1. Quartz-wolfram lodes. Little cassiterite, sulphides, or tourmaline, characteristically no chlorite. Upper level of tin and tungsten zone. Occurring in the slate or just in the granite, at or near the crest of the mass.

2. Quartz-chlorite-wolfram-cassiterite-mispickel lodes. Chlorite predominant over tourmaline. Cassiterite usually more than wolfram. Sulphides common. Middle of tin-tungsten zone.

3. Quartz-tourmaline-cassiterite lodes. Tourmaline predominant. Wolfram absent. Sulphides absent or subordinate. Lower part of tin-tungsten zone. Occurring in depth in the granite.

It was also noted that if wolfram was present in the lode, copper was absent or subordinate. The detailed microscopic characters of the veinstones were given in tabular form at the end of the paper.

CORRESPONDENCE.

PHYSIOGRAPHIC RELATIONS OF LATERITE.

Sir,—In reply to Professor W. M. Davis's inquiry in the September number of this Magazine, I should in the first place explain that my paper on Lateritization in Sierra Leone was concerned essentially with the chemical and mineralogical changes undergone by the different rocks of the country in the course of their transformation into laterite, and only to a minor extent with the relation of the laterite to surface forms and physiographic old age. Nevertheless, I am indebted to Professor Davis for directing my attention to several additional points of interest.

In Sierra Leone, as elsewhere in the tropics, laterite is in general best developed on surfaces of gentle slope or low relief, as the following examples from different parts of the country will show:

1. *The Coastal Plain.*—This plain, which along the inner margin rises to a height of about 400 feet above sea-level, consists of sediments, probably of Pleistocene age, which are still in process of lateritization. Locally on these sediments there occur large bare sheets of laterite, free from vegetation and soil, similar to those described by Mr. Morrow Campbell,[1] and explained by him as due to rapid growth of highly ferruginous laterite; this laterite diminishes the fertility of the soil, which, losing the protection of the dying vegetation, becomes gradually washed away by the torrential rains.

2. *The Crystalline Rocks of the Lowlands.*—These rocks under the following conditions are in general deeply kaolinized and lateritized—

(*a*) Where rising as low hills above the sediments of the coastal plain:

(*b*) On those undulating areas in which the plain merges along its

[1] "Laterite, its Origin, Structure, and Minerals": *Mining Mag.*, vol. xvii, 1917, p. 178.

inner margins into the uplands. Where, on the other hand, the change from coastal plain to upland or plateau country is abrupt, and the relief of the crystalline rocks is considerable, altered rocks are rarely seen and laterite is practically absent.

3. *Ancient Sedimentary Rocks of the north-west corner of the Protectorate.*—These sediments, which do not depart greatly from the horizontal, are capped by a great thickness of dolerite. The sediments and the dolerite, together with the underlying crystalline rocks, form a great scarp over 2,000 feet in height. Laterite is well developed on the dolerite, but it is now undergoing extensive erosion.

4. *The Norite of the Colony.*—Laterite is best developed on certain ancient platforms carved into the mountain mass.

5. *The Great Plateau forming the north-eastern part of the Protectorate.*—Over a large portion of this plateau, away from the margins, conditions are very different from those considered above, because an extensive area of the crystalline rocks, which make up the plateau, is overlain by a sand formation,[1] which so far has not been observed in any other part of the country. This sand formation locally attains a thickness of more than 300 feet. It is undergoing extensive erosion, which has resulted in the central areas of the sand-sheet in the carving of deep valleys, at the bottoms of which the crystalline rocks are again exposed; towards the margins of the sheet the sands appear as numerous flat-topped and conical hills, and finally, along the limits of the sheet, the sands form only a few caps on the crystalline plateau. This plateau is generally well-defined, although it is for the most part trenched by steep-sided valleys; locally erosion has proceeded much further. The upper surface of the main sheet of the sands consists of a series of plateaux, which do not differ greatly in height. Laterite is developed on the sands and on the crystalline rocks as follows:—

(*a*) The Sands.—The laterite forms a continuous crust, rarely exceeding 2 feet in thickness, on the surfaces of the plateaux and on the flat-topped hills. The laterite of the higher plateaux must be regarded as older than that of the lower. On the sides of the hills laterite does not occur except as fallen blocks, and on the low ground between the hills it is developed only as occasional thin patches of gravel.

(*b*) The Crystalline Rocks.—Laterite has very rarely been observed on these rocks within the limits of the sand formation. The sands, often containing near their base fragments of the country rocks, frequently rest upon a perfectly fresh surface; elsewhere they rest upon a surface which is variably, but not deeply, kaolinized. Sometimes, far beyond the present limits of the sand-sheet, there occur extensive flat or gently convex areas of the crystalline rocks, chiefly

[1] I have recently given a brief description of these sands and the ferruginous laterite capping them; see "Primitive Iron-ore Smelting Methods in West Africa": *Mining Mag.*, October, 1920.

https://doi.org/10.1017/S0016756800107010 Published online by Cambridge University Press

granites; these areas, which are quite bare except where covered by occasional clumps of grass, are remarkable in being quite fresh, showing no signs of weathering or any other kind of alteration. The absence of laterite on such surfaces has been explained by Mr. Morrow Campbell, who has paid much attention to the conditions under which rocks become kaolinized and lateritized in the tropics. This writer considers that crystalline rocks must be altered before they can be lateritized, and also that the alteration necessary, generally kaolinization, can be produced only when the rocks have been for a long time continuously in contact with vadose water, i.e. in the zone of permanent saturation.[1] Accordingly, the fresh surface rocks referred to above, not having been subjected to such conditions, remain unlateritized.

F. DIXEY.

UNIVERSITY COLLEGE, CARDIFF.
October 4, 1920.

AN UNDESCRIBED SPECIES OF *TROCHILIOPORA*.

SIR,—I desire to draw attention to a band of Chalk in Sussex, about 10 feet thick, near the base of the zone of *Micraster coranguinum*, in which an undescribed Polyzoon belonging to the genus *Trochiliopora* is very common. As this fossil appears to be confined to the said band of Chalk, and also owing to its abundance, it has proved to be a very useful local zonal guide fossil. The exact position in which it occurs in the *Micraster coranguinum* zone is as follows:—

Lower fourth of zone of *Micraster coranguinum*.	Strong *M. coranguinum* tabular flint band.
	Chalk, about 35 feet.
	Chalk with *Trochiliopora* sp., 10 feet.
	Chalk, about 17 feet.
Chalk of zone of *Micraster cortestudinarium*.	

I propose to call the 10 feet of chalk referred to "the *Trochiliopora* bed"

The genus *Trochiliopora* has been described by Professor J. W. Gregory in the GEOLOGICAL MAGAZINE, 1909, p. 65, and also in the British Museum Catalogue of Cretaceous Bryozoa, vol. ii, p. 265. The species above referred to resembles *T. humei*, Gregory, but its body tapers to a much finer stem than the stout blunt stem of the latter species.

The *Trochiliopora* bed is rich is Polyzoa, it having yielded some rare and interesting forms.

CHRISTOPHER T. A. GASTER.

LEWES, SUSSEX.
October 4, 1920.

GEOLOGY OF THE NINGI HILLS.

SIR,—Major Williams' paper on the geology of the Ningi Hills of Nigeria in the October number is very welcome. It indicates not

[1] Morrow Campbell, op. cit., p. 123.