Although the number of rats used was small, the results confirm McCarrison's finding that the northern Indian diet is superior to both the Hindu diets. The poor Hindu diet is defective on all points ; and it is of interest to note that, judged by modern standards, the northern Indian diet is further capable of improvement.

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[1] McCarrison, *Nut. Abst. Rev.*, 2, 3 (1932-33).
[2] McCarrison, "Food", pp. 113-115 (Madras, 1931).

Solubility of Silica Dusts

THE industrial disease of silicosis has been postulated to have a relation to the dissolution of particles of mineral silicates in the lung. Whether this 'solubility theory' of silicosis be true, considerable interest is attached to the production of soluble silica from finely divided mineral dusts. The amount of silicic acid which a mineral form of silica will yield in solution is exceedingly small when it is present as crystals or as coarse fragments. But if it be reduced to a particle size of the order of the dust in the air (that is, < 1 to 10 microns) then the dissolution rate becomes appreciable.

In a recent paper, Emmons and Wilcox[1] gave figures for the silica dissolved from a number of mineral silicates. The method adopted in the study of the dissolution of these dusts is open to grave criticism. For the separation of the liquid phase (blood serum) from the solid (the powdered mineral) these workers relied on centrifugalization at 3,500 r.p.m. for fifteen minutes : the dusts having been exposed to the serum for two months at 37°. The total amount of silica in the supernatant fluid was determined by ashing an aliquot, following by gravimetric analysis.

The rate of sedimentation of particles depends on their shape ; a roughly spherical particle tends to settle more quickly than a fibrous particle, even though the particles be of approximately the same size. Centrifugalization at the modest speed of 3,500 r.p.m. for fifteen minutes will not completely remove fine particles of the size (1–10 μ) used by Emmons and Wilcox—particularly from a viscous fluid like blood serum ; and the extent to which they are removed will depend on the particle shape. It is notable that the figures showing the greatest percentage of silica dissolved are for fibrous minerals. Thus, in the results for human blood serum, sericite and asbestos give a much greater apparent 'solubility' than opal, quartz or cristabolite. In some cases, for example, that of quartz, which sediments rapidly, the results may approximate to the true solubility figure, but in others where the rate of sedimentation is low they are probably greatly in excess. If the results are expressed in terms of the mgm. SiO_2 contained in 100 c.c. of solution, then figures of 5·0 and 3·8 are found for quartz, a solubility figure in reasonable agreement with other published data. But the figures found for sericite, namely, 14·3 and 9·2, are very much higher than other recorded results. It is suggested that these results do not, in fact, represent the silicic acid in solution ; they represent the total amount of silica left in suspension, plus what small amount may be in solution. Only by high-speed centrifugalization, for example, 15,000 r.p.m. for forty-five minutes, is it possible completely to remove these particles from suspension.

A true measure of the amount of silicic acid which has gone into solution from a powdered mineral can be gained in two ways. The suspended material can be completely separated from the soluble, and the total silica in the separated liquid determined by gravimetric analysis ; or secondly, advantage can be taken of the fact that in certain chemical reactions only the silica present as silicic acid will take part. Such a reaction is represented by the well-known formation of silico-molybdic acid, a substance which imparts an intense yellow colour to its aqueous solution even when it is present only in minute amount.

Powdered amorphous or crystalline silica when freshly suspended in water gives no colour on the addition of molybdic acid, but does so after it has stood in contact with the water for some hours, that is, when some of the silica has passed into solution as silicic acid. The measurement of the intensity of the yellow colour (or of the blue colour in a refinement of the method where the silico-molybdic acid is reduced to a blue complex) furnishes a means by which the amount of silicic acid in solution can be estimated, the maximum part of the suspended material having been removed by filtration through very fine paper. Results obtained by this type of procedure probably show fairly accurately the actual soluble silica content of the solution. Such results will vary, of course, with the concentration of the dust and its degree of fineness, as well as with the type of mineral and liquid used. In the accompanying table are presented figures which are believed substantially to represent the rate at which silicic acid will pass into solution from a powdered mineral of a certain range of particle size when suspended at a given concentration in a liquid.

DISSOLUTION OF MINERAL DUSTS

(mgm. SiO_2 dissolved by 100 c.c. of liquid)

(1) 0·1 gm. of dust in 100 c.c. of 1 per cent sodium bicarbonate

Days at 37°	Quartz 20–40 μ	Quartz < 1–5 μ	Sericite Plate*	Sericite Fibrous*
1	0·71	0·70	0·32	0·51
3	0·97	1·65	0·39	0·57
5	1·02	2·08	0·32	0·62
8	1·20	2·74	0·46	0·78
Hours at 100°				
2	1·25	2·05	0·30	0·37
4	1·46	4·15	0·40	0·39
6	2·02	4·37	0·42	0·39

(2) 2 gm. dust in 100 c.c. acetic fluid at 37°

Days	Ppt'd. silica	Quartz	Kaolin	Mica
4	7·04	4·53	0·22	—
8	7·12	5·91	0·26	1·0
16		5·82	0·24	1·8

* Plates of sericite < 1–2·5 μ (few larger) ; fibres of sericite 1–10 μ in length by about 0·1–1 μ in width.

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[1] Emmons and Wilcox, *Amer. Mineral.* 22 256 (1937).