"On a New Series of Lines in the Spectrum of Magnesium." By A. FOWLER, A.R.C.Sc., F.R.A.S., Assistant Professor of Physics, Royal College of Science, South Kensington. Communicated by H. L. CALLENDAR, F.R.S. Received March 9,—Read March 26, 1903.

Although the spectrum of magnesium has been the subject of many investigations, certain lines which occur in the arc spectrum appear to have hitherto escaped notice. The lines in question are comparatively feeble, but on account of their theoretical interest it seems desirable to draw attention to them.

The new lines make their appearance in the spectrum when the arc is made to pass between poles consisting of magnesium rods, but they do not always appear with equal intensity. They are somewhat nebulous, especially on their less refrangible sides, so that their positions cannot be determined with great accuracy; but as nearly as they can be ascertained with the instruments at my disposal, the wave-lengths are (in air), 4511·4, 4251·0, 4106·8, and 4018·3.

A mere inspection of the photographs suggests that these lines constitute a regular series, associated with the much stronger series described by Rydberg*, having wave-lengths 5528·75, 4703·33, 4352·18, 4167·81, 4058·45, and 3987·08, according to the measures of Kayser and Runge. This view seems to be sufficiently confirmed by calculation.

Rydberg found that neither his own general formula nor that of Kayser and Runge could be applied with sufficient accuracy to the stronger series, and employed a combination of the two formulæ, namely,

$$n = a + \frac{b}{(m+\mu)^2} + \frac{c}{(m+\mu)^4},$$

where n is the oscillation frequency, m has the values 3, 4, 5, &c., and a, b, c, and μ are constants to be determined from four lines belonging to the series. For the magnesium series, the equation calculated by Rydberg is

$$n = 26{,}631{\cdot}44 - \frac{111{,}856{\cdot}92}{(m+0{\cdot}406)^2} + \frac{147{,}764{\cdot}05}{(m+0{\cdot}406)^4},$$

n being the oscillation frequency *in air*, and m having the values 3, 4, 5, 6, 7, 8 for the six lines named above.

Using the same formula for the new series, and calculating the constants from the four lines, the equation for frequencies *in vacuo* is

$$n = 26{,}595{\cdot}4 - \frac{102{,}496{\cdot}6}{(m+0{\cdot}618)^2} + \frac{168{,}840{\cdot}5}{(m+0{\cdot}618)^4}.$$

* 'Öfversigt af Kongl. Vet. Akad. Forhandl.,' 1893, Stockholm.

Another formula* which may be conveniently employed is

$$n = n_{\infty} - \frac{C}{(m+\mu)^2 - m_0}$$

This formula gives for the two magnesium series the equations :

$$\text{“Rydberg” series,} \quad n = 26{,}601\cdot49 - \frac{107{,}071\cdot37}{(m+1\cdot2304)^2 + 2\cdot13282},$$

$$\text{New series,} \quad n = 26{,}587\cdot4 - \frac{100{,}033\cdot6}{(m+0\cdot495)^2 + 2\cdot38919},$$

n being the oscillation frequency *in vacuo* in each case.

It will be seen that the convergence frequency of the new series is as nearly equal to that of the Rydberg series as can be expected with the comparatively rough wave-lengths employed, and it may be added that in each case the constant m_0 is of unusual magnitude. These facts, in conjunction with the general characters and relative intensities of the lines, render it highly probable that the new series is associated with the Rydberg series as second and first subordinate series respectively.

Applying the formula to the calculation of the members of the new series for which $m = 3$ and $m = 2$, the corresponding wave-lengths in air are 5065·0 and 6674·5. The first is probably represented by a line having an approximate wave-length 5067, which is not so readily observed in the photographs as the others, because the plates employed are comparatively slow for this part of the spectrum, and if the exposure be lengthened, the banded spectrum of magnesium becomes strong enough to almost mask the line. The line 6674·5 is perhaps too far in the red to be conveniently observed, seeing that it is probably feeble and not well defined.

It may be reasonably concluded that the arc spectrum of magnesium includes two subordinate series of single lines in addition to the two well-known subordinate series of triplets. No such combination of series appears to have been previously noted in the spectrum of a metal, but two sets of series, each set consisting of a principal and two subordinate series, are well-known in the spectra of helium and oxygen.

The author desires to express his obligations to Mr. Herbert Shaw for valuable assistance in making the computations involved in investigating the various formulæ which have been suggested for series, as applied to the series which forms the subject of the present paper.

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* After much labour, this formula was arrived at by Mr. Herbert Shaw and the author as the one giving the most consistent results for series in general, but it was afterwards found that a similar formula, expressed in wave-lengths, had already been employed by Mr. Rummel (‘Roy. Soc. Victoria Proc.,’ vol. 10, Part I, 1897, p. 75).