Heteronucleation in Barium Sulphate Precipitation

By D. MEALOR and A. TOWNSHEND

(*Birmingham University, Birmingham,* 15)

THE results of some recent investigations of the precipitation of barium sulphate at low concentrations [1–4] have been explained by assuming that the nucleation process is heterogeneous, *i.e.*, it involves minute impurity particles. We have carried out experiments that show that this is undoubtedly so.

We investigated the effect of different sources of water, and of filtration of solutions through 0·1 μ pore size filters, on the concentration of barium sulphate particles* produced by mixing equal volumes of 0·012M-barium nitrate and sodium sulphate solutions. This concentration falls well within the region in which particle concentration does not vary with reagent concentration.[5,6]† Care was taken to eliminate ageing and stirring effects. The results are summarised in Table 1. Not only does the particle concentration vary with the source of the water, but tap water obviously contains some particles >0·1 μ in diameter that can act as heteronuclei.

The possibility of concentrating heteronuclei by gentle evaporation of the solution was studied by reducing the volumes of 0·006M-reactant solutions on a vacuum rotary evaporator at 50°. Table 2 shows the marked increases in particle concentrations compared to solutions of the same final concentration and volume that had been rotated but not evaporated. These increases cannot be ascribed to changes in reactant concentration, because of the independence of particle and

---

* Measured by conventional blood-cell counting techniques.

† The existence of this region was one of the facts that led to the heteronucleation hypothesis.

reactant concentrations. The increase arising from merely rotating the vessel is similar to that caused by vigorous stirring, and is assumed to arise from glass fragments introduced into the system, that can also act as heteronuclei.

The only reasonable explanation of these results is that the nucleation process involves heteroparticles, mostly $>0{\cdot}1\ \mu$ in diameter, in the water used to make up the solutions. The identity of these particles remains a matter for speculation.

TABLE I

Variation in particle concentration with water source

H_2O Source	Distilled from glass		Distilled from metal		Deionised tap	Tap	
Filtered	No	Yes	No	Yes	No	No	Yes
Particles ($\times 10^{-5}$) per ml.	**33**	**32**	**45**	**44**	**64**	**65**	**50**

TABLE II

Increase in particle concentration by concentrating the heteronuclei

	No. particles ($\times 10^{-5}$) per ml.				
Type of water	No R No E	Concentration factor	R No E	R E	Increase on evaporation
Distilled	33	2×	53	73	20
	33	3×	58	101	43
Tap	65	3×	76	148	72

(R = rotation on evaporator; E = evaporation.)

(*Received, November* 17*th*, 1965; *Com.* 719.)

[1] A. E. Nielsen, *Acta Chem. Scand.*, 1957, **11**, 1512.
[2] A. E. Nielsen, *Acta Chem. Scand.*, 1961, **15**, 441.
[3] A. G. Walton and T. Hlabse, *Talanta*, 1963, **10**, 601.
[4] D. H. Klein and B. Fontal, *Talanta*, 1964, **11**, 1231.
[5] R. A. Johnson and J. D. O'Rourke, *J. Amer. Chem. Soc.*, 1954, **76**, 2124.
[6] K. Takiyama, *Bull. Chem. Soc. Japan*, 1958, **31**, 944.