cells) as that of the remarkable contractile vesicle observed in the pulmonate Gasteropoda, and which I have studied in *Limax*. It is probable that the two parts are homogenous."

So far as any comparison between the Cephalopod yelk-sac and the Gasteropod foot is legitimate, it appears to me that I had made it in the above passage some years since.

As to the homologies generally of Gasteropod and Cephalopod, I am inclined to agree with Mr. Brooks when he says "we cannot expect any valuable results to follow from the attempt to compare any part of the body of a Cephalopod with structures which, like the epipodial folds, are not common to the Gasteropoda, but somewhat exceptional." I consider that a close relationship exists between the siphonal folds of the Cephalopod and the "pteropods" of Pteropoda, and, again, between the arms of the former and the arms (bearing suckers in *Pneumodermon*) of the latter; but there appears to be no ground for going further when we compare these parts with those of a Gasteropod than is involved in assigning them all to "the foot," which certainly cannot be given up to the sole equivalence of the yelk-sac, and is not to be limited, as Mr. Brooks would have it, to an unpaired median growth. I do not see the cogency of the arguments put forward by Jhering for regarding the arms of Pteropods and Cephalopods as distinct from foot; and assuredly it is necessary absolutely to reject Grenacher's notion of their identity with the velum, a notion with which every morphologist has at one time or other amused himself; and, lastly, there appears to be no ground capable of statement for regarding, as Brooks would do, the siphon (funnel) as a growth peculiar to the Cephalopod. Its condition in *Nautilus* alone is sufficient to show that it is a part of the molluscan foot.

XLV.—*The Structure and Affinities of* Euphoberia, *Meek and Worthen, a Genus of Carboniferous Myriopoda.* By Samuel H. Scudder*.

The genus *Euphoberia* was established in 1868, for some remarkable spiny Myriopoda found in the ironstone nodules of Mazon Creek, in Illinois, and which were first fully described and figured in the third volume of the Geological Report of the Illinois Survey. The only characteristics then noted, in which they differ from modern types, were the tapering form of the body and the presence of branching

* From the 'American Journal of Science,' March 1881, pp. 182–186.

spines on all the segments in longitudinal rows. An opportunity of examining a series of these animals from the same locality, due to the kindness of Messrs. Carr and Worthen, and especially of studying a fine fragment of *Euphoberia major*, M. & W., giving an admirable view of the ventral plates, proves that the differences between these ancient types and modern forms are so numerous and important as to compel us to refer them to a distinct suborder, for which the name of Archipolypoda is proposed.

One main distinction between the two groups, Diplopoda (or Chilognatha) and Chilopoda, into which existing Myriopoda are generally divided, consists in the relation of the ventral to the dorsal plates of the various segments of which the body is composed. In the Chilopoda there is a single ventral plate, bearing one pair of legs, for every dorsal plate; in the Diplopoda, on the contrary, there are two such ventral plates, each bearing a pair of legs, for every dorsal plate (with the exception of a few segments at the extremities of the body). The Diplopoda are universally considered the lower of the two in their organization; and it is therefore not surprising to find that no Chilopoda have been found in rocks older than the Tertiary series*; while Myriopods with two pairs of legs corresponding to each dorsal plate may be found as far back as the Coal-measures. In such comparisons as are here instituted, the Chilopoda may therefore be left out of account.

In modern Diplopoda each segment of the body is almost entirely composed of the dorsal plate, forming a nearly complete ring; for it encircles, as a general rule, nine tenths of the body, leaving small room for the pair of ventral plates. On the side of the body it is perforated by a minute foramen, the opening of an odoriferous gland. Usually the ring is nearly circular; but occasionally the body is considerably flattened, and the sides are somewhat expanded into flattened laminæ with a smooth or serrate margin; a few species are provided with minute hairs, sometimes perched on little papillæ; and the surface of the body, ordinarily smooth or at best wrinkled, is occasionally beset with roughened tubercles, which may even form jagged projections. So far as I am aware, no nearer approach to spines occurs on the dorsal plate than the serrate edges of the lateral laminæ, the roughened tubercles, or the papilla-mounted hairs.

In the *Euphoberiæ* from the Coal-measures a very different condition of things obtains. The segments of the body

* *Geophilus proavus*, Germ., from the Jura, is certainly a nereid worm, as stated by Hagen.

may be circular, or laterally compressed, or, as in many modern types, depressed; but in all the dorsal plate occupies scarcely more than two thirds of the circuit of the body, or even less, being opposed by broad ventral plates. This dorsal plate is not perforated for foramina repugnatoria*, but, as means of defence, it is armed with two or three huge spines upon either side: one row (for they occur on all the segments alike) lies above, near the middle line of the body; another is placed low down upon the sides, near the lower margin of the dorsal plate; and a third row is sometimes found between them. These spines are sometimes forked at the tip; and they are (probably) always provided to a greater or less extent with spinules springing from the base or the stem; sometimes these are so numerous as to form a *whorl* of little spines around the main stem. Usually the main spines are at least half as long as the diameter of the body; often they are as long as the diameter; and one may readily picture the different appearance between one of these creatures, perhaps a foot or more in length, bristling all over with a coarse tangle of thorny spines, and the smooth galley-worm of the present day.

If we pass to the ventral plates we shall find differences of even greater significance. In modern Diplopoda these plates are minute; the anterior forms the anterior edge of the segment, continuous with that of the dorsal plate; together, however, they are not so long as the dorsal plate at their side; and the latter appears partly to encircle the posterior of the ventral plates by extending inward towards the coxal cavities. The legs are attached to the posterior edge of each ventral plate; and those of opposite sides are so closely crowded together that they absolutely touch. The stigmata, of which there is a pair to each ventral plate, are placed at the outer edge, rather towards the front margin; and their openings are longitudinal (*i. e.* they lie athwart the segment); the coxæ of the legs of the anterior plate are therefore opposite the stigmata of the posterior plate. No other organs are found upon the ventral plates; one might indeed say there was not room for them. The legs themselves are composed of six simple cylindrical joints subequal in length, the apical armed with a single terminal claw; the whole leg is short, generally not more than half as long as the diameter of the body.

In the ancient *Euphoberiæ* all is very different. The ventral

* This is what would be expected from the presence of spines; for two such means of defence should not be looked for in the same animal; offensive glands are present only in slow-moving or otherwise defenceless creatures, as in Phasmidæ among Orthoptera for example.

plates occupy the entire ventral surface, perhaps may be said to extend partly up the sides of the rounded body; and no part of the dorsal plate passes behind the posterior ventral plate. They are together equal in length to any part of the dorsal plate, the segments of the body being equal in length throughout; while in modern Diplopoda the upper portion of the dorsal plate is always considerably longer than the ventral portion, allowing the creature to coil ventrally without exposing any intersegmental portion of the back devoid of hard armature: in these ancient forms the animal appears to coil dorsally as readily as ventrally; at least, when not extended straight upon the stones in which they are preserved, they are as frequently found bent upward as downward; and there is certainly nothing in their structure to prevent such mobility.

Then the legs, instead of being inserted at the extreme posterior edge of the plate, are planted almost in its very centre, and are indeed so large that they occupy nearly its entire width; neither are those of opposite sides inserted close together, but are removed from one another by a space equal to their own width, giving them ample play. The legs themselves differ from those of modern types in having the second joint as long as the others combined, and the whole leg at least as long as the diameter of the body, and sometimes nearly twice as long; moreover they are not cylindrical but compressed and slightly expanded, strengthened also on the flattened surface by longitudinal carinæ, and in every respect, in those specimens in which the legs are best preserved, have the aspect of *swimming-organs*. No aquatic forms are known among recent myriopods.

The stigmata, instead of having the position they hold in modern Diplopoda, where they are necessarily minute, are very large, situated in the middle of each ventral plate, each spiracle opposite to and indeed touching the outside of the coxal cavity of the plate to which it belongs, and running therefore with and not athwart the plate, *i. e.* across the body. But in addition to these structures, which make up the sum of the furniture of the ventral plate in modern Diplopoda, we find in these ancient myriopods some further interesting organs, which are so perfectly preserved that no doubt can be entertained concerning their presence and their adherence to the ventral plate. The coxal cavities are not circular but oval, and are situated with the major axis in an oblique line, running from near the middle line of the body forward and outward: this and the slight posterior insertion of the legs leave even a wider space between them at the anterior border of the

plate than at the posterior; and this place is occupied by a pair of peculiar organs, situated one on either side of the median line at the very front edge of every ventral plate. These, I think, may be supports for branchiæ; they consist of little triangular cups or craters, projecting outward from the under surface, through which the branchial appendages protruded. Until recently no other organs than branchiæ had been found in any arthropod, situated within the legs, and repeated on segment after segment. The only exceptions known are *Peripatus*, a strange creature, allied certainly to the myriopods, but of lower organization, in which Balfour has found segmental organs (heretofore known only in worms) having their external openings somewhat similarly situated, and *Scolopendrella*, a minute chilopodous myriopod, in which Ryder has just described organs which he calls tracheæ, opening externally between the legs. But as branchiæ also occur *together with spiracles* in some low-organized insects, and then in essentially similar relative positions to that in which they are here found, and as the possession of legs adapted to swimming leads us to presume in these creatures an aquatic or amphibious life, it would seem as if we might fairly conceive these crateriform appendages to be branchial supports*, and conclude that we are dealing with a type of myriopods very different from any existing forms—suited to an amphibious life, capable of moving and breathing both on land and in water. Moreover the assemblage of forms discovered in the Mazon-Creek beds lends force to this proposition; for the prevalence of aquatic Crustacea, of fishes, and ferns indicates that the fauna and flora were those of a region abounding in low and boggy land and pools; and the presence of marsh-frequenting flying insects does not contradict such a belief.

These, however, are not the only points in which the ancient forms differed from the recent. We have so far examined only a typical segment; let us now look at the body as a whole and at special segments. The modern Diplopoda are of uniform size throughout, tapering only at the extreme tips; while these ancient forms, at least when seen from above, diminish noticeably in size towards either end, and especially towards the tail, giving the body a fusiform appearance, its largest part being in the neighbourhood of the seventh to the tenth body-segments, which were often two, or even three, times broader than the hinder extremity, and considerably broader than the head or the first segment behind it. A single segment seems to have carried all the appendages related to

* Even if they were segmental organs, they may still have been connected with respiration.

the mouth-parts, while in modern Diplopoda two segments are required for this purpose: this peculiarity of the fossil is inferred solely but sufficiently from the fact, perhaps even more remarkable, that every segment of the body (as represented by the dorsal plates), even those immediately following the single head segment, is furnished with *two* ventral plates and bears *two* pairs of legs. As is well known, each of the segments immediately following the head-segments in existing Diplopoda bears only one ventral plate and only a single pair of legs—a fact correlated with the embryonic growth of these creatures, since these legs and these only are first developed in the young diplopod. The mature forms of recent Diplopoda therefore resemble their own young more than do these Carboniferous myriopods—a fact which is certainly at variance with the general accord between ancient types and the embryonic condition of their modern representatives, and one for which we can offer no explanatory suggestion worth consideration.

Unfortunately the preservation of the appendages of the head in these Carboniferous forms is not sufficiently good in any that have yet been found to allow any comparison with modern types. This is the more to be regretted since these parts are those on which we depend largely for our judgment of the relationship of the Myriopoda to other Insecta and to Crustacea. If they were present and sufficiently well defined, we may well suppose that they would afford some clue to the genetic connexion of these great groups.

The structure of the Carboniferous *Euphoberiæ* has thus been shown to differ so much from that of modern Diplopoda that, as stated at the outset, we seem warranted in placing them in a group apart from either of the suborders of modern Myriopoda and of an equivalent taxonomic value.

Cambridge, U. S., January 7, 1881.

XLVI.—*Polyzoa, Cœlenterata, and Sponges of Franz-Joseph Land.* By Stuart O. Ridley, B.A., F.L.S., Assistant in the Zoological Department, British Museum.

[Plate XXI.]

The specimens here to be described were collected by Mr. Grant, the naturalist accompanying Mr. Leigh Smith in his cruise last autumn to Franz-Joseph Land and Spitzbergen. They were presented by the latter gentleman to the British Museum, and form the first collection from the former locality which has yet