New Bands in the Molecular Spectrum of Hydrogen.

IN the molecular spectrum of hydrogen, 3667 lines have been measured by Finkelnburg between λ4861 and λ3314, and Gale, Monk, and Lee have given a list of 3064 lines measured by them between λ3394 and λ8902. Of course, many of the lines in the two lists are common. There are several hundreds of lines in the extreme ultra-violet, first discovered by Lyman and later by Werner and Weizel. Of this multitude of lines, only about a thousand have been classified by Richardson and his co-workers, by Finkelnburg and Mecke, by Weizel, Hori, Dieke, and others. Thus we still have to account for more than 75 per cent of the lines.

Recently Richardson has given an account of all the levels which have so far been observed and also their interpretation according to Hund's theory of axial quantisation. It appears that to account for such a large number of unclassified lines, some of the selection principles must be sacrificed, and the one that naturally suggests itself is that for the azimuthal quantum K, namely, that $\Delta K = \pm 1$. It is well known that this principle is violated even in the case of atomic spectra when a large electrostatic field is present, for example, in Koch's experiment on the production of $1P$-mP lines of helium, and in the recent work of Nils Ryde (*Zeits. f. Physik*, **59**, 836), in the production of forbidden lines corresponding to $\Delta K = \pm 2$, 0, in the spectrum of neon. Since in molecule formation we have a very large electrostatic field coming into play, it may reasonably be expected that this principle will be completely violated.

Working on this idea, I have been able to identify a number of bands due to otherwise forbidden transitions; for example, between the B-level of Dieke and the a-level of Richardson $[2p'\Sigma \leftarrow 2p\pi_{a,b}]$ in Richardson's recent notation. P, Q as well as R branches have been obtained for vibration frequencies $n = 0, 1, 2 \ldots$ and $n' = 0, 1, 2 \ldots$ The lines are mostly very weak. It appears that a large number of lines otherwise not accounted for may be due to a similar cause.

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Mar. 8.

Relation of Fluidity of Liquids to Temperature.

IN reference to the editorial comment in NATURE of Mar. 29, may I say that my letter of Feb. 3 on the subject was communicated at the same time to the *Journal of Rheology* and appeared in its January issue in this country. As you have stated, I was unaware that Prof. Andrade was working on the subject. His formula $\eta = Ae^{k/T}$, where η = viscosity, is obviously identical with the one which I proposed,

$$\log \phi = -\frac{k}{T} + A,$$

where $\phi = 1/\eta$, the fluidity. As pointed out in my note of Feb. 15, also published in NATURE of Mar. 30, both of us were actually anticipated by Señor de Guzman and Prof. C. Drucker. It is curious that such a considerable lapse occurred in the recognition of what certainly appears to be the most satisfactory formula relating viscosity or fluidity of liquids to temperature. I was led to it myself by the work of Stewart, Katz, Prins, and others on the X-ray diagrams of liquids. The existence of 'partial regional orientation' of the molecules in liquids suggests a partition into non-oriented and oriented species, the latter being regarded as slightly deformed. Applying the Maxwell-Bolzmann equation, in the form

$$\frac{N-n}{N} = e^{-k/T},$$

where N = total number of molecules per unit space, n = number of oriented molecules,

and assuming that the fluidity is proportional to $\frac{N-n}{N}$,

then $$\phi = Ae^{-k/T},$$

where A and k are constants.

This derivation does not cover the actual mechanism of momentum transfer in liquids, and Prof. Andrade's theoretical treatment of the subject will be read with great interest.

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The Exit Gas from an Ammonia Discharge Tube.

WHEN ammonia is passed through a discharge tube, under the same conditions as used to prepare atomic hydrogen, an active gas is obtained. This active gas is reducing in character as shown by the reduction of cupric oxide and of a zinc oxide–chromium oxide catalyst. Small solid particles are heated to incandescence; a phenomenon often observed with atomic hydrogen. The solid ammonia condensed in the liquid air trap (1·5 m. from the discharge tube) gave an intense blue-green glow when the active gas passed over it.

If a substance like the zinc catalyst (which is known to remove atomic hydrogen) is placed in the gas stream, the glow in the trap is not affected. This must mean that the glow is not caused by atomic hydrogen, and suggests that there must be at least one other active product present.

Since the ammonia is broken up into hydrogen and nitrogen, there is a possibility that the exciting agent might be active nitrogen. However, if ammonia is allowed to condense in the trap and active nitrogen passed over the solid, the glow is not obtained. Ammonia, when passed into the stream of active nitrogen, extinguished the yellow afterglow and caused the reappearance of the green glow in the trap.

These experiments seem to indicate the presence of atomic hydrogen along with a nitrogen-hydrogen compound, probably NH or NH_2, in the exit gas from the ammonia discharge tube. We are continuing the work in an attempt to correlate the above with the ammonia synthesis and decomposition.

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Light in Four Dimensional Space.

WILL you kindly allow me to make a correction to my letter in NATURE of Feb. 8.

As dt is generally defined as the time co-ordinate *after* correction for the ordinary velocity of light over the distance dx the equations are true for all cases, and it is therefore unnecessary to assume the velocity of light infinite even in flat space. This and the fact that it becomes definitely a unit vector and loses the invariant character it possessed in the orthodox theory dispose of the suggestion that it might be a measure of the curvature of space. Restated, the assumption made is that at any point of space the angle between a ray of light and the world-line of its source is a constant.

J. HALCRO JOHNSTON.
Orphir House, Orkney, Mar. 26.