILDE, F.R.S.†

[Plate VIII.]

THE announcement made by Professor Ramsay that a gas from the mineral *Cleveite* showed the yellow spectral line of solar helium λ 5876, and was therefore identical with that hypothetical element ‡, was received by physicists with some amount of incredulity, as it was illogical to predicate the identity of any element from the near coincidence of a single line among the numerous lines which belong to other elementary substances in the gaseous condition. Nevertheless, the conspicuous brightness and comparative isolation of the chromospheric line D_3 , together with the statement by Crookes, that the yellow line of the cleveite gas was single §, in agreement with the reputed singleness of D_3 , gave some force to the idea that the solar and terrestrial gases were identical. Lockyer || and Runge ¶, however, subsequently discovered that the yellow line of the new gas was double, and the latter observer justly remarked "that the unknown element helium, causing the line D_3 to appear in the solar spectrum, is not identical with the gas in cleveite unless D_3 is also shown to be double."

* These curves have been kindly drawn for me by Mr. Julius Frith, Exhibition (1851) Scholar of the Owens College.

† A paper read before the Manchester Literary and Philosophical Society, October 1, 1895. Communicated by the Author.

‡ *Chemical News*, March 29, 1895.

§ *Ibid.* p. 151.

|| *Proc. Roy. Soc.* April 25, p. 69.

¶ *Nature*, June 6, p. 128.