

siderably harder, and of a milky colour. The exterior of the deposit was coated with a hard black rind, much resembling the charred bark of a tree. Black grains of the same substance in a soft powdery state permeated the mass, which had a cellular and towards the exterior a somewhat fibrous character. The general appearance of the mineral was highly suggestive of a vegetable origin. Pieces with the rind attached, and having a fibrous structure, much resembled portions of a gigantic cocoa nut. Two specimens were obtained from the same place, which have been secured for the Brighton Museum, which were mistaken for the stems of fossil trees, being in the form of a trunk, and described by Mr. J. Howell, of Brighton, as "six inches in diameter, the bark changed into lignite, and medullary rays diverging from the centre." The substance on the exterior of the specimens, which so much resembled lignite, has been examined by Dr. Flight, of the British Museum, and has been found to consist of manganese with a certain proportion of cobalt. Both opposite Vernon Terrace and at this locality a layer of chalk flints was continuous through the deposits of Websterite, proving that the original substance which has been replaced by the Websterite was contemporaneous with the chalk. A considerable number of specimens from the excavations in the Montpelier Road and Clifton Hill I have presented to the Museum of Practical Geology in Jermyn Street, and to the Brighton Museum. The discovery of the Websterite I communicated to Mr. T. W. Wonfor, of the Brighton and Sussex Natural History Society, and to Mr. J. Howell, of 7, Guildford Road, who have since investigated the deposits, and have brought a notice of it before the Brighton Society. The finest examples of this mineral which have been obtained from Newhaven, and which were collected by Mr. H. Catt, of Brighton, are in the Pavilion Museum, and are mentioned in "Merrifield's Natural History of Brighton."

No doubt many deposits of the mineral have been met with and overlooked in excavating for the foundation of houses in this part of Brighton.

NOTICES OF MEMOIRS.

I.—ON SOME OPERCULATED CORALS, SILURIAN AND RECENT.

By Dr. GUSTAF LINDSTRÖM, Wisby, Isle of Gotland.

DURING the spring and summer last year, I received two specimens of the very remarkable four-sided Rugose Coral *Goniophyllum pyramidale*, His.,¹ by which quite unexpected elucidations concerning the nature of the opercular apparatus of this coral were gained. These specimens are still provided with the operculum, almost complete, in its original position. Far from consisting of

¹ For figures and other details concerning it and some of its congeners, I may refer to a paper in "Öfversigt Vetenskaps-Akademiens Förhandlingar," 1865, p. 271, Pl. xxx. and xxxi., of which a translation is given in the GEOLOGICAL MAGAZINE, 1866, Vol. III., page 356, Pl. XIV.

only one valve, as in the kindred genera *Calceola* and *Rhizophyllum*, it is composed of four valves, attached one to each side of the pyramid. These four valves form two pairs, as the opposite valves resemble each other. They meet with their apex in the centrum of the coral, and overlapping each other in a sort of spiral way, to be described further on, they completely close the calice of the coral. In the specimen I first received, all four valves are left in their place, and although two are sunk in the calice and somewhat crushed, their outline may still be seen. In the other specimen, only three valves are left behind. By this material, together with valves found detached, a sufficiently accurate opinion of the shape of this curious apparatus may be formed. Those valves that are attached to the bottom side (that on which the coral rests when in its natural position), and to the opposite or the uppermost side, have a trapezoidal shape (See Fig. 6, Pl. XIV., GEOL. MAG., 1866). The valves of the left and the right side are both triangular. The lateral borders of all the valves are slightly curved, rarely straight. Along the middle of their outside a groove runs from the nucleus to the apex. It is broad and flat-bottomed in the trapezoidal valves, and its section forms only an obtuse angle in the triangular ones. The first and original part of the bottom valve, or what is called its nucleus, is circular; then it acquires a semicircular shape, and this is again surrounded by other lines of growth giving the final trapezoidal outline. The nuclei of the other valves are from their first origin already of the triangular or trapezoidal shape. Thus the successive changes in the shape of the opercular valves are, I think, clearly indicated. As the valves during their growth increase faster at the apical than at their basal part, the nucleus comes more closely to the basal line, and lies below the centrum (fig. 6, pl. xxx. in *Ofversigt Vet. Ak. Förhandl.*, 1865). Excepting the lines of growth, no other sculpture is to be discerned. The dimensions of the different valves are in the most complete specimen as follows, viz:—

	<i>Basal line.</i>	<i>Length from Basal line to apex.</i>
Bottom valve	20 ^{m.m.}	somewhat more than 10 ^{m.m.}
Left-side valve	17 „	10 „
Uppermost valve	16 „	10 „
Right-side valve	15 „	9 „

Hence, the bottom valve is the largest, and the other valve decrease in size as they are remote from that in a direction towards left. The left-side valve covers with its right border the left border of the bottom valve, and it is itself in the same way covered by the left border of the uppermost valve, whilst the valve of the right side reposes with both its borders on the adjoining borders of the uppermost and the bottom valve. So that the last-mentioned valve is situated beneath the three others with its borders, and its truncated apex is hidden far below the apex of the opposite valve. I now suppose that the situation and the size of the different valves signify their different age and origin in such a way that the largest and deepest situated is the oldest, and for a time the only valve existing that

was sufficient to cover the incipient coral. The shape of its nucleus, as described above, is in accordance with such a supposition, the nucleus being at first quite circular, as the calice of the coral itself was. The specimen, which is still covered by its operculum, is at its basis cylindrical, then acquires a semiconical shape, having one side flat—the bottom side—and one convex. First, at a distance of 9^{mm} from the basis, the whole length of the coral being 16^{mm}, it is quite four-sided. The bottom valve is the only one that is completely homologous, as to its interior surface, to the single-valved operculum of the genera *Calceola* and *Rhizophyllum*, as I endeavoured to point out in my former paper. Its median ridge is very faint, and it is at the basal or cardinal line above that ridge provided with a pit into which, just as in *Calceola*, no doubt the blunt edge of the corresponding calicular septum has been inserted. The uppermost valve, on the contrary (pl. xxx., fig. 8, in *Ofversigt Vetenskaps-Akademiens Förhandlingar*), has a very large median ridge, larger than in any of the other valves, and this large prominence corresponds with the deep septal groove in the calice. The triangular valves—those of the left and right side—are quite similar to each other, and resemble also the uppermost valve, although the median ridge is not so prominent. The valves are with their basal or hinge line so closely affixed to the borders of the calice, that no opening is seen, excepting in one of the crushed valves, which is a little lifted, so as to show how the teeth-like prominences on the valve are lodged in the interstices between the uppermost edges of the septa.

In the Proceedings of the Royal Academy of Sciences in Stockholm (*Ofversigt Vet. Ak. Förhandlingar*), 1868, page 421, pl. vi., fig. 4, 5, I described a new species, *Cystiphyllum prismaticum*, and I also then, as well as in my first paper on the Corals (*GEOL. MAG.*, 1866, page 411, Pl. XIV., Fig. 22, 23), gave a description of its operculum. This coral is formed as an obtusely four-sided prism, and has now been found in sufficient numbers to show not only that the animal shed its operculum, and formed a new one at intervals, some bearing two opercular valves above each other, affixed to the same side below the calicular rim, but also that its calice was closed by several valves on different sides, these being still attached to at least two sides in some specimens. But it cannot now be decided whether there were only four valves, as in *Goniophyllum*, in accordance with the four-sidedness of the coral, or more.

It is of great interest to find that these Palæozoic operculated corals have their counterparts among the recent corals. Prof. Koeliker in 1866, in his "*Icones Histologicae*," 2te Abtheil. 1 Hft. p. 135, described an operculum consisting of eight valves in some species of the genera *Primnoa* and *Paramuricea*. Such species, according to him, are *Primnoa lepadifera*, L., and *Param. placomus*, L. Through the great kindness and liberality of Prof. S. Lovén, I have been enabled to examine specimens of both these species, as well as of *Primnoa verticillaris*, L., and of an undescribed species of the genus *Calyptrophora*, J. E. Gray (*Proceed. Zool. Soc.*, 1866, p. 25). In *Param. placomus* and *Primnoa verticillaris* these opercula are incom-

plete, being only composed of valves of two long and narrow sclerites, which do not close the mouth of the calice. *Primn. lepadifera* and the *Calyptrophora*, on the contrary, have a complete operculum, and they agree in several points with *Goniophyllum*. The valves in all these are triangular, and cover completely the top of the polypary, in such a way that some valves repose with their borders on those of the others. As is the case in *Goniophyllum* the median line of the outside of the valves is deepened, and to this channel or groove an elevated ridge corresponds on the interior surface. This ridge in the *Primnoæ* is a fulcrum to muscles from the basis of the tentacula. In other respects there is not much similarity between the Palæozoic and the recent species. The opercular valves of the *Primnoæ* have grown in a radial way, the calcareous bodies radiating towards all sides from a nucleus, or centrum, situated at the lower side of the operculum. In the *Rugosa*, again, the growth has been concentric, each new layer being added around the previous. Moreover, no traces of spiculæ or calcareous bodies are seen, the operculum and the coral are made up of homogeneous matter, and there is no reason to believe that the original structure has been obliterated by external metamorphosing agencies. Other fossils, Brachiopoda and Perforate Corals, in the same stratum, retain the most minute details of their characteristic microscopical structure unaltered, and metamorphosing agencies affect generally all fossils in the same stratum. The opercular valves of the *Primnoæ* are, in all probability, morphologically identical with the scales that cover the polyp all round, to which they bear a close resemblance, being entirely composed of the same sort of calcareous bodies, arranged in the same radial manner. If this scaly covering of the polyp is an ectodermic secretion, the calcareous spiculæ that are scattered so abundantly in the interior of the soft parts of the animal, and which are quite dissimilar to the spiculæ ("Kalkkörper," Koelliker) that compose the scales and the opercular valves, alone represent in the *Primnoæ* the sclerenchyma or the polyparium proper of other Anthozoa. I think there exists some sort of homology to these ectodermic scales of the *Primnoæ* amongst the *Rugosa* in *Cyathophyllum* (*Pholidophyllum*, n.g.), *Loveni* Edw. and H.¹ Specimens of this very common and widely distributed fossil show, when in a good state of preservation, a thick covering of small ($\frac{1}{2}$ mm), very thin scales, tightly clustered together in longitudinal rows along the costæ. There are two rows of scales on each costa, this being indeed double or divided

¹ The authors of this species themselves doubt its belonging to the genus *Cyathophyllum* (Hist. Nat. Cor. III., p. 367, Brit. Foss. Corals, p. 280, pl. 66, fig. 2). In this they are quite right, as it does not in any way coincide with the species commonly considered as *Cyathophylla*. Its strange exothecal covering in scaly rows, its septa, its well-developed tabulæ, its double costæ, and the complete want of dissepimental structure between the septa, justify my forming a new genus out of it, which I propose to name *Pholidophyllum*. As it now stands, it contains only a single species, *Ph. Loveni*, which is found most abundantly in Gotland, and also in Russia (Oesel), Norway (Christiania), England (Dudley and other localities), N. America (Lake Huron, St. Joseph's Island). It occurs also in the Drift of Northern Germany, from whence Ludwig, in *Palæontographica*, vol. xiv., pl. 47, fig. 3, and pl. 51, fig. 4, has obtained it and named it *Tæniocyathus* and *Tæniolepas spinosa*.

into two halves by a shallow furrow. Thus, each moiety of the costa is provided with its row of scales. The adjoining rows of the same costa meet in an obtuse angle, the point directed downwards. This position of the scales on the theca or epitheca of the coral gives them an exothecal character, and reminds one of the corresponding position of the many opercular valves left on the epitheca of *Cystiphyllum prismaticum*, as well as sometimes on that of *Goniophyllum pyramidale* (See *GEOL. MAG.* 1866, Pl. XIV., Fig. 4 c, and *Ofvers. Vet. Ak. Förh.*, 1868, pl. vi. fig. 4). I am therefore inclined to think that the opercula of the Rugose Corals, although much diversified, are secretions of an exothecal nature, homologous to the small scales of *Pholidophyllum Lovéni*, and perhaps also to the scales and opercular valves of the Primnoæ.

II.—THE GEOLOGICAL SURVEY OF INDIA.

Memoirs of the Geological Survey of India. Vol. VII., Part 2. 1870.

Records of the Geological Survey of India. Vol. III., Part 4. 1870.

THIS Part of the Memoirs contains two reports by Mr. T. W. H. Hughes, F.G.S., etc.

1. *On the Kurhurbari Coal-field.*—This coal-field, situated in the district of Hazaribagh, although one of the smallest in the Indian empire, has for many years attracted public attention, owing partly to the superiority of its coals to those from any of the fields in the Damuda valley, and partly to its position as a source whence to supply the wants of the East Indian Railway and the larger towns west of Dinapore. It occupies an area of about eleven square miles, in which occur the Talchir and Damuda series, and also two inliers of crystalline or metamorphic rocks. The area is bounded by crystalline rocks. The distribution of these rocks is shown on a small geological map, drawn to the scale of one inch to the mile.

The Talchir series occupies but a small portion of the field; it consists of conglomerates, shales, and sandstones, without coal.

Of the Damuda series, only the lowest or Barakar group is represented. This group comprises pebbly-beds, grits, and sandstones, with beds of carbonaceous shale and seams of coal. The structure of the coal-field is, roughly, that of a basin. Trap-dykes occur in great frequency, and, of course, will have impaired the coal through which they pass.

There are not more than three, or at most four, workable beds of coal, and it is chiefly with a full description of these, at the different localities where they crop out, or have been already worked, that this Memoir is occupied.

The principal seams exhibit an irregularity which is characteristic of the Barakar group. Mr. Hughes estimates eighty millions of tons as being the probable amount of coal available in this field.

2. *On the Deoghur Coal-fields.*—The name Deoghur is applied generally to three outliers of coal-measures which occur in the neighbourhood of the Adjai River, to the east of the Kurhurbari

coal-fields. These outliers were so long ago as 1853 pointed out by the Geological Survey, but only recently the increased facility of communication with Calcutta and the provincial towns, afforded by the construction of a railway from Sitarampur to Lakki Serai, suggested the possibility of working the coal. A further examination of the rocks to determine this question shows, however, that, owing to the poor quality of the coal and the limited area over which it occurs, no successful competition with the Kurhbari field could be carried on.

This Number of the Records contains two papers:—

1. *On the Geology of Mount Tilla in the Punjab*, by A. B. Wynne, F.G.S.

This hill, which rises to the height of 3,242 feet above the sea, is a very striking feature in the country, and mainly so through great dislocations of the stratified rocks of which it is composed, whereby beds of greater or less hardness are placed in abnormal contact with others possessing different degrees of resistance to disintegrating forces. The rocks include Tertiary (Sivalik) beds, Nummulitic limestone, and beneath them a considerable thickness of calcareous, shaly beds, and sandstones. The lofty portion of the ridge of Mount Tilla coincides with a fractured anticlinal curvature of the strata, while along its south-eastern side three, if not four, step-like faults repeat some portions of the strata. This interesting structure of Mount Tilla is illustrated by a Sketch-map and Section.

2. *Reports on the Copper Deposits of Dhalbhum and Singhbhum*, by V. Ball and Emil Stöchr.¹

The copper ores occur for the most part in a zone of schists, situated near the base of the sub-metamorphic rocks. These ores have been repeatedly worked by the ancients, as numbers of old excavations testify, and Mr. Ball is of opinion that the earliest workers were an Aryan race called Seraks.

In regard to the mode of occurrence of the copper, it seems probable that in Singhbhum it occurs both in lodes and as a deposit disseminated through the rocks.

Two companies have of late years been formed to work the mines, and both have failed. Nevertheless, the authors think that copper-mining might be profitably carried out; but for that purpose such colossal companies as these were not suited. H. B. W.

III.—GEOLOGICAL EXPLORATIONS IN THE ROCKY MOUNTAINS, U.S.A.

PROFESSOR O. C. Marsh, of New Haven, Conn., U.S.A., has recently returned from an extensive tour in the Rocky Mountain region for palæontological purposes, and has enriched the shelves of the Geological Peabody Museum of Yale College with a crowd of magnificent specimens, besides adding largely to the list of American fossils. His party consisted of thirteen amateurs and students, besides numerous guides and an occasional military escort. They

¹ The Mining Geologist to the Singhbhum Copper Company.

were in the field more than five months, in Kansas, Nebraska, Colorado, and Utah. The Union Pacific Railroad formed their base of operations, from which they made excursions both to the north and south, one or two hundred miles. In the midst of wild beasts and still more dangerous savage Indians, their path was beset with difficulties and fraught with adventure. The scientific results of the expedition will be published as soon as possible.

The fossils obtained in Nebraska, Utah, and Colorado were chiefly from the "Loup River" Pliocene and the "Mauvais Terres" or the Miocene, both deposits formed beneath enormous fresh-water lakes, whose banks were tenanted by many of the peculiar Pachyderms of the Paris Basin. The number of American fossil horses—some of them contemporary with the earliest human tribes, but now entirely extinct—has been enlarged to eighteen. One of them is allied to the *Hipparion*, and another is a pigmy only two feet high. The well at "Antelope Station" (U.P.R.R.), an excavation ten feet in diameter and only eight feet deep, has furnished specimens of fifteen mammals! Four of these are horses, two rhinoceroses, an animal allied to the boar, two camels, and three large carnivores. The Miocene strata were found two hundred miles further south than they had been noticed previously. Much additional information was obtained about the *Titanotherium Proutti*; tending to show that it was only half as large as originally described.

The most important expedition of the summer was along the main tributaries of the Colorado River in Utah, a region hitherto unexplored by scientific men. It proved to be a Miocene country, formerly one of those enormous fresh-water lakes, abounding in crocodiles, serpents, turtles, and fishes. At one point of view eleven fossil turtles could be seen at once without turning the head. Rhinoceroses and various other mammals of the warmer regions seem to have frequented the shores of this ancient lake. Numerous specimens illustrating the anatomical structure of the Mosasauroid reptiles were exhumed in Kansas; after which the party disbanded and returned home. This Rocky Mountain region is wonderfully inviting with its stores of Pachyderms and fresh-water reptiles, and no industrious collector can fail to be liberally rewarded by a visit. Not a hundredth part of the region has yet been carefully explored.

C. H. H.

IV.—REPORT ON THE TESTACEOUS MOLLUSCA OBTAINED DURING A DREDGING EXCURSION IN THE GULF OF SUEZ, IN THE MONTHS OF FEBRUARY AND MARCH, 1869. By ROBERT M'ANDREW.

[Annals and Magazine of Natural History, December, 1870.]

THE dissimilarity between the fauna of the Red Sea and that of the Mediterranean has attracted much attention from naturalists; and this fact, combined with the more or less distinct character of the deposits now forming over the bottoms of the two seas—that in the Red Sea being essentially calcareous, while at the mouth of the Nile the deposit is chiefly sand—has bearings of much importance to the geologist.

Having some time previously been struck with the novelty of species of Mollusca occurring on the shore of the Gulf of Suez, Mr. M'Andrew determined to go again and make some detailed observations on the marine fauna. Accordingly in 1869, accompanied by Mr. Edward Fielding, he proceeded to Suez, and devoted six weeks to dredging along the coast of the Sinai peninsula. The results of his investigations are communicated in the Report now before us. The total number of species of Mollusca obtained amounts to 818, of which 619 have been identified or described, the remaining 199 being still undetermined. 355 of the species have not been previously recorded as inhabiting the Red Sea; and of these, fifty-three, including three genera, are new to science, and have been described by Messrs. H. and A. Adams. Most of the undetermined species will, it is expected, prove to be new.

Professor Issel, of Genoa, in a recently-published work upon the shells of the Red Sea, enumerates but 640 species of recent Mollusca from the whole area—a fact which speaks well for the important results that have been obtained by Mr. M'Andrew; while, in addition to Mollusca, he lost no opportunity to collect specimens of Echinodermata, Crustacea, Corals, etc., accounts of which will probably be published.

Mr. M'Andrew observes that further researches only tend to confirm the distinction between the Red Sea and Mediterranean species of Mollusca, so that a barrier between the seas must have existed from very remote time. This, however, is quite consistent with Professor Issel's statement, that an examination of the geological conditions of the Isthmus leads to the conclusion that the two seas were united during the Eocene and Miocene periods.

What influence the Suez Canal may have in modifying the distribution of the forms of life, is at present a source of much interest.

H. B. W.

REVIEWS.

I.—REPORT ON THE PRESENT CONDITION OF THE GEOLOGICAL SURVEY OF THE COLONY OF VICTORIA. (Melbourne, 1870.)

A SHORT time ago we had occasion to notice the termination of the Geological Survey of Victoria, which had for a long period been most ably conducted by Mr. A. R. C. Selwyn. The suddenness of the course taken by the Colonial Government created much surprise, and considerable regret was felt that the Survey of a Colony, so important in its economic bearings, should be left in an unfinished state.

We have just received a report, dated 23rd September, 1870, made by Mr. R. Brough Smyth to the Hon. Angus Mackay, M.P., Minister of Mines, in which the writer submits his plans for the completion of the Geological Survey of Victoria. He first points out the amount of work done by Mr. Selwyn and his staff of assistants. They surveyed an area of 3,510 square miles, which was published on maps, drawn to a scale of two inches to a mile. Mr.