no case were any ice crystals detected either by the counter or by visual inspection of the residual cloud by light scattering.

Although these small cloud droplets ($< 20\ \mu$m) were not frozen by the passage of a shock wave, there remained the possibility that larger drops such as those present in the plume of Old Faithful might have been more sensitive to shock, particularly because it is well established that large drops are more readily shattered[7]. We therefore carried out a series of experiments on drops 2 mm in diameter. We first established by high speed photography that, at room temperature, 2 mm drops are disintegrated by 130 mbar shock waves into myriads of smaller droplets within a few milliseconds of the passage of the shock front. A dish of oil placed 20 cm below a particular drop collected about 250 water droplets per cm^2, the largest droplets being about 250 μm.

To determine the number of ice crystals generated by the blast, a drop was suspended 20 cm above the sampling aperture of the cold chamber on a chromel–alumel thermocouple previously cleaned by ignition to red heat. When the drop temperature reached the temperature of the chamber ($-10°$ C), the explosive was detonated as in the earlier experiments. The experiment was repeated several times but no ice crystals were detected by the counter, showing that, of the thousand or so droplets that entered the sample aperture, not one had frozen.

It is our conclusion that supercooled water is not induced to freeze either by the passage of a weak shock wave or by the mechanical disruption caused by an air blast. On the other hand, there is evidence that mechanical shock can induce freezing when the supercooled water is in contact with certain solid surfaces[8]. We have confirmed this by several experiments in which a drop of water sandwiched between films of 'Polythene' or 'Teflon' was exposed, at $-5°$ C, to a shock wave of the same intensity as used for the earlier experiments. In each case, the droplet was found after the explosion to be disrupted into many smaller droplets, each of which was frozen to an ice pellet. The same result was obtained when the sandwich was subjected to direct mechanical shock by striking it with a steel ball bearing, 0·125 inches in diameter, moving at 40 feet/s. The role of the hydrophobic solid surface in this type of shock nucleation is being investigated further.

It thus seems that only in the presence of certain solid surfaces does mechanical shock induce supercooled water to freeze and it is possible that, in the Old Faithful experiments, the few droplets which were frozen by the detonation were contaminated with suitable solid particles.

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Dust Precipitation

At a recent meeting of the Static Electrification Group of the Institute of Physics and the Physical Society[1], Dr M. Madden of the Central Electricity Generating Board described a method by which solid material is extracted from the flue gases of electricity generating stations. The system uses a number of stages of electrostatic precipitation and, although an overall efficiency of extraction of more than 99 per cent is achieved, much of the dust that escapes is extremely fine because the efficiency of the process falls off with reduced particle size.

Some time ago I was involved in a study of dust deposited on electronic circuits in a room where there was efficient air filtration down to 5 microns. I found that most of the material was of black (probably carbon) particles that had quite reasonably passed through the filters. It had, however, formed into a mat of material the basis of which was filamentary particles derived, I believe, from the clothes of personnel in the room. These larger particles consisted chiefly of man-made fibres, and had presumably acquired an electrical charge thus providing suitable agglomerate centres on which the finer particles could collect.

It seems reasonable to suggest that this phenomenon should be applied in a scavenging process in the filtering of gases containing very small particles by deliberately introducing comparatively coarse particles, suitably charged, into the gas stream, and removing these by a mechanical filter after they have collected the finer material by electrostatic attraction.

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[1] IPPS meeting, January 31, 1969.

Dr Madden writes: It has been known for some time that precipitation efficiencies increase if coarse particles are introduced. These larger particles tend to act as nucleation sites for agglomerates, which are more readily captured electrostatically than the individual fine particles. Further, when filter bags are used in gas cleaning plants, manufacturers have found that good collection efficiencies can be achieved for particles appreciably smaller than the pore sizes. This is attributed to static charges generated on the fabric fibres due to gas friction effects.

The efficiencies achieved on large generating stations are limited to 99·3 per cent by economic considerations. Precipitators can satisfactorily collect millimicron particles, but low effective migration velocities mean that large collector areas and costs are involved in the realization of very high extraction efficiencies.

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Secondary Flows associated with the Weissenberg Effect

Normal stresses cause some of the more vexing characteristics of flows involving non-Newtonian fluids. One manifestation of normal stresses is the appearance of rod climbing (the Weissenberg effect) in a system where a rotating shaft is immersed in a non-Newtonian fluid. Another manifestation is to reverse the sense of secondary flows (compared with the direction observed in flows with Newtonian fluids) near rotating spheres and cones (compare Giesekus[1]). Although the Weissenberg effect is presented in a number of treatises, for example, Coleman[2] and Fredrickson[3], the detailed structure of the flow has apparently not been reported. It is customary, moreover, to simplify mathematical analyses by assuming that the flow field in the space between rotating cylinders is the

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