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Polarisation of scattered light-quanta

It is well known from the work of Barkla, Compton and others that X-rays scattered through 90° by matter are completely polarised, irrespective of whether the electron remains bound or suffers ejection from the atom as the result of the impact of the quantum upon it. The recent discovery of a new type of light scattering with altered frequency (*Nature*, May 5, p. 711) makes it of importance to ascertain whether a light-quantum which is scattered with diminished energy is less perfectly polarised than in the ordinary case.

We have investigated this question with several liquids by analysing the scattered light with a spectrograph having a suitably orientated Nicol placed in front of its slit. The results obtained are extraordinarily interesting, as will be seen from figure 1. Figure 1(*b*) represents the spectrum of the incident light from the mercury arc. Figure 1(*a*) represents the spectrum of the scattered light from liquid benzene, the upper and lower halves of the spectrogram corresponding respectively to the two principal directions of vibration. It is seen that some of the new lines which appear only in the scattered spectrum are actually polarised much more completely than the lines present in the incident spectrum. Further, the degree of polarisation varies greatly from line to line, some of the new lines being strongly polarised, others only very partially so. So large are the differences in polarisation that the relative intensity of the lines is quite different in the upper and lower halves of the spectrogram. In the case of amyl alcohol as well

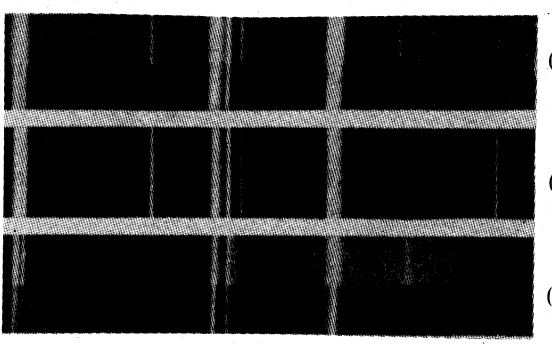

Figure 1

(Figure 1(*c*)) the new lines in the scattered spectrum are polarised to varying extents, and the continuous radiation appearing in it is also partially polarised.

The strong polarisation of the modified light scattering is intelligible in view of the analogy with the Compton effect. Since the different modified lines represent different electronic transitions induced in the molecule by the incident radiation, the varying extents of their polarisation may be interpreted as due to the optical anisotropy of the molecule being very different for different types of deformation. That some of the intense modified lines are polarised even more strongly than the unmodified lines need not occasion surprise, if we remember that the classical light scattering in a liquid is much less perfectly polarised than the scattering by the molecules of the corresponding vapour. If we assume that the modified scattering is an incoherent type of radiation, we should expect its intensity to be proportional to the density of the fluid, and its polarisation to be comparable with that of the classical scattering in the corresponding *vapour* (not liquid). These expectations appear to be not very far from the truth.

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