were accompanied by a well defined PcP, although Fig. 1 demonstrates that the amplitude ratios may have great variability, probably due to conditions at the source and possibly at the point of reflexion. A very careful study of these effects is required before a precise determination of the density ratio at the inner core boundary, for example, can be made. But we feel certain that a sharp inner core boundary relative to short-period P waves has finally been established.

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Energy Content of Covington's Lightning Ball

COVINGTON's well documented sighting[1] of ball lightning involves a clear interaction of the lightning with familiar objects, in this case a wharf pile. I have estimated the energy released by the destruction of the pile as described by Covington. This estimate places a lower limit on the energy of the ball, when reasonable assumptions on the composition and size of the piling are made.

The pile is described as having been "shattered . . . into long splinters". Charring is not mentioned, and I assume it to have been minimal. If the detonation was produced by the rapid boiling of the water absorbed in the wood, the energy required to vaporize a sufficient amount of water to shatter the wood may be readily calculated.

Assuming that the specific heat of water is $4 \cdot 16 \times 10^7$ ergs g^{-1} °C^{-1} and that the latent heat of vaporization of water is $2 \cdot 02 \times 10^{10}$ ergs g^{-1}, it follows that $2 \cdot 35 \times 10^{10}$ ergs g^{-1} are needed to boil water in the piling which was initially at, say, 20° C.

If the log is to shatter as described by Covington, the pressure acting outwards on the surface of the log must exceed the tensile strength perpendicular to the grain of the wood. This tensile strength varies depending on the type of wood between 200 and 500 kg cm^{-2}. I assume the larger figure which is characteristic of oak[2]. To pressurize a cylinder D centimetres in diameter to a pressure S, equal to the tensile strength of the wood, it is necessary to vaporize a column of water of diameter d. This diameter may be calculated from the perfect gas law.

The volume of water vaporized is $\pi d^2 l/4$, where l is the length of the column. This produces $\pi d^2 l/4 \times 18$ moles of steam which expand to fill the volume of the log, $\pi D^2 l/4$. Thus the perfect gas law gives us

$$V = \pi D^2 l/4 = nRT/S = \left(\frac{\pi d^2 l}{72}\right)\frac{RT}{S} \qquad (1)$$

The diameter of the column is thus

$$d = \sqrt{\frac{18SD^2}{RT}} \qquad (2)$$

where T is taken to be 100° C.

The energy required to explode a 50 cm diameter log (per centimetre of log length) is thus

$$E' = 2 \cdot 35 \times 10^{10} \times \frac{\pi d^2}{4} = \frac{2 \cdot 35 \times 10^{10}\pi}{4}\left(\frac{18SD^2}{TR}\right) \qquad (3)$$

$$= 2 \cdot 35 \times 10^{10} \times \frac{\pi}{4} \times 0 \cdot 73 = 1 \cdot 3 \times 10^{10} \text{ erg cm}^{-1}.$$

To destroy one metre of such a log, an energy

$$E = 0 \cdot 13 \times 10^6 \text{ joule} \qquad (4)$$

is needed.

It is therefore reasonable to conclude that the lightning ball reported by Covington possessed an energy of at least 10^5 joules. This estimate is necessarily a lower limit, and I have explicitly assumed a 50 cm diameter oak piling. From the absence of a report of charred wood, I also assume that most of the energy of the ball was dissipated in heating the water held in the wood, and this prevented the temperature from rising above the ignition point of the wood. I have not attempted to estimate the energy dissipated in the lake.

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Formation of Two-dimensional Organic Polymers on a Mineral Surface

ALTHOUGH a great many examples of naturally occurring and synthetic inorganic sheet polymers are known[1,2], very little work has been done on their organic counterparts. Planar organic macromolecules have attracted a considerable amount of interest because of the unusual properties they are expected to possess, but they have proved difficult to synthesize and there is a distinct lack of information about their properties. Synthesis may be approached either by carrying out the polymerization at an interface[3,4], or on a surface[5,6], or by using a monomer which for steric reasons is constrained to polymerize in two dimensions[7]. The polymerization of methyl methacrylate adsorbed in the interlayers of montmorillonite by means of γ-rays has been studied by Blumstein[5]. The resulting interlayer polymer was resistant to the usual solvent extraction procedures and could be isolated only by dissolving out the silicate lattice with hydrofluoric acid, a treatment liable to damage most polymers. From the dilute solution properties of the polymer it was deduced that the interlayer polymethyl methacrylate developed a two-dimensional sheet structure when a cross-linking agent was present during the polymerization[8]. I report here the results of attempts to prepare organic sheet polymers on the surface of a synthetic calcium aluminate hydrate of composition $4CaO \cdot Al_2O_3 \cdot xH_2O$ (ref. 9). This mineral was selected because it can be made in a pure state, because it has a layer structure, and because it is capable of intercalating a wide range of organic materials[9] and is soluble in dilute hydrochloric acid.

To establish whether the mineral would form interlayer complexes with organic monomers, a small quantity (about 1 g) of the "dry" powder was contacted with excess liquid monomer at room temperature or at 50° C for varying periods of time, usually overnight. (The basal spacing of the mineral, dried over silica gel in vacuo at room temperature, was 7·9 Å corresponding to $x = 12$ in the