The Blue Flame produced by Common Salt on a Coal Fire.

THE blue flame produced by sprinkling salt on a glowing coal fire is a good example of common knowledge, which, not finding a niche and an explanation in text-books, becomes a recurrent topic of inquiry and discussion in scientific journals. It may perhaps be of interest if I add a historical note to what Prof. Merton has stated in NATURE of May 27, p. 683.

The blue flame in question appears to have been first treated from the spectroscopic standpoint by the late Dr. J. H. Gladstone in 1862 in a letter to the *Philosophical Magazine* (ser. iv., vol. 24, p. 417). Without being quite conclusive he seems to have regarded copper chloride as the source. The matter was raised again by an anonymous letter to NATURE in 1876 (vol. xiii. p. 287), and a discussion has recurred from time to time in these columns from that date until 1890. Full references to this are to be found in Kayser's "Handbuch der Spectroscopie," vol. v. p. 391. A communication to NATURE by T. N. Müller in 1876 (vol. xiii. p. 448) seems to have hit the mark. He recognised the flame as being like that of copper chloride, and, surmising that the source of the copper lay probably in the pyrites of the coal, found that the blue flame did not appear when salt was sprinkled on a glowing fire of charcoal. The matter was clinched by Salet in 1890 (*Comptes rend.* 110, p. 282), who identified the spectrum with that of copper chloride as carefully mapped by Lecoq de Boisbaudran, and he actually isolated metallic copper from the fuel ash.

The blue flame given by salt always seems to me distinguishable from that of carbon monoxide, and appears very bright by contrast with the yellow-red glow of the fire. It is somewhat surprising to see how far the yellow sodium flame is suppressed.

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The University, Leeds, May 28.

Optical Resolving Power and Definition.

IN NATURE of May 27, p. 678, Mr. A. Mallock suggests as a quantitative measure of "definition" in an optical instrument "the angular or linear size of the field of view compared with the smallest corresponding quantity which can be clearly distinguished," and proceeds to extend "definition" on an equivalent general basis to a number of other instruments.

Whether or not this proposal will serve a useful purpose in other directions need not be discussed here, but in the case of optical instruments the measure proposed will not commend itself to opticians, for it involves a radical change in the accepted meaning of "definition" in this connection. The suggestion in fact amounts to nothing more than the measurement of the angular field of view in terms of a unit which varies with the aperture of the lens and the wave-length of the light which is used, a proposal which surely carries its own condemnation in its enunciation. That the ratio in question is worthless as a measure of "definition" is obvious from the consideration that in many instruments, at say the centre of the field, the resolving power and the "definition"—that is the degree to which details of an object are clearly discernible in its image—may remain unaffected while the field of view is greatly changed by an alteration in the size of a suitably placed stop. Conversely in apparently similar instruments the "definition" may vary appreciably from one instrument to another while the field of view and the resolving power are alike in all cases.

The distinction between resolving power and definition is real but not easily defined in a few words. The former deals with the discernment of separate sources of such apparent minuteness that it cannot be claimed that the image indicates with any accuracy the shape of the source itself. The latter is concerned with the sharpness of the apparent image outline of larger objects. The former depends primarily on the dimensions of the first dark ring in the image of an apparently point source, and the conditions of observation require the range of wave-lengths of light forming the focussed image to be limited. The latter depends more upon the broad light distribution in the diffraction pattern than upon the alternations of light and darkness, and the range of wave-lengths is not an important factor. As the size of the rings is not greatly affected by small amounts of aberration, the resolving power is not a suitable measure of the correction of a lens system, but it is precisely upon the degree to which aberrations are removed that definition depends. Of two photographic lenses with the same resolving power, and the same field of view, one may give brilliant pictures because the definition is good and the other comparatively flat pictures because the definition is poor. To the user of simple instruments definition is of great importance, resolving power does not concern him.

This is not a suitable occasion on which to discuss the measurement of "definition" or the standards which are suitable for application to various types of instrument. The subject is one of great difficulty particularly in view of our ignorance of the extent to which it is possible to eliminate aberrations in systems of simple construction. Lest, however, readers of NATURE should be misled it cannot be too emphatically stated that in omitting from "definition" its most essential factor and substituting therefor an independent conception, Mr. Mallock's attempted generalisation is likely to prove only a cause of confusion to those who hope to measure the merits of optical instruments by its means.

T. SMITH.

The Difference between Series Spectra of Isotopes.

PROF. P. ZEEMAN mentioned to me recently some new measurements of the absorption spectrum of lithium which he undertook in order to prove the presence of both isotopes. It seems to me, that at the present time it is not certain what one should expect here theoretically. Bohr's formula for the change in the frequency ν due to the motion of the nucleus has been applied by him only to the cases in which a *single electron* moves around the nucleus; namely, to H and He^+. Recently the formula has been also applied by various authors (see F. W. Aston, "Isotopes," p. 123—London 1922) to the calculation of the difference between series spectra of isotopes; this means to atoms in which *several electrons* move around the nucleus. So far as I know there are as yet no investigations on the equation which must for these cases replace Bohr's equation

$$\nu_2 : \nu_1 = \frac{M_2}{M_2 + m} : \frac{M_1}{M_1 + m} \quad . \quad . \quad . \quad (1)$$

(M_1, M_2, m are respectively the masses of the nucleii of the isotopes and of the electron; ν_1, ν_2 are the frequencies of corresponding lines).

In the case of one electron only, (1) follows immediately from the well-known transformation of the "problem of two bodies" from absolute to relative co-ordinates (see, *e.g.*, Whittaker, "Analytical