LETTERS TO THE EDITOR

Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the twentieth of the preceding month; for the second issue, the fifth of the month. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

Communications should not in general exceed 600 words in length.

On the Rotation-Vibration Spectrum of Acetylene in the Photographic Infrared

We have reinvestigated the absorption spectrum of C_2H_2 in the photographic infrared in order to obtain more information about the rotational and vibrational structure of this molecule. Using an absorbing length of 16.5 m and pressures up to 1.6 atmos., we have found 9 new absorption bands and in connection with that have remeasured some bands which were formerly incompletely known. Table I gives the wave-lengths and the wave numbers of the origins of the newly found bands as well as their probable interpretation following the scheme recently proposed by Herzberg and Spinks.[1] Two very weak bands have been added in parentheses, which, because of bad overlapping involve some uncertainty. As is well known C_2H_2 is a *linear* polyatomic molecule. It therefore shows $\parallel$ and $\perp$ bands depending on the direction of the oscillations of the dipole moment. The $\parallel$ bands have P and R branches only, whereas the $\perp$ bands have in addition one strong Q branch. Three of our new bands show Q branches and are therefore $\perp$ bands. For two of these, however, only the heads of the Q branches have been measured so far on account of their weakness. The third $\perp$ band which could be completely resolved and measured is rather interesting because from it information may be derived about the doubling of the degenerate upper state. This, according to theory,[2] is expected to be similar to the Λ-type doubling of diatomic molecules. We in fact found a slight but definite doubling which increases proportionally to $J(J+1)$ as does also Λ-doubling. The difference is that in this case the doubling originates not in an electronic but in a vibrational degeneracy.

Two or possibly three of the new bands (9801.7 cm^{-1} 12,618.4 cm^{-1} (11,591.0 cm^{-1})) do not show the usual alternation of intensities. In order to explain this the same assumption has been made as was advanced by Herzberg and Spinks for the band at 10,410A; namely, that both in the upper and in the lower state the transverse vibration ν_5 is excited. Then both the upper and the lower states are degenerate for zero rotation. If the splitting occurring at higher rotations is small then no intensity alternation should occur. This is quite analogous to the case of Π–Π transitions of diatomic homonuclear molecules. In order to test this assumption we have made exposures with the absorption tube imbedded in solid carbon dioxide. At the corresponding temperature (−80°C) the percentage of molecules excited to the first vibrational state (ν_5) is greatly diminished. In fact we found as is to be expected on the above assumption, that the band 10,410A disappeared completely, whereas the bands *with* alternating intensities did not change their total intensities.

TABLE I.

λ(A)	ν(cm^{-1})	INTERPRETATION	TYPE	
11007	9085	$\nu_1+\nu_2+\nu_3+\nu_5$	$\perp$	Q only
10924	9151.7	$3\nu_1+\nu_3$	$\parallel$	
10677	9366	$2\nu_1+\nu_2+3\nu_4$?	$\perp$	Q only
10202	9801.7	$2\nu_2+\nu_3+\nu_5-\nu_5$	$\parallel$	
9645	10364.8	$\nu_2+2\nu_3+\nu_4$	$\perp$	*
8640	11570.8	$2\nu_1+2\nu_2+\nu_4+\nu_5$	$\parallel$	
(8625	11591.0	$\nu_1+3\nu_3+\nu_5-\nu_5$)	$\parallel$	
(8614	11605.0)	?	$\parallel$	
7923	12618.4	$\nu_2+3\nu_3+\nu_5-\nu_5$	$\parallel$	
7865	12710.7	$\nu_1+3\nu_3+2\nu_5$	$\parallel$	**
7671	13033.3	$3\nu_2+\nu_3$	$\parallel$	
6839	14617.0	$\nu_1+\nu_2+3\nu_3$	$\parallel$	

* The occurrence of this band has previously been noted by K. Hedfeld and P. Lueg (Zeits. f. Physik **77**, 446 (1932)) but was not measured by them. R. Mecke in his report (Hand- and Jahrbuch d. Chem. Phys. **9**, II (1934)) mentions that it is a $\perp$ band though he, too, gives no data.

** This band has already been found by C. A. Bradley and A. McKellar, Phys. Rev. **47**, 914 (1935) who have given a slightly different origin.

The experimental work was carried out at the Physikalisches Institut der Technischen Hochschule Darmstadt, Germany. Our thanks are due to the Agfa firm which generously supplied us with its excellent new infrared plates.

GÖSTA W. FUNKE
Department of Physics,
University of Stockholm, Sweden.

GERHARD HERZBERG
Department of Physics,
University of Saskatchewan, Canada,
December 9, 1935.

---

[1] G. Herzberg and J. W. T. Spinks, Zeits. f. Physik **91**, 386 (1934).

[2] Cf. D. M. Dennison, Rev. Mod. Phys. **3**, 280 (1931); R. S. Milliken, Phys. Rev. **42**, 364 (1932).

Alpha-Particle Yield from Lithium under Proton Bombardment

Cockcroft and Walton,[1] Henderson,[2] and Oliphant and Rutherford[3] have studied the yield of 8.5-cm alpha-particles from lithium under proton bombardment. The results of these studies have been interpreted as indicating that the probability of disintegration of Li^7 tends to become constant for proton energies around 400 kv. More recently Herb, Parkinson and Kerst[4] have measured the yield from both thick and thin films of lithium at voltages ranging from 70 to 400 kv. Their results indicate that the disintegration probability increases practically uniformly between 200 and 400 kv, with no appreciable tendency toward a constant value in this range. Further, the thick film yield of the latter observers is of the order of ten times that reported by Cockcroft and Walton around 400 kv. Also Hafstad and Tuve,[5] using thin films, have determined the excitation function of the disintegration in question at voltages up to above 1000 kv, and found that the probability increases continually in the observed