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Microscopic and X-Ray Investigations on Calcification of Tissue.

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An attempt has been made to determine exactly the nature of the solid inorganic phase in several types of calcified tissues, including normal bone, dental enamel, dentine, and in pathological conditions such as rachitis, salivary calculus and calcified tubercular lung tissue. Measurements were made of the mean index of refraction, n, by the oil immersion method of Becke as used by mineralogists in identifying rock constituents. The crystals present are too small to show characteristic cleavages or angles but are seen to be present in small particles apparently encased in a thin organic sheath of low refractive index. The smaller the relative amount of organic matter, the higher is the refractive index: dental enamel, which is the maximum of this group ($n = 1.62$), has only 1 or 2% of organic material. Thus the index of refraction may be taken as a measure of the degree of calcification. The following are typical values of refractive indices: human cheek-bone 1.561, dentine 1.577, enamel 1.625, rachitic rat bone 1.560, salivary calculus 1.563, and calcified lung 1.585, ± 0.003. The upper limit, 1.625, which comes the nearest to representing pure inorganic crystals, is practically the index of refraction of the minerals of the apatite series $3Ca_3(PO_4)_2 \cdot CaX_2$, where X_2 may be CO_3, O, $(OH)_2$, F_2 or SO_4. Typical minerals of this formula are fluorapatite, dahllite and podolite. We are, therefore, of the opinion that apart from the variability of X_2 the crystal phase is essentially the same in all the cases of calcification examined. No evidence was found for either $CaHPO_4.2H_2O$ or the so-called tri-calcium phosphate, $Ca_3(PO_4)_2$. The latter is unknown as a mineral and has never been prepared in a pure state in the laboratory.

X-ray diffraction patterns by the powder method were obtained for natural apatite (free from iron), and for dental enamel, normal bone, salivary calculus, tubercular calcified lung and synthetic "tri-calcium phosphate." The "tri-calcium phosphate" which we prepared had an index of refraction 1.628 and, therefore, is to be assigned to the apatite group. While there are minor differences, the patterns are very similar with respect to both position and intensity of lines. Thus they indicate similarity of crystal structure, corroborating the optical evidence.

We wish to emphasize the point that the conditions for precipitation in the bone and elsewhere will be governed by the solubility relations of these apatite minerals (such as $3Ca_3(PO_4)_2.CaCO_3$) rather than by $Ca_3(PO_4)_2$, to which much attention has hitherto been given.

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Antagonization of Anesthetic Effect of Magnesium Sulphate by Chlorides of Potassium, Rubidium and Sodium.

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Meltzer and Auer in 1905 reported that subcutaneous or intravenous injections of magnesium sulphate would completely anesthetize animals, and that they could be instantly and completely aroused from this anesthesia by intravenous injections of $CaCl_2$ but not by $SrCl_2$. They made no mention of the effects of the monovalent cations. In this series of experiments we have anesthetized rabbits intravenously with m/6 $MgSO_4$ (5.5 to 11.6 cc. per kg.) solution. The controls recover equilibrium and voluntary movements in 7 to 12 minutes. Eleven rabbits completely anesthetized with $MgSO_4$ recovered equilibrium and power of voluntary movement in from 30 seconds to 2 minutes when injected with a mixture of 9 volumes m/6 NaCl + 1 volume m/6 KCl; and 2 rabbits recovered in 30 seconds and 1¼ minutes respectively after receiving 20 cc. m/30 KCl alone. Two rabbits which received 20 and 25 cc. m/30 RbCl recovered in 1 minute and 1¾ minutes respectively. Rabbits also recovered when NaCl alone was used, but much larger amounts (30-40 cc. m/3 NaCl) had to be used, and the recovery obtained in 1¼ to 2 minutes was less complete than with potassium or rubidium for though the animals would sit up, they did not regain