

II.—THE GEOLOGICAL WORK OF THE CONWAY SPITZBERGEN EXPEDITION.

By E. J. GARWOOD, M.A., F.G.S., and J. W. GREGORY, D.Sc., F.G.S.

THE discovery by Keilhau in 1827 of Carboniferous fossils in Spitzbergen first called attention to the geological interest of this archipelago. The collections subsequently made by Robert during the voyage of the "Recherche" in 1833, by Loven in 1837, by Drasche in 1872, and by the series of Swedish expeditions under Baron A. E. von Nordenskiöld between 1858 and 1873, proved the occurrence of beds belonging to the Archean, Lower Palæozoic, Devonian, Carboniferous, Triassic, Jurassic, Cretaceous, and Miocene systems. The fossils collected by these explorers are now in the museums of Christiania, Paris, Stockholm, and Vienna; but up till the present the only collections in London are a few specimens of Devonian fish obtained by exchange, and of Carboniferous Brachiopods collected by Mr. Lamont. It was, therefore, part of the work of Sir Martin Conway's expedition to obtain a series of fossils to represent as fully as possible all the successive faunas and floras of this far northern archipelago. Previous work on the geology of Spitzbergen had, moreover, been carried out on the coast, and it was Sir Martin Conway's main object to explore the interior. These two considerations lessened the thoroughness of the geological study of the country and the extent of the collections, for we had to travel long distances to reach rocks of different systems, and transport of heavy geological specimens from the interior was difficult. Nevertheless, considerable collections were made, which, besides serving to represent the Spitzbergen fossils, will probably aid in the more exact correlation of the horizons from which they come, and throw light on the migrations of the faunas.

The expedition arrived in Advent Bay on the 19th of June, and finished landing the stores by the evening of the next day. Preparations were at once made for the march inland, Sir Martin Conway and Mr. Garwood leaving on the 21st to establish the first food dépôt. From this point the inland party pushed up the valley that ascends from the head of Advent Bay; after three days' march we camped on a col leading into a corresponding valley that runs inland from Sassen Bay. During the descent into this valley we found a remarkable esker, which told the story of its formation. At this point the party had to halt, owing to the collapse of the sledges; while one of us returned to Advent Bay to repair them, the other made a collection from the Triassic rocks of the mountains beside the camp. Below the Trias were beds of Carboniferous limestone and chert; a stream had cut a deep gorge through these, and at its head plunged over a fine waterfall, which gave our resting-place the name of "Waterfall Camp." The sledges having returned, we resumed our journey to the east. At first our route lay along a valley cut through the Triassic rocks to the Carboniferous; occasional outcrops of the latter could be seen on the foot of the valley-walls. Most of the floor was occupied by recent alluvium, while a series of raised

beaches containing shells of *Mya truncata* and *Saxicava arctica*, etc., formed terraces along the sides. Above the level of the marine terraces the valley contracted, and was blocked by a bar of moraine hills, 400 feet in height; in the hollows we often came upon beds of fossil ice, which added greatly to the difficulty of the traverse of these very irregular hills. After crossing the moraine, we had to leave the ponies and sledges and cross the glacier to the east coast, which we reached on July 16. We returned to Waterfall Camp by the same route; thence one of us walked back to Advent Bay overland, and the other along the coast, so that we were able to help in the geological examination of two east and west sections.

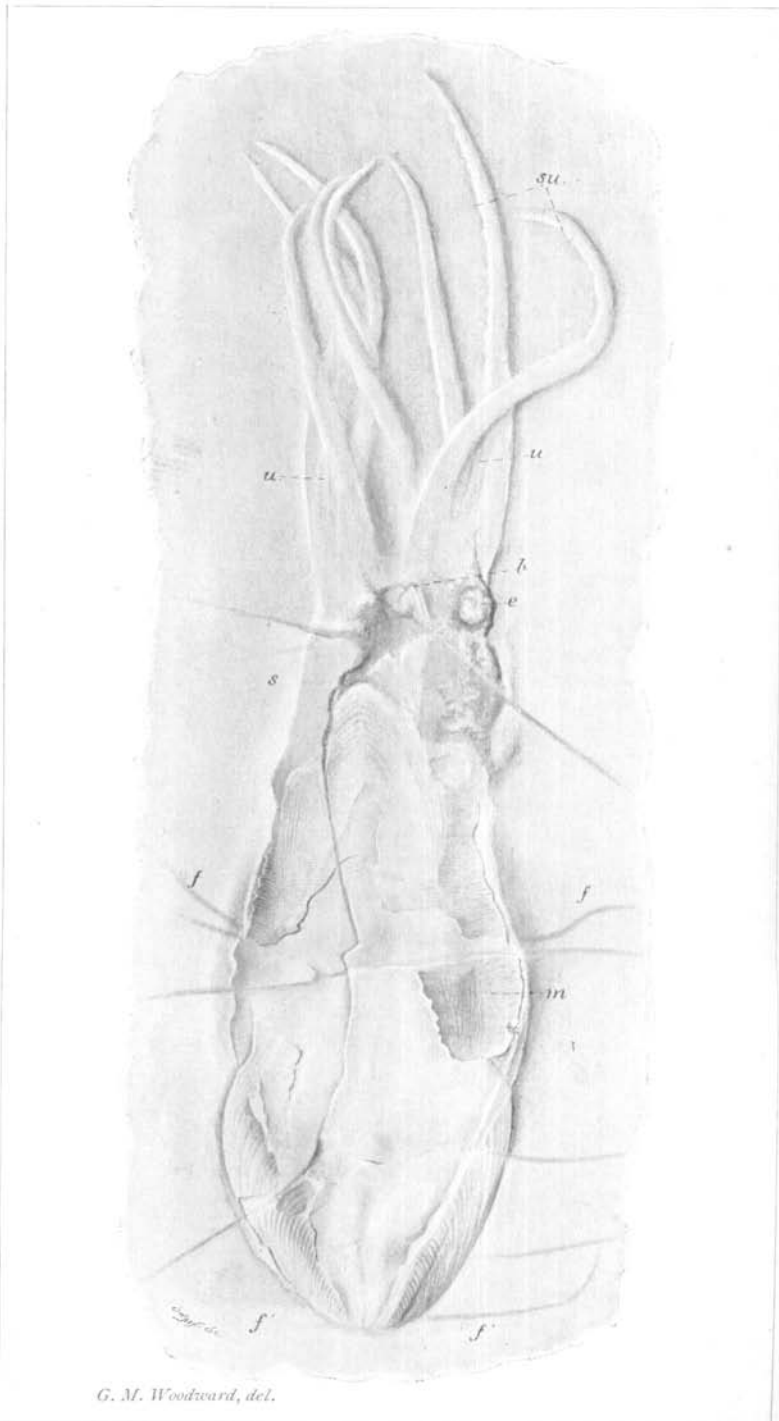
After meeting at Advent Bay we went with Mr. H. E. Conway, the artist of the expedition, to Green Harbour to collect fossil plants from the Tertiary beds there. Unfortunately the layer from which Baron Nordenskiöld made the collection in which Heer recognized over a hundred species, has been washed away by the sea. We obtained, however, a series of leaves of dicotyledons and of *Poacites*, and specimens of *Taxodium*, *Sequoia*, etc. Jurassic, Triassic, and Carboniferous rocks occur to the west of the Tertiary Plant-bed, and from these we also made collections.

After a few days' stay at this locality, Sir Martin Conway called for us in the "Expres," a small 13-ton steamer. In this vessel we sailed to the Seven Islands, through Hinlopen Straits, near to Prince Charles' Islands, and to the head of Wiide Bay. An attempt to circumnavigate Spitzbergen was frustrated by a belt of fast ice, which blocked up the passages into Stor Fiord, and formed a barrier across the broad Olga Strait. The excursion, however, gave us an opportunity for studying some fine sections in the Archean series of the Seven Islands, of the Devonian of Wiide Bay, and also of the Carboniferous and Tertiary rocks of Bel Sund, in which we spent a day during our return voyage.

One of us (E. J. G.) subsequently had the opportunity during the first ascent of Hornsund Tind, the highest mountain in Spitzbergen, of working out its geological structure.

It is too early to attempt any summary of the results of this journey, as many of the fossils are yet unpacked, and upon the examination of these the conclusions will depend. Sir Martin Conway made a careful map, on the scale of one inch to the mile, of the belt of country between Advent Bay and Agardh Bay, where we reached the east coast. We collected materials on which to prepare a geological edition of this map.

The stratigraphical sequence in Spitzbergen is remarkably complete, and its general characters are of great interest. The oldest beds are some schists, cut through and altered by some intrusive gneisses. These occur in the Seven Islands and in the north-west of Spitzbergen. Above these come the quartzites and schists of the Hecla Hook series; these are no doubt Lower Palæozoic, but fossils have not yet been found in them. The stratigraphical evidence proves them to be pre-Devonian. The series is named from their occurrence in the headland overlooking the bay in which Parry's ship, the "Hecla,"



Coccoteuthis hastiformis, Ruppell, sp.

Lower Kimeridgian (Lithographic Stone): Solenhofen, Bavaria.

spent the winter of 1826–7. Of the Devonian series we saw less than of the other formations, but obtained some fish-remains on the south-western shore of Wiide Bay. The Carboniferous system is one of the most extensively developed of any in Spitzbergen, and we obtained collections (mainly of Brachiopods) from various localities. The Carboniferous rocks are succeeded by those of the Trias, the two systems being sometimes separated by a slight unconformity. Another and greater break in the sequence occurs above the Trias, for the next fossiliferous beds apparently belong to the Upper Jurassic; fossils of this age occur in several localities, and they are succeeded by beds containing a species of *Aucella* very nearly allied, if not identical, with *A. concentrica*, Keys. After this comes another gap, including the upper part of the Cretaceous (if not the whole of that system) and the Lower Tertiary. There are no marine fossils later than the *Aucella* beds until we reach the Pleistocene raised beaches, with the exception of some unsatisfactory casts from beds associated with the Tertiary plant-beds.

The sequence of faunas in Spitzbergen is instructive, but the faunas themselves are thin. Species of certain classes, as of Brachiopods in the Carboniferous, and of Cephalopods in the Trias, may be numerous; but the classes represented are always very limited. The main lesson that the faunas teach seems to be that they always lived under unfavourable conditions. We had expected to find evidence of former climates not only much milder than the present, but even subtropical in warmth. In this we were unsuccessful; we found, on the contrary, beds of more than one period in the deposition of which ice must have taken part. We found boulders weighing three tons lying in beds of comparatively fine material; and it seems difficult to see what but ice could have transported them.

The ice of Spitzbergen consists of sea-ice, valley glaciers, and an ice-cap. The opportunity of the study of these three agents working side by side, was one of the greatest privileges we enjoyed during the expedition.

III.—ON A SPECIMEN OF *COCCOTEUTHIS HASTIFORMIS*, RÜPPELL, SP., FROM THE LITHOGRAPHIC STONE, SOLENHOFEN, BAVARIA.

By G. C. CRICK, F.G.S., of the British Museum (Natural History).

(PLATE XIV.)

THE specimen which forms the subject of the present notice belongs to the genus which is termed by some authors *Trachyteuthis*, and by others *Coccoteuthis*. Both names were originally given to the internal shell of a *Sepia*-like Cephalopod; the former to examples from the Lithographic Stone (Lower Kimeridgian) of Bavaria, and the latter to a specimen from the Kimeridge Clay of Dorset. They are regarded as synonymous, but some authors use one and some the other.

The genus was first figured in 1755 by Knorr,¹ who mistook the

¹ "Sammlung von Merkwürdigkeiten der Natur und Alterthümern des Erdbodens, welche petrificirte Körper enthält," pt. i, pl. xxii, fig. 2.