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Raman Spectrum of Diamond
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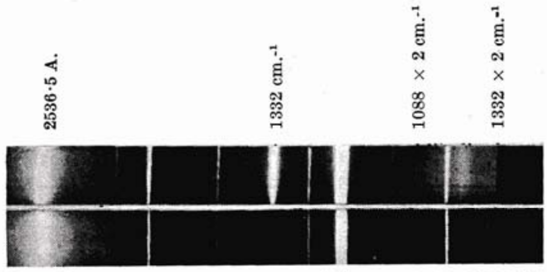
THE new approach to the dynamics of crystal lattices made by Sir C. V. Raman[1] leads in the case of diamond to the result[2,3] that the atomic vibration spectrum of this crystal should exhibit *eight* distinct monochromatic frequencies. Of these, the highest frequency (1,332 cm.$^{-1}$ in spectroscopic units) corresponds to the triply degenerate vibration of the two Bravais lattices of the carbon atoms with respect to each other, this being *active* in the Raman effect. The other seven frequencies represent oscillations of the layers of carbon atoms parallel to the faces of the octahedron or the cube occurring normal or tangential to these planes with the phase reversed at each successive equivalent layer. All the seven modes of vibration of this description are *inactive* in the Raman effect as fundamentals. The *octaves* of these frequencies may, however, appear as frequency shifts in the Raman spectrum, though with intensities extremely small compared with that of the Raman line of frequency shift 1,332 cm.$^{-1}$. Besides the octaves, various combinations of these frequencies may also appear in the Raman spectrum.

The new lattice dynamics thus predicts that besides the frequency shift of 1,332 cm.$^{-1}$ corresponding to the so-called principal or fundamental oscillation, numerous other frequency shifts appearing as sharply defined lines should manifest themselves in intensely exposed Raman spectra of diamond. This result has been strikingly confirmed in an investigation already reported by me[4]. Since then, I have recorded spectra of much greater intensity and much better resolved, with the aid of a large quartz spectrograph and an exceptionally large plate of diamond of the ultra-violet transparent type recently acquired by Sir C. V. Raman. Under the conditions employed and using the 2536·5 A. resonance radiation from a water-cooled magnet-deflected mercury arc in quartz as the exciter, the Raman line with frequency shift of 1,332 cm.$^{-1}$ is recorded with an exposure of only two minutes. With an exposure of 72 hours, a satisfactory picture showing what may be designated as the Raman spectrum of the *second order* is obtained. This is the upper spectrum shown in the reproduction herewith, the lower spectrum being that of the mercury arc recorded with comparable intensity. It will be noticed that a whole series of discrete Raman lines appear in the former, which stand out on a feebler background evidently made up of unresolved combinational frequency shifts.



Above, RAMAN SPECTRUM OF DIAMOND ; below, MERCURY SPECTRUM.

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[2] Bhagavantam, S., *Proc. Ind. Acad. Sci.*, A, **18**, 251 (1943).
[3] Chelam, E. V., *Proc. Ind. Acad. Sci.*, A, **18**, 334 (1943).
[4] Krishnan, R. S., *Proc. Ind. Acad. Sci.*, A, **19**, 216 (1944).