Letters to the Editor.

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On the Oxygen Spectral Line $\lambda = 5577 \cdot 35$ Å.U.

A NUMBER of investigators, including Merton, Barratt, Johnson, Cameron and others, have shown that the spectrum of an element in the gaseous state can be profoundly modified if an electric discharge be passed through it when one or other of the rare gases helium, neon, argon is mixed in excess with it.

For example, Merton and Pilley showed that by this method it is possible to enhance greatly the arc spectrum of atomic nitrogen and even to isolate it completely from the spark spectrum of this element.

Again, it was shown a year ago by McLennan and Shrum that a line of weak intensity existed at λ 5577·35 Å.U. in the spectrum of oxygen, and that this line could be considerably strengthened when helium or neon were added in excess to oxygen excited by the passage of an electric discharge through it.

As McLennan and Shrum put forward the view that this line in the spectrum of oxygen is identical with the famous "green line" λ 5577 Å.U. observed in the spectrum of the light from the night sky, and in the spectrum of the aurora, we were led to engage during the past year in a rather exhaustive study of the main characteristics of the line. The results of this investigation will be given in detail elsewhere, but in the meantime we think it well to state here a few results that are of special interest now.

(1) The spectral line λ 5577 Å.U. has been shown to be obtainable with pure oxygen and with intensity the strongest when the gas is at a pressure of two millimetres of mercury and the exciting electrical discharge is passed through a tube about one metre long and three centimetres in diameter.

(2) When currents varying in strength up to 160 milliamperes were used, the intensity of the line steadily increased with the strength of the exciting electrical current.

(3) A new series of measurements has shown that the wavelength of this spectral line is very close to λ 5577·35 Å.U.

(4) This spectral line, λ 5577·35 Å.U. has never been observed in our experiments in the spectrum of any electrical discharge in the absence of oxygen.

(5) When an electrical discharge was passed through oxygen at a pressure of 2 mm. of mercury mixed with helium, the line was obtained with strongest intensity when the partial pressure of the helium was about 20 mm. of mercury.

(6) A series of carefully executed experiments has shown that the power possessed by the rare gases of enhancing the oxygen line λ 5577·35 Å.U., assuming the strength of the line in oxygen alone to be 1, is as follows: helium 1·7, neon 4·6, argon 84·2.

(7) When argon in excess was mixed with oxygen the line λ 5577·35 Å.U. was obtained with an intensity greater than that of any known line in the spectrum of atomic oxygen having a wavelength shorter than λ 6000 Å.U.

(8) Observations with a powerful echelon spectrograph showed that the oxygen line λ 5577·35 Å.U. is simple and without any fine structure.

(9) In studying the Zeeman effect with the line λ 5577·35 Å.U. it was found that magnetic fields of weak to moderate intensity produced a symmetrical broadening of the line, the magnitude and the character of this broadening being of the order and of the nature respectively of that usually shown by spectral lines having an atomic origin.

(10) It would appear that this spectral line λ 5577·35 Å.U. originates in an electron transition between atomic levels for oxygen provided by one or other of two new singlet-triplet schemes that were based on Hund's theory and were recently put forward (*Proc. Roy. Soc.*, July 1926) by McLennan, Grayson Smith and McLay.

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Interference and Corpuscular Light.

IN the new wave theory of matter (Einstein, L. de Broglie, Schrödinger), the material point is conceived as a singularity in a wave. More precisely, in the absence of any field of force, the wave phenomenon called 'material point' is represented by a sinusoïdal solution of the equation:

$$\Delta u - \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2} = \frac{4\pi^2}{h^2} m_0{}^2 c^2 u, \quad . \quad . \quad . \quad (1)$$

where m_0 is a constant characteristic of the wave (proper mass of the material point). The function u has a uniformly moving singularity which *is* the material point. If the point at rest has a spherical symmetry, then the solution of (1) will be (the line of motion being chosen as z axis)

$$u = \frac{A}{\sqrt{x^2 + y^2 + \frac{(z - vt)^2}{1 - v^2/c^2}}} \sin 2\pi\nu\left[t - \frac{vz}{c^2}\right].$$

Further, the energy of the moving point is identical with the product $h\nu$.

In the special case of the light quant, we must suppose m_0 to be equal to an extremely small quantity if not to zero. Then the wave equation (1) reduces to the classical form:

$$\Delta u = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}. \quad . \quad . \quad . \quad (1')$$

For each problem of interference or diffraction, classical optics tries to find a solution of the form:

$$u = a(x, y, z)e^{2\pi i\nu[t - \phi(x, y, z)]}, \quad . \quad . \quad (2)$$

satisfying the adapted limiting conditions. But, for the new mechanics, the motion of the light quants is given by a solution of (1′) of the form:

$$u = f(x, y, z, t)e^{2\pi i\nu[t - \phi(x, y, z)]}, \quad . \quad . \quad (3)$$

where the amplitude f has many moving singularities. The function ϕ is to be the same in (2) and (3), and the singularities, *i.e.* the light quants, must describe the curves normal to the surfaces ϕ = Constant.[1] In substituting (2) and (3) in (1′), we get the two following relations connecting the classical amplitude a and the 'granulated' amplitude f, respectively, with the phase-function ϕ:

$$\frac{2}{a}\frac{\partial a}{\partial n} = \frac{1}{a^2}\frac{\partial(a^2)}{\partial n} = -\frac{\Delta\phi}{\partial\phi/\partial n}, \quad . \quad . \quad (4)$$

$$\frac{\partial\phi}{\partial n} \cdot \frac{\partial f}{\partial n} + \tfrac{1}{2} f \Delta\phi = -\frac{1}{c^2}\frac{\partial f}{\partial t}, \quad . \quad . \quad (5)$$

dn being an element of trajectory.

[1] Of course it remains to prove the existence of such a solution of equation 1′ in each case.