I am in complete agreement with the opinion expressed by Wheeler and Jaswon[18] that the main factor causing the broadening of the lines is the internal stress; the same view has been held for some years by a number of Continental workers (Dutch, French and Polish).

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New Method of Excitation of the Cometary Emission Bands at 4050 A.

UP to the present, two methods have been chiefly used for observing in the laboratory the 'cometary emission bands' at 4050 A. assigned to CH_2. Herzberg[1], who was the first to excite these bands, used an interrupted discharge through methane, and Herman[2] succeeded in photographing the bands with higher dispersion, using a discharge between carbon rods in an atmosphere of hydrogen diluted with a rare gas. The presence of the 4050 group was also reported in an ordinary discharge through diazomethane and ketene by Goldfinger, Le Goff and Letort[3]. No analysis of the bands has hitherto been attempted.

In order to undertake a more detailed study of these bands, we have developed a new method of excitation. We have used a graphite hollow cathode, operating at 500–1,000 V. with an intensity of about 200 m.amp. The 4050 group is strongly emitted in the hollow cathode discharge through various hydrocarbons (toluene, benzene, methane, even ordinary motor-oil), but it has been also possible to obtain a strong emission in pure hydrogen; this is of particular interest because it promises to give some valuable information concerning the molecules responsible and the conditions of their formation.

We have succeeded in photographing the main bands in an exposure of six hours with a 4·5 prism spectrograph in Littrow mounting giving a dispersion of 1·6 A./mm. at 4000 A. Even so, the resolution of the bands is far from being complete, but a well-developed Q-branch points to a convergency at 4051·4 ± 0·1 A. This origin corresponds approximately to the position of the strongest band of the group observed in cometary emission. Within the same band a relatively strong head measured at 4049·95 A. corresponds to another feature reported in certain cometary spectra. This last value corresponds also to the position of the head of the main band observed with smaller dispersion in the laboratory.

In the present stage of our investigation, it seems difficult to assume that the CH_2 radical is responsible for the band at 4051·4 A. Indeed, the moment of inertia deduced from the observed fine structure indicates a much heavier molecule.

It is worth while noticing, however, that in the spectra of some comets this band seems to have a behaviour different from the other bands of the same group. Therefore, the possibility of assigning it to a different molecule cannot be excluded.

We are now engaged in a more complete analysis of the whole system and in a study of the conditions of formation of the molecule responsible for it. We are also attempting to excite the corresponding bands in heavy hydrogen.

A full account of this work will be published elsewhere.

Note added in proof. The 4050 group excited in a graphite hollow cathode operating in deuterium showed no noticeable shift of the bands with respect to those excited in hydrogen. This is a new argument against their assignment to CH_2.

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Quantum Mechanics of Canonical Field Variables

WITH the assumption that space is quantized according to the recent theory of Snyder[1] and Flint[2,3], the Fourier resolution of the vacuum electromagnetic field is not valid. Let us assume, however, that the field within a large cube is still describable in terms of an enumerable set of conjugate pairs of variables, q_λ and p_λ. In classical theory, there is a strong analogy between the q_λ and p_λ and the independent Cartesian co-ordinates and momenta of a set of particles each with one degree of freedom. Let us therefore assume further that the eigen-values of the q_λ are integral multiples of a small constant α, that those of the p_λ are continuous and, by analogy with Snyder's commutation relations together with the usual rule of quantum mechanics that variables belonging to different particles commute, that the commutation relations for the field are:

$$\left.\begin{aligned}[q_\lambda, q_\mu] &= 0,\\ [p_\lambda, p_\mu] &= 0,\\ [q_\lambda, p_\mu] &= i\hbar\{1 + \left(\frac{\alpha}{\hbar}\right)^2 p_\lambda p_\mu\}\,\delta_{\lambda\mu}.\end{aligned}\right\} \quad (1)$$

The solution for q_λ in a p-representation is

$$q_\lambda = i\hbar\left\{1 + \left(\frac{\alpha}{\hbar}\right)^2 p_\lambda{}^2\right\}\frac{\partial}{\partial p_\lambda}. \quad (2)$$

One may set up a Hamiltonian operator for the λ'th oscillator as in the Jordan–Pauli theory, the orders of non-commuting factors being chosen so as to avoid an infinite zero-point energy; and with the use of (2) and the omission of a term in α^4, one obtains the wave equation