FIG. 2.—*Olenoides*, sp. ? Walcott, Fauna of the Lower Cambrian or Olenellus Zone: 10th Rep. U.S. Geol. Surv., 1899, p. 752, etc., pl. xciv, fig. 1. This genus is represented by an imperfect pygidium, in size equalling *Olenoides Fordi*, Walcott. The border is wanting, but a single spine lies near the left anterior margin, which may have been a marginal spine of the pygidium or a detached median spine.

FIG. 3.—*Helenia bella*, Walcott. Two or three elongate, narrow, flattened, curved tubes may be seen upon the surface of the same slab, one of which is reproduced in Fig. 3. It resembles a specimen figured by C. D. Walcott (Fauna of the Olenellus Zone: 10th Ann. Rep. U.S. Geol. Survey, 1889, pl. lxxviii, fig. 4), which he names *Helenia bella* and refers provisionally to the Dentaliæ.

II.—NOTES ON OCEAN ISLAND (BANABA).

By F. R. COWPER REED, M.A., F.G.S.

OCEAN ISLAND, which is also known as Banaba or Paanopa, lies in the Pacific west of the Gilbert group, in lat. $0^{\circ} 52' S.$, long. $169^{\circ} 35' E.$ Our knowledge of it is but scanty; Darwin¹ briefly mentioned it, and it is not the same Ocean Island as Dana² described, for the latter lies in lat. $28^{\circ} 25' N.$ and long. $178^{\circ} 25' W.$ It may be therefore of some interest to record a few notes on a small collection of specimens of phosphatic and coral rocks made on it by Capt. R. Tupper, R.N., of H.M.S. "Pylades," who hoisted the British flag there in the year 1900. I am also indebted to him for a description of the island, and to the Pacific Islands Company, Ltd., for kindly furnishing me with further particulars of its physical features and analyses of the phosphatic rocks.

The island is of subcircular shape, with a circumference of about six miles at high-water mark; along its southern side there is a shallow concavity known as Home Bay, bounded on the west by Lilian Point, and on the east by the longer and more prominent headland known as Sidney Point. Except along a small portion of this bay the island is surrounded by cliffs from 12 to 30 feet high, and soundings show that very deep water extends close up to them. The interior forms an elevated tableland rising to a height of about 260–270 feet, with a few surface depressions. The whole island consists entirely of coral formation, and is covered with extensive phosphatic deposits worked by the above-mentioned company. The coral-rock is much weathered, rising in places into high pinnacles and prominent masses of peculiar shapes, and is seamed by deep gullies and fissures in which the phosphatic deposits attain their greatest thickness. A boring of 29 feet in one place failed to pierce them. It is stated that there is a sharp line of demarcation between the phosphatic material and the underlying coral-rock, but some of the specimens submitted to me show that the former has infiltrated and impregnated the latter. The rocks are in many cases of detrital origin, being composed of fragments of calcareous rocks cemented together into a more or less compact mass. One specimen is a coarse breccia; another is

¹ Darwin: "Coral Reefs," 3rd ed., 1889, p. 217.

² Dana: "Corals and Coral Islands," 3rd ed., 1890, p. 361.

an irregular conglomerate of rounded or subangular fragments or grains of various shapes and sizes. Recognisable remains of organisms are very rare, but under the microscope a few fragmentary foraminiferal shells can be distinguished in a thin section. The cementing material is a hard pale yellowish or brownish substance of a semi-translucent and resinous appearance, which encases the fragments and lines or more or less fills up the interstices between them. In one specimen the grains are of fairly regular size, and represent a coral sand, converted into a fine oolite by each grain being surrounded by concentric coats of the same cement, and the whole mass thus bound into a solid and compact rock which rings under the hammer. Under crossed nicols a thin section shows that the coats consist of a series of regular concentric layers with a fibrous radial structure, like Renard¹ has described in the oolitic calcareous rocks of Ascension Island. In these examples from Ocean Island we find all degrees of coarseness in the oolitic structure—from a coarse pisolite to a very fine oolite; and in some specimens the cementing material is in excess of the included grains and forms the mass of the rock, losing then its radial structure and behaving under the microscope as an almost isotropic groundmass. The cement in all cases effervesces scarcely at all or but feebly with acid, and is of a phosphatic nature. A completely different type of phosphatic rock consists of regular narrow bands of a yellowish or brownish substance of a semi-translucent resinous appearance. This agate-like rock is very tough and heavy, and has a sub-conchoidal fracture. It seems to consist entirely of the cementing phosphatic material found in the above-mentioned oolites, and behaves in a similar fashion with acids.

One mass of coral (*Mæandrina*) is encrusted with stalactitic deposits of the brownish phosphate which surrounds the corallites, and has more or less obliterated their structure round the margins. Irregular mammillary or stalactitic forms of the phosphate are also met with, and sometimes they enclose patches of fine soft calcareous mud with a hard porcellaneous fibrous coating of a bluish or buff colour. One specimen seems to represent the soft calcareous mud of the ancient lagoon, and it now forms a tough fine-grained chalky limestone of a white or buff colour with a conchoidal fracture. Under the microscope minute irregular fragments or broken prisms of calcite are seen to be scattered through it. In another specimen this consolidated mud is banded by brownish layers of a homogeneous opaque substance, not effervescing in the least with acids, and apparently representing original layers of deposition. A fragment of calcareous tufa with the typical arborescent and cavernous structure is present in the collection, but it has a hard brownish phosphatic crust.

The detailed distribution and relations of these various types of rocks have not been studied, and I have no precise information as to their mode of occurrence. The guano which has led to the formation

¹ Renard: "Challenger" Reports, Physics and Chemistry, vol. ii, Rep. Rocks, p. 71.

of the phosphates on Ocean Island is no longer being deposited there, but at what period it ceased is a matter of speculation, though the present condition of the deposits suggests that a considerable time must have elapsed. On many other islands in the dry central parts of the Pacific, such as Howland's, Jarvis', Baker's, and Malden's Islands, guano deposits occur and are still forming, as Dana¹ and others² have described.

By the courtesy of the Pacific Islands Company, Ltd., in furnishing me with Dr. Voelcker's analyses of the phosphates of Ocean Island, I am able to state that representative samples show an average of 86·57 phosphate of lime, 2·26 carbonate of lime, 0·21 oxide of iron, and 0·31 alumina.

A complete analysis by Dr. Voelcker of one sample of "hard rock," exported as phosphate, is as follows:—

Organic matter and combined water	...	...	...	1·30
Phosphoric acid	...	...	...	39·53
Lime	...	...	...	52·54
Oxide of iron	...	...	...	·15
Alumina	...	...	...	·26
Magnesia, etc.	...	...	...	4·50
Carbonic acid	...	...	...	1·62
Insoluble siliceous matter	...	...	...	·10
(Sample dried at 100° C.)				

The coral-rocks and phosphates of Christmas Island, which Dr. C. W. Andrews has kindly allowed me to examine, appear to be of a different character to those from Ocean Island. Mr. J. Stanley Gardiner, M.A., has kindly examined the two fragmentary corals in the collection presented to us, and has identified them as belonging to the genera *Mæandrina*, E. & H. (? subgen. *Cæloria*, E. & H.), and *Orbicella*, which he states are both widely distributed in the Pacific at the present day, and are among the most important of the reef-builders.

III.—ON SOME *ISOCHILINÆ* FROM CANADA AND ELSEWHERE IN NORTH AMERICA.

By Professor T. RUPERT JONES, F.R.S., F.G.S.

AMONG a large number of Canadian fossils sent to me by Col. C. C. Grant, of Hamilton, Ontario, for transmission to the British Museum (Natural History Branch), there were three particular specimens of fossiliferous limestone worthy of careful examination. These came from a glacial drift at Hamilton, known as 'Bala Drift.' There being no real 'Bala' strata in Canada, the appellation of 'Bala Drift' at Hamilton applies to a glacial drift containing fossils more or less allied to those of *Bala*, most probably to the Trenton Limestone, a Lower Silurian (or Ordovician) formation.

¹ Dana: "Corals and Coral Islands," 3rd ed., 1890, pp. 318–324.

² Hague: Amer. Journ. Sci., ser. II, vol. xxxiv (1862), p. 224. Julien: *ibid.*, vol. xl (1865), p. 367.