

band in the spectrum of the fire-fly. Fig. 3 is an enlarged reproduction of the spectrum.

The glow-worm was not seen to emit any light by day even when observed in a dark room. Even at

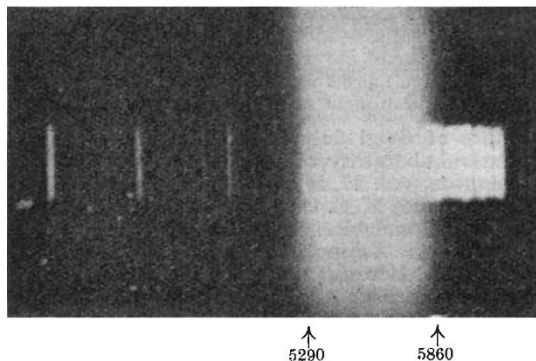


FIG. 3.—Spectrum of light from a glow-worm with a comparison spectrum (neon).

night the emission is not continuous. The worm can apparently do this at will. Slight irritation or shaking seems to make it well disposed to glow very brilliantly.

L. A. RAMDAS.

L. P. VENKITESHWARAN.

¹ H. E. Ives, "The Fire-fly as an Illuminant", *Journal of the Franklin Institute*, vol. 194, p. 213; 1922.

The Viscosity of Liquids.

IN NATURE for April 12, 1930, Prof. E. N. da C. Andrade states his theory of the viscosity of liquids as based upon "a temporary union of molecules in contiguous layers". This theory has been proposed in order to account for the temperature variation of the coefficient of viscosity in liquids, which is opposite in sign to that of gases. The nature of viscosity must be importantly different in a liquid and a gas.

It is the purpose of this brief letter to direct attention to the agreement of the theory of Prof. Andrade with the conception of the nature of the liquid state which arises from X-ray diffraction studies of various liquids. It is common for physicists to regard a liquid from the point of view of the nature of a gas, although in practically every kind of physical measurement except fluidity the liquid is more like the crystalline than the gaseous state, and even this exception is more apparent than real. The X-ray experiments have shown that there is coherent diffraction in liquids analogous to that in a crystal. Instead of sharply defined periodicities of structure in liquids there are found bands of periodicities. There is molecular arrangement caused by the molecular fields which cannot be accounted for by the existence of that portion of the field which has the effect of a shape or volume. This somewhat orderly arrangement of molecules is unstable; the distance of molecular separation is a matter of probability. At any instant there are spots throughout the liquid where the molecules have a more orderly arrangement which fades off into one of much less regularity. These spots or groups are not merely instantaneous, for periodicity occurs frequently in more than one direction—indeed, sometimes it is detectable in three, but there is also a constant change occurring in the constituents of a periodic region. This structure of a liquid is not crystalline. A word is needed, and I have suggested 'cybotaxis' as indicative of space arrangement.

No. 3234, Vol. 128]

Now the theory of Prof. Andrade postulates a duration of the 'temporary union' of molecules which does not exceed the very brief time for the molecules to acquire a common velocity of translation. Obviously the cybotactic condition is not described precisely in this manner, but the theory of Andrade may be said to represent one aspect, and may therefore be said to be to this extent in harmony with the cybotactic conception of liquid structure.

According to my own view, in these well-ordered spots or groups the slippage of one layer past the other is hindered by the molecular fields, and hence the larger or more perfect these groups the greater the viscosity of the liquid. This view is borne out by an examination of 22 octyl alcohols. Here a definite correlation has been found between the perfection of the orderly arrangement and the viscosity. The results are shortly to be published. It is clear that the effect of rising temperature would be to reduce the extent of a well-ordered group, and hence to decrease the viscosity.

It would seem therefore that X-ray diffraction experiments indicate strongly that Andrade's theory is in the correct direction, though not yet developed in accordance with my interpretation of the periodicities clearly evidenced by X-rays.

G. W. STEWART.

University of Iowa,
Iowa City, Iowa.

Nature of Viruses.

READING General Smuts's presidential address to the British Association and listening to a sectional discussion on the nature of viruses, I have been wondering whether the following will satisfy those who find great difficulty in believing that things so small as the agent of foot-and-mouth disease or the bacteriophage can be live organisms. General Smuts says that the world is constructed on a biological plan, that it is made up of events, and that matter, life, and mind are three grades of the same thing. In common thought, inorganic phenomena are quantitatively related to the matter with which they are associated. Mind, on the other hand, has no perceptible quantitative relations. Life would be generally considered to be quantitatively related either (by the mechanist) to living matter or (by the organicist) to living organisms. But need this always be so? Cannot life sometimes or partly be more like mind, so that the events of life are quantitatively out of proportion to the perceptible matter involved?

A. E. BOYCOTT.

Radlett, Oct. 4.

Spin of Light Quanta.

[BY RADIOGRAM.]

THE possession by photons of intrinsic angular momentum is further strikingly confirmed by investigations of light scattering in liquids. The spin theory indicates diminution of rotational scattering to half the value given by classical considerations. Spectroscopic measurements of the depolarisation of scattered light, using broad and fine slits, furnish a convenient test. Observations by Venkateswaran with carbon disulphide and benzene liquids quantitatively confirm the predicted results.

C. V. RAMAN.
S. BHAGAVANTAM.

210 Bowbazar Street,
Calcutta, Oct. 12.