

appears so that it appears to be due to the presence of water. The phenomenon is very widespread, being noticeable with almost any white salt. It is not confined to those salts which are appreciably soluble in water; silica, for example, showing the effect to a marked degree (this possibly accounts for the blue triboluminescence seen, for example, at the heels of a runner on wet sands at night).

In most cases there is also a phosphorescence lasting for some seconds after the extinction of the exciting light. The spectrum, seen in a small direct vision spectroscopy, appears to consist of a broad band with its maximum in the green at about 5500 Å. The colour of the luminescence with various salts is always some shade of blue varying from whitish blue to Italian sky blue, suggesting a variation in the spectral distribution in different salts.

This phenomenon had a special interest for me in the light of other work recently carried out on the nature of the luminescent centre. It has now been established by a number of workers in this field that the luminescence of inorganic salts is due to the presence in solid solution of a trace of an activator, for example, bismuth in calcium sulphide. It has been shown by me (preliminary communication to the *Proceedings of the Leeds Phil. Soc.*, January 1929) that the relation between the brightness of luminescence and the atomic or molecular concentration of the activator is quantitatively accounted for by the hypothesis that the luminescence is due to the existence of centres consisting of one molecule or atom of the activator associated in solid solution with a definite number of solute molecules. This leads to the relation  $I = A.c.e^{-nc}$ , where  $c$  is the molecular concentration of the activator and  $n$  is the number of molecules making up the luminescent centre. Thus the existence of an optimum concentration is accounted for at the concentration  $c = 1/n$ .

This relation has now been shown to be satisfied for various activators, bismuth, tin, lead, in calcium oxide, and also for uranin in aqueous solution. Thus a determination of the optimum concentration gives the size of the centre.

In the case of the luminescence activated by water, it was again observed that the brightness varied with the amount of water present, passing through an optimum or a number of optima. It therefore appears that this blue luminescence is due to the association of water with the solid salts to form centres of a definite composition.

Preliminary measurements on lithium fluoride show that there exist in this case two optima, corresponding to the existence of centres of the composition  $\text{LiF} \cdot \text{H}_2\text{O}$  and  $\text{LiF} \cdot 2\text{H}_2\text{O}$ . It is hoped that further quantitative work on the luminescence activated by water will throw light on the nature of the association of water with the salts which it activates. J. EWLES.

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#### Do Glass Tubes or Rods Bend under their own Weight?

LORD RAYLEIGH, in his letter published in *NATURE* of Mar. 1, directs attention to an experiment performed to answer the question, Do glass tubes or rods bend under their own weight? I have tried a similar experiment bearing on this subject, and the results may be of interest to readers of *NATURE*.

The belief is current that glass tubes and rods of about 1 m. length and 1 cm. diameter, standing on end, will bend permanently under their own weight. To test the idea a 110 cm. length of glass tubing, 1 cm. in

diameter and 1 mm. in wall thickness, was supported on horizontal supports 1 m. apart. The tube was loaded at the centre with a weight of 885 gm. This weight was just a little short of the average weight necessary to break a number of tubes of the same diameter and wall thickness, from the same lot of tubing. The percentage composition of the glass used was approximately as follows:— $\text{SiO}_2$ , 64;  $\text{Na}_2\text{O}$ , 8.5;  $\text{K}_2\text{O}$ , 5.5;  $\text{PbO}$ , 22.

Young's modulus for this glass is  $6400 \pm 100$  kgm./mm.<sup>2</sup> and the tensile strength is  $6.0 \pm 0.5$  kgm./mm.<sup>2</sup>. This experiment was started in March 1924. The tube selected was originally straight enough to roll on a flat surface. After the lapse of six years there is a permanent deformation (with the bending weight removed) of 9 mm. at the centre of the 110 cm. length.

Lord Rayleigh interprets the data obtained in his experiment as indicating that the permanent deformation (resulting from suspending a weight of 300 gm. at the centre of a metre length of glass rod 4.9 mm. in diameter, for seven years) was too small to measure. In the experiment that I have described a large permanent deformation has been observed, but in this case the glass tube was stressed almost to its breaking point. Both experiments lead to the same conclusion, that glass rods and tubes of mature age do not bend under their own weight.

May I suggest that the common belief that laboratory tubing and cane glass will become permanently bowed if stood on end for a year or more can be explained in the light of the following consideration. Until the introduction of the machine method for drawing tubing, about ten years ago, all tubing was produced by hand shops. Hand-produced tubing in lengths of 1 m. is never perfectly straight—some of it is in fact badly bowed. The individual sticks in a loose bundle of slightly bowed sticks of tubing, stood on end in the corner of a room or in a rack, will assume under the influence of vibrations and the occasional disturbances caused by withdrawing a stick from the bundle, a configuration strongly suggestive of permanent flow under gravitational force. This is especially true if straight sticks enjoy first choice.

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#### The Crystal Structure of White Phosphorus.

WHITE phosphorus crystallises in the cubic system. Previous attempts to determine its crystal structure by X-rays have not given positive results, notwithstanding its high symmetry. As a matter of fact, white phosphorus at room temperature gives, by the powder method, poor photographs, showing very few weak lines.

It has been also stated (H. Joung, *Centralblatt f. Min. u. Geol.*, 107; 1926) that X-ray researches on white phosphorus are impossible because of its transformation into the red modification by the action of X-rays.

We failed to observe any appreciable transformation under the action of X-rays of long wave-length, and have inferred that the difficulty of getting good photographs could be ascribed only to the imperfection of the crystals and to the remarkable thermal agitation of the atoms at a temperature approaching the melting point, similar to the behaviour of certain alkali metals, which give sharp interference lines only at temperatures much below their melting point.

We experimented by dipping a glass capillary,