

XXIX., but these figures show rather the structure of the nodules themselves than the microstructure of the mineral. It may be seen from the figures that the manganese is disposed in fine concentric layers, marked off by black opaque or brown lines. The fine black undulatory zones may be recognised as having a concretionary arrangement even with high powers, as represented in Pl. XXIX. fig. 3. The appearance of nodules with many centres, and other peculiarities of structure, are well shown in many of the microscopic sections. In Pl. XXVIII. fig. 3 there are several centres of concretion, organic and inorganic—fragments of teeth, palagonite, and other volcanic rocks; the deposition has commenced around each of them, and they ultimately became united into a single nodule by successive layers of manganese. In Pl. XXIX. fig. 2 another concretion is represented containing several nuclei; near the upper part of the figure there is a section of a shark's tooth as one of the principal centres, and immediately below this another large nucleus consisting of a volcanic lapilli containing green augite and plagioclase. Pl. XXIX. fig. 4 shows again the zonary arrangement of the manganese around two centres composed of altered material and their subsequent envelopment in one nodule by the continuous deposition of manganese, which has enclosed at the same time the clayey matters with fragments of minerals and organisms.

The microscopic as well as the macroscopic examination shows a well-marked zonary structure, always combined with a dendritic arrangement. In Pl. XXVIII. fig. 1 the arborescent form of the black manganese is directed parallelly to the radii of the nodule, and is intercalated in yellowish brown muddy materials. This is quite the ordinary aspect of dendrites of this mineral; the figure also shows the zonary structure indicated by curved bands of a deep brown colour. Pl. XXVIII. fig. 2 shows likewise the dendritic arrangement, but not so well marked; the large ovoid body occupying the centre of the figure was probably the primary form of the original nucleus, now mostly transformed into manganese. In Pl. XXVIII. figs. 4 and 5 variations of the same zonary and dendritic structure are represented.

It may be concluded from the study of the microscopic sections that the deposition of the manganese has been continuous, for the manganese oxides can be seen to ramify across the earthy or clayey layers, and are thus continuous with the manganese in the purer and darker zones. In all respects the microscopic examination confirms the views arrived at from a macroscopic examination as to the structure of the nodules and their varied nuclei.

*Chemical Composition.*—To what mineral species or ore of manganese are these nodules to be referred? The numerous analyses given below prove that we have to do with a hydrated oxide of manganese, mixed with variable quantities of limonite, clay, and other earthy and sandy matters. Among the associated substances there are several which are in a way peculiar to the concretionary and reniform manganese ores, for instance, copper, cobalt, nickel, &c. The general mass of the substance of the nodules