

### The Raman Effect with Hydrochloric Acid Gas : the 'Missing Line.'

I HAVE obtained lines of modified wave-length by the excitation of hydrochloric acid gas at atmospheric pressure, by the light of a glass Cooper-Hewitt lamp about five feet in length, placed parallel to and in contact with the tube containing the HCl, the whole being completely surrounded by a cylindrical reflector of very highly polished aluminium, which was in contact with the two glass tubes. Under these conditions the temperature of the gas was about 100° C., as indicated by a thermometer introduced into the metal cylinder.

With an exposure of only twenty-four hours, and a Hilger constant deviation spectroscopy, I obtained a very sharp and distinct line nearly midway between the mercury lines 4358 and 4915. It was almost in coincidence with the argon line 4579 (used as a comparison spectrum). Considering this line as excited by the mercury line 4046, the frequency difference between the exciting line and the modified line ( $\lambda = 4581$ ) corresponds to the frequency in the infra-red which would represent a line at 3.47  $\mu$ , almost exactly the centre of the vibration rotation band. The line thus appears to be the so-called 'missing line,' corresponding to a vibration transition unaccompanied by change of rotation, which does not appear in the absorption spectrum of the gas.

The first photograph which I obtained showed a double line, namely, the 'missing line' and the first vibration-rotation line next to it. In this case the tubes were not completely surrounded by reflectors and the temperature was lower; the tube may also have contained some air and a trace of moisture. This point is under investigation. In my last photograph, I find also six lines immediately on the long wave-length side of 4358, but have not yet determined whether they represent a part of the infra-red band or are due to interference produced by the thin glass of the bulb. As they appear on one side only of 4358, I feel sure that they are real.

R. W. WOOD.

### Magnetic Properties in Relation to Chemical Constitution.

IN the recent letter by Prof. Lowry and Mr. Gilbert (NATURE, Jan. 19, p. 85) some interesting points are dealt with concerning the evidence afforded by magnetic data as to the chemical constitution of various compounds. The authors note that the fact that cupric sulphide, CuS, is diamagnetic suggests that this compound must be a cuprous compound with a double molecule rather than a cupric salt as previously supposed. They also mention that X-ray analysis has shown that iron pyrites must be a ferrous disulphide, Fe<sup>++</sup>S<sub>2</sub>.

Magnetic measurements can furnish further information as to the chemical constitution of the latter compound. The magnetic properties of the cubic crystals of the type represented by iron pyrites, FeS<sub>2</sub>, cobaltite, CoAsS, etc., were recently investigated. The case of iron pyrites may be taken as typical. It was found that after allowing for the diamagnetic properties of the sulphur atoms, the iron atom possessed a small residual positive magnetic moment, and the susceptibility was independent of the temperature. These properties are in agreement with what would be expected for a twofold co-ordination compound of ferrous iron, but are quite different from those of simple ferrous salts. The Fe<sup>++</sup> ion in iron pyrites must therefore have a constitution corresponding to that of the iron atom in, say, potassium ferrocyanide, and not to that of the iron atom in, say, ferrous sulphate.

We must therefore classify these minerals, of which iron pyrites is typical, as co-ordination compounds. Incidentally, their properties are in agreement with Cabrera's scheme for the relation between constitution and magnetic properties in co-ordination compounds, but the above conclusions are independent of the view taken as to the arrangement of the electrons in such compounds.

L. C. JACKSON.

The University, Bristol.

### Energies of Dissociation of Cadmium and Zinc Molecules.

THE 2288 (<sup>1</sup>S - <sup>2</sup>P) absorption line of cadmium broadens symmetrically with pressure until it reaches a sharp limit at the 2212 cadmium absorption band, but reaches no definite limit on the long wave-length side. In the electrodeless discharge in cadmium vapour, the 2288 line is surrounded by a continuous spectrum corresponding to the broad band found in absorption, but the limiting band at 2212 does not appear.

These facts can be correlated with a pair of potential energy curves for the cadmium molecule, and from these curves the energy of dissociation of Cd<sub>2</sub> can be found.

The limiting band at 2212 is correlated with the transition of an electron from the non-vibrating 'grund' state of Cd<sub>2</sub> to the <sup>2</sup>P level of the cadmium atom; that is, to the limit of the vibrational levels of the excited molecule. The transition from the limit of the vibrational levels of the normal state to the limit of the vibrational levels of the excited molecule is an atomic transition which in the present case is <sup>1</sup>S - <sup>2</sup>P ( $\lambda 2288$ ). Therefore the difference in energy between the limiting band at 2212 and the atomic line at 2288 gives the energy of dissociation of the normal Cd<sub>2</sub> molecule. This equals 0.200 volt for Cd<sub>2</sub> and 0.246 volt for Zn<sub>2</sub>.

The full report of this work, which was done in Palmer Laboratory, Princeton University, will appear in the *Philosophical Magazine*.

J. G. WINANS

(U.S. National Research Fellow).

University of Göttingen.

### Piles of Pebbles on Beaches.

IN a letter published in NATURE of Dec. 1, a correspondent directs attention to the occurrence of regularly spaced groups of pebbles along a beach in the New Hebrides, separated by patches of sand devoid of pebbles. I may say that a similar occurrence is frequently to be observed on the beach in Bournemouth Bay to the west of Alum Chine, where the piles of stones collect at distances of from 15 to 25 yards between centres, to a height of one or two feet, and appear to contain all sizes indiscriminately between  $\frac{1}{4}$  in. and 4 in. The regularity of the spacing along the water's edge can be well observed from the cliffs above.

The action of the tides and wind in this part is such as to cause frequent changes in the nature of the beach, both in position of normal high-water mark and in the slope of the beach, and the occurrence of the regular spacings is therefore apparently haphazard.

It might be suggested that when the slope of the beach bears a certain relation to the mean distance between waves, to the angle of incidence, and to the mean quantity of water in each wave, then the time of return of each exhausted wave may be in agreement with, or bear some integral relation to, the time interval between waves. It would then seem possible for a regular condition to arise which might cause the observed facts.

R. M. CLARK.

Municipal College, Bournemouth.