

appeared in recent times. Cohen and Dijkgraaf deal with mechano-reception followed by Barber on Chemoreception and thermoreception. Advances in the field of pigmentary effector system are discussed in a brilliant chapter by Kleinholz. Newton Harvey surveys the subject of light production. Wiersma contributes the next two chapters on neuro muscular system and the central nervous system. Discussion of neurohumours and neurosecretion in crustacea by Welsh follows. Lochhead deals with crustacean locomotion while Kinetic and Tactic responses form a chapter by Pardi and Papi. Physiological rhythms of crustacea, migration of various kinds and complex behaviour are reviewed in three chapters by Brown, Bainbridge and Schone respectively. The final chapter of the series is on comparative physiology by Waterman which is again an admirable review of problems of comparative physiology as applied to crustacea. In this chapter the author attempts the difficult task of comparing

crustacean physiology with that of other animal groups and has endeavoured to present certain concepts of evolutionary relationships amongst the different orders of crustacea. There is also an indication of lines of further research which might be profitable and throw light on aspects in which our knowledge is hopelessly incomplete.

These two volumes present the combined efforts of many distinguished zoologists who have worked on crustacea, and whose labours have made possible such a comprehensive approach to this group. Prof. Waterman's leadership in this effort has earned the gratitude of all zoologists, both laboratory and field workers, for this most valuable work. The Academic Press is to be congratulated on the production of these volumes which should be in the hands of every student of crustacea and of comparative physiology for many years to come.

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## LATTICE-TYPE VIBRATIONS IN ASSOCIATED LIQUIDS AND RAMAN EFFECT

IT is well known that in the spectrum of the Raman Effect in liquids even when strictly monochromatic light is used under ideal experimental conditions, the incident, or Rayleigh, line is always accompanied by a continuum which extends to several angstroms on either side of it. The origin of these Rayleigh 'wings', as they are called, has been the subject of many previous studies. In unassociated liquids and their corresponding solids, rotation of the molecules should give rise to broad wings on either side of the exciting line, the broadness of these wings depending on the rotational constant and the temperature, and in general being less than  $100 \text{ cm}^{-1}$  for all but very light molecules.

In associated liquids and solids although rotations of molecules may still occur, the major cause of the Rayleigh wings probably arises from excitation of the optical modes of an associated or lattice-like structure. Such excitation of the optical modes may give rise to both a first- and a second-order Raman effect, the frequency maximum of the former corresponding to the optical frequency observed in the infra-red while the second-order Raman effect will extend out to nearly twice this frequency.

In the case of highly associated liquids, excitation of the optical branch of the quasi-lattice-

like structure has not been reported previously. In a note to *Nature* (1961, 192, 1061) J. K. Wilmshurst reports his observations on the low-frequency infra-red spectra of some highly associated liquids and their corresponding solids; e.g., water, aqueous lithium nitrate, fused lithium nitrate, chlorate and hydroxide, and fused sodium nitrate and hydroxide.

The one-angle reflection technique was used to obtain the low-frequency spectra, and the optical constants in the  $200\text{--}1000 \text{ cm}^{-1}$  region have been calculated in the above cases by suitable analysis. These results show that the intense band in the low-frequency region studied can be assigned in every case to the excitation of the optical branch of a quasi-lattice, and the frequency of this band suggests that the Raman effect should show broad wings out to  $400\text{--}900 \text{ cm}^{-1}$  in fused salts, and  $\sim 1600 \text{ cm}^{-1}$  in aqueous solutions, consistent with the Raman spectra observations.

It would be of interest to study the anomalous Rayleigh wings more fully in highly associated liquids. In this direction the 'laser' giving an intense monochromatic light source with no spurious arc continuum, should be ideal as a Raman source and should certainly clarify this question.