

## LETTERS TO THE EDITOR

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## RAMAN X-RAY REFLECTIONS IN DIAMOND

THE work of Sir C. V. Raman and his collaborators has definitely shown that the second kind of monochromatic X-ray reflections given by the lattice planes of a crystal represent the X-ray analogue of the well-known Raman effect observed in light scattering. The appearance of these Raman reflections from the (111) planes of a diamond crystal belonging to the normal variety were discussed theoretically by the present writer in a previous paper.<sup>1</sup> The conclusions of that paper are in complete agreement with the observations of Raman and Nilakantan made in this laboratory and also those of Lonsdale and Smith<sup>2</sup> made at the Royal Institution.

In a recent letter<sup>3</sup> to *Science and Culture* Sirkar and Bishui have raised a few points regarding that theory. They believe that the assumption of the existence of continuously varying long wave-lengths for the infra-red vibrations of the crystal lattice is inadmissible. However, if one remembers that the strong coupling between the various atoms of a diamond lattice would prevent any appreciable variation of phase between the oscilla-

tions of two neighbouring cells, it is easy to realise the necessity of the phase wave-lengths of the oscillations being *very large* compared to the lattice spacing.

Another point raised by these authors is that the theoretically predicted symmetrical cross, with the Bragg reflection at its middle for the setting  $\theta_i = \theta_b$  is absent with some specimens. The accompanying picture taken by Dr. Nilakantan before the publication of the theory shows the cross clearly. The intense photographic halation at the correct Bragg setting has necessitated a considerable reduction in the exposure so that the full length of the streamers is not recorded. The absence of these

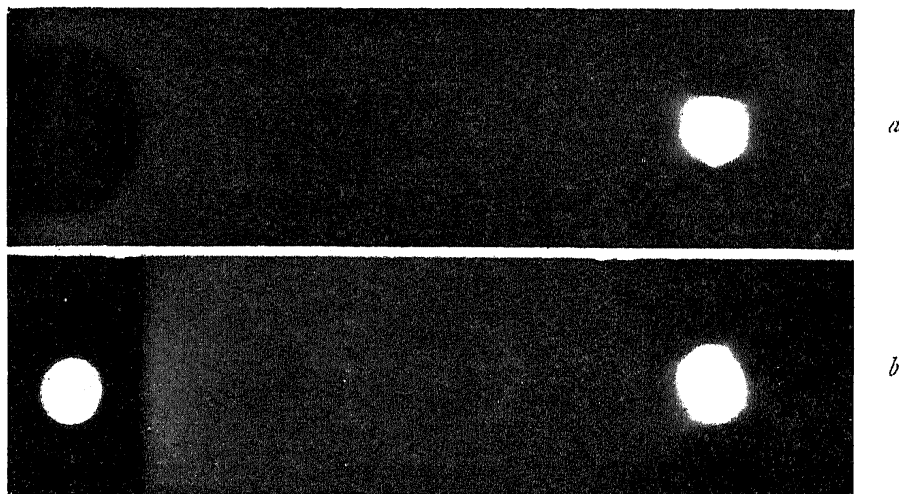


FIG. 1

subsidiary phenomena in the rare type of diamond has been explained by the present

writer and Subrahmanian<sup>4</sup> to be due to its mosaic structure and the consequent lack of co-operation between the lattice planes of the different mosaic blocks.

Thirdly Sirkar and Bishui report that the Raman reflection for the setting  $\theta_i < \theta_n$  appears as a diffuse triangular spot with its apex towards the Laue spot and not circular as required by the theory. The five pictures published in the *Proc. Ind. Acad. Sci., A*, Vol. XIV, Plate XVII, Figs. 5 g, h, i, j, k show the circular spots demanded by the theory.

The original and later theories of Zachariassen<sup>5, 6</sup> give half-breadths for these Raman reflections which should be of order of the missetting ( $\theta_i \sim \theta_n$ ) when this is more than 1 or 2°. The accompanying pictures are taken with a narrow slit 0.2 mm. wide, 5 mm. high and 130 mm. deep and a diamond plate 4 mm. × 7 mm. × 0.76 mm. The Raman reflections take place from the (111) plane of the crystal, ( $\theta_i - \theta_n$ ) being +4°42' and +1°35' for the two figures (a) and (b) respectively.

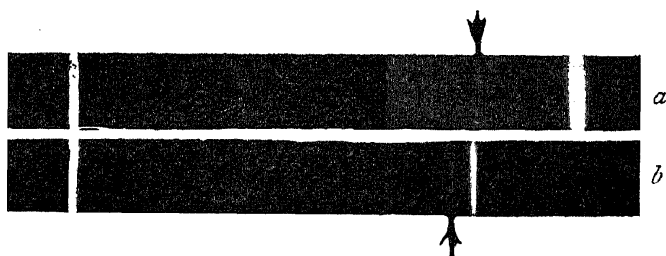


FIG. 2

The sharpness of the reflections clearly shows how Zachariassen's theories are totally inadequate to explain the facts.

The sharpness of these Raman reflections has been emphasised by the Royal Institution workers also.<sup>7</sup> But they avoid the inevitable conclusion as to the specular character of the new phenomenon by calling these reflections as "secondary phenomena", on the basis that they are absent in mosaic crystals of diamond, in spite of the fact that these Raman reflections are far more intense than the weak diffuse effect they have observed and which they prefer to call the 'primary'. The absence of the Raman reflections in the mosaic type of diamond simply shows the very high degree of coherence necessary between the secondary

radiations from the various individual atoms to make the new phenomenon observable with crystals having large binding forces.

The diffuse effect itself can be accounted for as due to the super-lattice oscillations described and employed in a recent symposium on the Thermal Energy of Crystalline Solids.<sup>8</sup>

Details of this will be published later.

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<sup>1</sup> Pisharoty, *Proc. Ind. Acad. Sci.*, 1941, **14**, 56.

<sup>2</sup> Lonsdale and Smith, *Proc. Roy. Soc., Lond.*, 1941, **179**, 8.

<sup>3</sup> Sirkar and Bishui, *Sci. and Culture*, 1941, **7**, 314.

<sup>4</sup> Pisharoty and Subrahmanian, *Proc. Ind. Acad. Sci.*, 1941, **14**, 439.

<sup>5</sup> Zachariassen, *Phys. Rev.*, 1940, **57**, 597.

<sup>6</sup> —, *Ibid.*, 1941, **59**, 860.

<sup>7</sup> Lonsdale and Smith, *Nature*, 1941, **148**, 112 and *Phys. Rev.*, 1941, **60**, 617.

<sup>8</sup> Raman, Norris, Anand, Dayal, Venkateswaran, *Proc. Ind. Acad. Sci.*, 1941, **14**, 459-515.

## ADSORPTION AND DISPLAY OF COLOURS

WHEN activated alumina gel is dropped into a mixture of benzene and carbon tetrachloride, the white gel becomes jet black, whereas with either benzene or carbon tetrachloride, the gel develops no such colour. This extremely interesting phenomenon, briefly indicated in a former communication,<sup>1</sup> is found to be of a general character, as revealed by further investigations.

Sulphate in alumina has an important role in this effect. Alumina gel<sup>1</sup> prepared from aluminium sulphate was found to contain some sulphate in it, in spite of prolonged washing. Such a gel, after activation, always showed the colour effect. Gel prepared from aluminium nitrate showed not a trace of the colour. On soaking the above gel in ammonium sulphate