direction of Professor Vern O. Knudsen, dean of the graduate division at Los Angeles. It is stated that research projects from other places are being carried out at the University of California. The work, however, is of a confidential nature and information regarding it is forbidden.

DISCUSSION

CARBONATE-APATITE AND HYDROXYL-APATITE IN URINARY CALCULI

CALCIUM phosphate often has been reported as a constituent of urinary calculi, but the specific phase or phases present have long remained unidentified. Recently, however, Jensen[1] has found that a substance designated by him as colloidal apatite occurs in many phosphatic calculi. We have examined a small collection of kidney and bladder calculi by x-ray diffraction and optical methods and have found 31 individual stones to be composed in part or entirety of carbonate-apatite (dahllite). Hydroxyl-apatite was identified in one stone, and its presence in small amounts was suspected in two other stones. No other calcium phosphates were found, but Jensen has reported brushite ($CaHPO_4 \cdot 2H_2O$) and whitlockite ($Ca_3(PO_4)_2$) in single instances. Carbonate-apatite, together with calcite, aragonite and vaterite B (μ–$CaCO_3$), has also been recognized by Phemister, Aronsohn and Pepensky[2] among the inorganic constituents of cholesterol gallstones.

Stones composed wholly of carbonate-apatite are relatively rare. Whewellite ($Ca_2O_4 \cdot H_2O$), weddellite ($CaC_2O_4 \cdot 2H_2O$) and especially struvite ($NH_4MgPO_4 \cdot 6H_2O$) are ordinarily present in greater or less proportion. Carbonate-apatite was not found in the five uric acid stones available for examination. Sufficient data are not yet at hand to warrant any conclusions as to the clinical significance of carbonate- and hydroxyl-apatite in urinary deposits.

The substances appear under the petrographic microscope as irregular grains with a banded or spherulitic structure. The material usually is colorless, pale yellow or brown. In some instances the color is deep reddish brown or an intense greenish yellow. The substances are sensibly isotropic, and the index of refraction varies widely both in different stones and in the same stone. The observed extremes in index are 1.520 and 1.605, but the usual range is 1.555–1.590 and the average value of all our measurements is about 1.575. The range in index between different layers in a single calculus is, on the whole, about 0.025, but may extend to as much as 0.04. The isotropic character is due to aggregate polarization in a mass composed of submicroscopic crystallites. The variation in index doubtless is due to variation in the content of adsorbed and capillary water. The material is not amorphous, as has been stated, and affords a distinct, although rather diffuse, x-ray powder pattern of the apatite type. It is interesting to note that the isotropic carbonate-fluor-apatite which forms the major constituent of fossil bone and teeth has in general a much higher range of indices. Rogers[3] found half of 250 measurements to lie between 1.600 and 1.610, with an overall range of 1.573 to 1.621. This difference must be due to the relatively large water content of the urinary deposits, since the macrocrystalline fluorine-containing apatites have in general lower indices than apatite members containing only hydroxyl.

A bladder stone composed of carbonate-apatite admixed with about 0.2 per cent. struvite was examined in some detail. The stone weighed 65 grams. A quantitative chemical analysis gave CO_2 5.50, Cl none, F none, H_2O lost at 110° 4.86, H_2O lost at 1000° 4.97 (total H_2O 9.83). The index of refraction largely ranged between 1.575 and 1.590. About three fourths of the total water content was lost by heating at 305° and the index increased to values in the range 1.595–1.605. The rest of the water was expelled by heating at 1000° C and the index increased to values between 1.635 and 1.655 with most grains about 1.643; this material was quite isotropic but gave a very sharply defined apatite-like x-ray pattern.

Hydroxyl-apatite can be distinguished from carbonate-apatite by the lack of effervescence in weak HCl. The test is conveniently made on crushed grains on a glass slide under moderate magnification. The indices of refraction are not diagnostic, as the slight differences in indices existing in macrocrystalline, birefringent samples are obscured by the large and variable content of non-essential water in the substances as they appear in isotropic urinary deposits. It should be emphasized that an isomorphous series in point of carbon content exists between the two compounds. The general formula may be written $Ca_6(OH)_2(P,C)_6O_{24}(Ca,C)_4$.

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THE SACRAL SPOT IN BENGAL

IN the summer of 1941, while engaged upon a serological study of a pair of fraternal Sindi twins in Calcutta, a faint discoloration was noticed on the

[1] A. T. Jensen, *Acta Chirurgica Scandinavica*, 84: 207, 1940.

[2] D. B. Phemister, H. G. Aronsohn and R. Pepensky, *Annals of Surgery*, 109: 161, 1939.

[3] A. F. Rogers, *Bull. Geol. Soc. Amer.*, 35: 535, 1924.