P and R branches, and only one assignment of rotational quantum numbers fulfils the combination principle exactly. Our conclusion as to the type of electronic transition involved agrees with that reached by Herzberg [4] as the result of unpublished work. A cursory examination of the breaking off of the rotational structure for bands with $v'' = 10$ and 11 also confirms his statements in this connexion. We do not propose to investigate the detailed effects of predissociation in this spectrum, as we understand that Dr. Herzberg is continuing his work in this phase of the problem.

F. A. JENKINS.
MURIEL ASHLEY.

Department of Physics,
University of California,
March 17.

[1] *Z. Physik*, **69**, 548; 1931.
[2] NATURE, **126**, 239, Aug. 16, 1930.
[3] *Phys. Rev.*, **39**, 552; 1932.
[4] *Erg. exakt. Naturw.*, **10**, 273; 1931.

Disintegration of Atomic Nuclei

THE epoch-making results as to the disintegration of atomic nuclei recently obtained in the Cavendish Laboratory serve to recall the experiments of Prof. J. N. Collie and his fellow-workers made twenty years ago. In some of these experiments it was thought that helium and neon were produced by sending powerful electric discharges through exhausted tubes. Sir William Ramsay observed the presence of helium in an old X-ray tube. Little information is available in the published accounts as to the potential difference employed in the experiments or as to the previous history of the (aluminium) electrodes. It was generally supposed that the balance of evidence was against such transformations, but it is possible that the failure of other investigators to reproduce the results of Collie may have been due to the fact that the precautions which they took resulted in an insufficient supply of swift protons in the discharge tube.

Be that as it may, taking into consideration the old and the new experiments, I should like to suggest that the aluminium nucleus, for example, may yield *neon* on disruption, in accordance with the process

$$Al^{27} + H^1 \longrightarrow 2He^4 + Ne^{20}.$$

In his report [1] of the discussion on the structure of atomic nuclei at the Royal Society, Dr. Ellis emphasises the uncertainty in speculating about such processes as

$$Al^{27} + H^1 \longrightarrow He^4 + Mg^{24},$$

but, in view of the possibility of the nucleus being built up of shells in a fashion somewhat resembling the electronic structure of the chemical atom, the suggestion that the neon nucleus is present in aluminium seems worthy of consideration.

In the second place, I should like to enter a caution as to accepting the particles of mass unity discovered by Dr. Chadwick in beryllium 'radiation' as representing the ultimate neutron. In a paper [2] on quantum magnetic tubes in rotation, published in 1925 and described in my book on "The Quantum and its Interpretation", I developed a suggestion due to Prof. E. T. Whittaker, that the difference between positive and negative electric charges might be interpreted as arising from different directions of rotation of the tubes. In the admittedly crude model there described, the mass of the neutron, in which there is no rotation of the tubes, would be the arithmetic mean of the masses of the proton and the electron. It therefore seems possible that the corpuscle of mass unity is composed of *two* neutrons. For, according to the hypothesis mentioned, the neutron is a magneton, and magneton pairs are likely to occur. Electron pairing is now recognised as an important factor in molecular structure, and may be attributed to the magnetic properties of the electron.

Experiments in an inhomogeneous magnetic field may serve to show that the corpuscles of Dr. Chadwick possess a magnetic moment, but probably the magneton pair would constitute a neutral magnetic system of small magnetic moment. Further search might be made for particles of about half the observed mass and possessing a magnetic moment.

H. S. ALLEN.

The University, St. Andrews,
May 11.

[1] NATURE, **129**, 674, May 7, 1932.
[2] *Phil. Mag.*, **49**, 981; 1925.

Oscillations of the Methane Molecule

FROM a consideration of the infra-red absorption data, Dennison [1] assigned 1304, 1520, 3019, and 4217 as the fundamental frequencies of the methane molecule, the highest, 4217, representing a symmetric expansion of the tetrahedron. In the Raman spectrum of methane, however, 4217 fails to appear, and we have instead a frequency 2918 recorded as an intense and sharp line, which is inactive in infra-red absorption and is therefore to be identified with a symmetric oscillation of the tetrahedron. I have accordingly suggested in a recent paper [2] that the fundamental frequencies of methane are 1304, 1520, 2918, and 3019, the frequency 4217 being merely a combination of the first and the third fundamentals.

Striking evidence in support of the new assignment is now forthcoming from observations made by me on the state of polarisation of the Raman lines. It is found that 2918 is nearly completely polarised ($\rho = 0{\cdot}08$), whereas the line 3019 is nearly unpolarised ($\rho = 0{\cdot}8$), thus presenting a complete analogy with the state of polarisation already ascertained for the third and fourth fundamentals in the case of the tetrachlorides. It is interesting to note that in the Raman spectra, 3019 appears accompanied by vibration-rotation components, while the more intense 2918 fails to exhibit them.

S. BHAGAVANTAM.

210 Bowbazar Street,
Calcutta, India,
April 1.

[1] *Astrophys. J.*, **62**, 84; 1925.
[2] *Ind. J. Phys.*, **6**, 595; 1931.

Swarming of Collembola in England

THE swarming of certain species of Collembola has been previously noted in Europe by several authors, notably Nicolet,[1] Löw,[2] Linnaniemi,[3] Latzel,[4] and Handschin,[5] and more recently J. M. Brown,[6] in a paper in the *Naturalist* for 1921, recorded several instances of this occurring in the north of England. The species in which he observed this phenomenon were *Podura aquatica* L., *Hypogastura viatica* (Tullb.), *Hypogastura purpurescens* (Lubb.), *Anurida maritima* Lab., *Isotomurus palustris* (Mull.), *Sminthurides malmgreni* var. *elegantula* Reut., *Sminthurinus aureus* var. *ochropus* Reut. All except the *Sminthurinus* and *Hypogastura purpurescens*, which were found on an old stone wall, are recorded as occurring on water.

In January this year I found two instances of the swarming of *Onychiurus armatus* (Tullb.). On Dec. 4, 1931, considerable numbers, mostly of the adult form of the species, were noted in a heap of dead leaves in a garden in Balham. By Jan. 18, 1932, the numbers