Seeley, H. G. 1870. On *Ornithopsis*, a gigantic animal of the pterodactyle kind from the Wealden. *Annals and Magazine of Natural History*

all those *Zoosporeæ* in which hitherto zoospores only have been found.

The following is a short summary of the results of this paper:—

1. In the division of the *Zoosporeæ* there are to be found motile brood-spheres which appear in the form of zoospores.

2. The resting brood-spheres are more or less abnormal forms of the zoospore, devoid of cilia.

3. The colourless anterior end of the brood-spheres of Algæ, the "canal-cell" of the higher Cryptogams, and the "filamentary process" of Phænogams are structures which are morphologically identical with the so-called mouth, germ-spot, or, what is the same thing, the *foot* of the zoospore.

4. By analogy to the phenomena of total and partial segmentation in animal ova, it happens in plants that sometimes the entire mass of the brood-sphere is appropriated to the formation of the embryo, sometimes only a portion of it; in the latter case there occurs an entire (?) or partial casting-off of the colourless foot of the brood-sphere, which casting-off occurs sometimes before (as in *Vaucheria*, *Coleochæte*, and *Salvinia*), sometimes after (?) impregnation (as in Phænogams).

5. The remarkable phenomenon that the zoospore is the morphologically fundamental state of the reproductive organs, is an argument for the embryological unity of the vegetable kingdom, and shows that there is a morphological as well as a histological point of contact between it and the animal kingdom.

XXX.—*A last word in Reply to* Dr. Chapman *and* Mr. Frederick Smith *on the Relations of the Wasp and* Rhipiphorus. By Andrew Murray.

The subject has now been so fully ventilated that further discussion seems unnecessary. We have reached that stage when little more can be said on either side until further observation shall have given us fresh materials to argue from. The discussion which has taken place, however, has been of good service in clearing away irrelevant matter, and showing us where the pinch really lies. I trust that Dr. Chapman may have every success in his researches during the ensuing summer; and should he succeed in proving me to be in the wrong, I promise to make him my fullest and handsomest acknowledgments.

To Mr. Smith I have still an answer to make.

In the postscript to my last paper I said:—"I had also the pleasure of showing to Mr. Smith my specimens of pupæ [of *Rhipiphori*] with the cast skin still sticking to their tail, and I think he will no longer" &c.

In his reply Mr. Smith writes, "The last paragraph of the postscript is entirely suppositional. Mr. Murray has not shown me any of his specimens."

Mr. Smith's memory is as much at fault as his courtesy. According to my recollection, when I went to see his specimens, I took my own with me to him at the British Museum, and then and there showed them to him. They were in small flat glass phials, preserved in Canada balsam; and I have a vivid impression on my mind of Mr. Smith examining them against the light with his pocket-lens, when I pointed out the cast skins adhering to the tails; and that he then made some remark which led me to conclude that he accepted the inference I drew from them; but, as it was not made explicitly, I stated this merely as my belief.

I scarcely think that I could have dreamed all this; and as a visit to the British Museum with specimens in hand is for me a sufficiently rare event to make some impression on my mind, whilst with Mr. Smith it must be the exception to have a day pass without numbers of visitors bringing specimens for examination, I do not think that I am any way unreasonable in claiming for my positive recollection (positive in its double sense) a preference over his negative assertion—that is, always supposing it to be put as a matter of memory, which, notwithstanding his peculiar mode of expressing himself, I do not doubt Mr. Smith to mean it to be. If, however, it is as a matter of veracity that Mr. Smith really puts it, I can only make him my bow once and for all, and leave him in the enjoyment of his own opinion, consoling myself with the assured conviction that it will be shared by no one but himself.

XXXI.—*On* Ornithopsis, *a Gigantic Animal of the Pterodactyle kind from the Wealden.* By Harry G. Seeley, F.G.S., Assistant to Prof. Sedgwick in the Woodwardian Museum of the University of Cambridge*.

The two vertebræ to which I would here call attention are in the British Museum; other remains allied to them were shown to me with much courtesy by the Rev. Mr. Fox, of Brixton. From these materials I am led to infer the existence of a new

* Communicated by the Author, having been read before the Cambridge Philosophical Society, Nov. 22, 1869.

order of animals. One of the British-Museum fossils is from Tilgate; the other, probably from the Isle of Wight, is labelled South-east of England. They are of size and structure and texture such that both might well have belonged to the same kind of organism; and as no other remains are known to which either bone approximates, they are here considered to indicate the same animal. One vertebra is from the lower part of the neck, and the other from the lower part of the back. When perfect, the neck-vertebra can scarcely have measured less, from the back to the front of the centrum, than ten inches. The neck would appear to have been carried erect, after the manner of birds. If seven cervical vertebræ were to be presumed (and there can scarcely have been fewer), it would give a neck from four to five feet long, and an animal of a minimum height of from ten to twelve feet, while it is not impossible that it may have been twice or three times as high. Both vertebræ agree in being constructed after the lightest and airiest plan, such as is only seen in Pterodactyles and birds; and they agree in possessing pneumatic foramina, which are an avian and ornithosaurian peculiarity. The foramina are of enormous size, and approximate to those of Pterodactyles rather than to those of birds. Seeing that in living animals these foramina exist for the prolongation of the peculiarly avian respiratory system into the bones, and that no other function is known for them, we are compelled to infer for this animal bird-like heart and lungs and brain. Both in Pterodactyles and birds one type of brain coexists with these foramina; therefore there is no reason to suspect a different organization for these specimens.

Our animal is therefore clearly ornithic. But it does not conform closely in the shape of vertebræ to either Pterodactyles or birds. And from the bones preserved, and many other indications of allied animals which I have seen from the Wealden and Potton Sands, I anticipate that it will form the type of a new order of animals which will bridge over something of the interval between birds and Pterodactyles, and probably manifest some affinity with the Dinosaurs.

In view of these considerations it is impossible not to recall with interest the gigantic ornithic footprints described by Mr. Beccles and Mr. Tylor from the Wealden. They might not improbably have been the tracks of this animal.

The Mantellian specimen in the British Museum, numbered 28632, is apparently a late cervical vertebra, with the centrum about nine inches from front to back, six inches from side to side, and about seven inches from the base of the neural canal to the base of the vertebra. It is much worn, the neural arch being too much abraded to give evidence of zygapophyses or neural spine, or the extent of the transverse processes.

The posterior articulation is vertically ovate and well cupped; seen from the side, its outline is concave, so as to admit (apparently) of lateral motion upon the adjacent centrum. In front the body of the vertebra is rather larger than it is behind, and convex; but it has been worn so that the whole of the external layer of bone over the anterior articulation has been removed: it was of paper thinness, as in the Pterodactyles. Wherever this external film is wanting is seen either an absolute cavity or enormous honeycomb-like cells of irregular polygonal form, for the most part long in the direction of the depth of the centrum, and divided by exceedingly thin and compact films of bone, which extend towards the articular ends of the vertebra.

In the middle of the upper part of the side of the centrum, below the level of the neural canal, is an enormous subtriangular hole lined with a continuation of the external bone for some distance inward. It is more than a third of the length of the centrum, longer than high; its upper angle is above the level of the base of the neural canal; and it narrows towards the concave end of the centrum. This large hole, between three and four inches long, is situate precisely as are the pneumatic foramina of Pterodactyles, and in this specimen is regarded as a pneumatic foramen which supplied the bone with air from the lungs after the plan of the class of birds.

In front of it the combined centrum and neural arch widen rapidly, as though for the attachment of a rib, though possibly the thickening may be only such as characterizes the neck-vertebræ of birds.

The external surface is dense and smooth, and gently concave from front to back, where the margin of the posterior cup is prominent. From above downward the sides are convex, and approximate in a natural compression so as to form an inferior mesial antero-posterior ridge.

The neural canal posteriorly is subovate, higher than wide, and about three inches high.

The lateral compression of the centrum is altogether avian; and in the anterior enlargement it resembles birds rather than Pterodactyles, though herein recalling certain Dinosaurs. The opisthocœlous centrum may be matched among mammals, Dinosaurs, and a few natatorial birds.

In the 'Geology of the South-east of England,' Dr. Mantell figured, at pl. 2. fig. 5, a bone which he describes as the tympanic bone of *Iguanodon*, at pp. 305, 306 of that work.

He compares the fossil to the tympanic bone of *Mosasaurus*, with which it certainly has no near resemblance. In the Palæontographical Society's volume for 1854 (Dinosauria, part 2), Professor Owen figured a similar bone, which he agreed with Dr. Mantell in regarding as the tympanic bone of *Iguanodon* (p. 18), but suggests that it may possibly belong to *Cetiosaurus* or *Streptospondylus*. This specimen I interpret as the lower dorsal or lumbar vertebra of *Ornithopsis*.

Dr. Mantell's description is as follows:—

"In these bones the body bears some resemblance to a vertebra, but the large cells or hollows which pervade it throughout readily distinguish it; it forms a thick pillar or column, which is contracted in the middle, and terminates at both extremities in an elliptical and nearly flat surface: two lateral processes or alæ pass off obliquely, and are small in proportion to the size of the column.... From the great size of the body in the fossil and the extreme thinness of its walls, the tympanic cellulæ must have been of considerable magnitude."

In this description there is not one character which can reasonably be presumed to characterize the quadrate bone of *Iguanodon*, or which is inconsistent with the identification of the fossil as a lumbar vertebra; for the cellular character, which weighed with Dr. Mantell against making such a determination, is seen, from the previous description of a cervical vertebra, to be evidence in its favour. The following characters are shown in Professor Owen's or, rather, Mr. Dinkel's figure. The centrum, from seven to eight inches long, shows large internal air-cells and a dense outer film, like the specimen 28632. Posteriorly the articular surface is about four inches deep, subcircular, and slightly hollowed. Anteriorly the centrum seems to be larger; but the articular surface is not preserved. The centrum is subcylindrical, expanded towards both ends, so as externally to be concave from front to back all round.

The pneumatic foramen is placed towards the anterior end of the vertebra, between the centrum and the neural arch. It is from two to three inches in length, compressed behind, about an inch high, and rounded in front.

The lunate mass, in Prof. Owen's figure, above the pneumatic foramen, is the transverse process. It is an exceedingly thin and dense film, only comparable to the transverse process in similar vertebræ of birds.

The affinities of this specimen are in accordance with the avian type. If supposed to belong to an animal of like species with the cervical vertebra, it would resemble Pterodactyles in the smaller size of the back relatively to the neck; in the elongation of the centrum it resembles the lower dorsal vertebræ of birds.

I have made this note, not as a sufficient description of the specimens to which it relates, but in the hope that other parts of this and allied animals may be made available for scientific description by those collectors who possess them, and that they will so make known a group of animals as marvellous in size and organization as any which have enriched the records of palæontology. With the fossil I would associate the name of my friend Dr. Hulke, chronicling the species as *Ornithopsis Hulkei*.

XXXII.—*On* Zoocapsa dolichorhamphia, *a Sessile Cirripede from the Lias of Lyme Regis.*

By Harry G. Seeley, F.G.S., Assistant to Professor Sedgwick in the Woodwardian Museum of the University of Cambridge.

Among some Lias fossils obtained at Lyme Regis by Mr. Henry Keeping, for the Woodwardian Museum, was one which exposed a portion of the tergum of a sessile Cirripede. It rested in a hard matrix of calcareous clay, immediately upon a layer of Pentacrinite-limestone; and it was not till after some days of dissecting that I had the pleasure of laying bare the entire tergum and entire scutum of the oldest known representative of the group. Every way it is a remarkable fossil: the scutum closely resembles that of the pedunculate Cirripede *Scalpellum*; the tergum, by its long beak, recalls certain *Balani*; while the emargination of its basal border points strongly to another beaked type, *Elminius*. Yet as it fortunately happens that the internal aspect of these opercular valves is exposed, it is manifest that neither valve displays the muscular scars which distinguish the Balanidæ; and herein they resemble the Verrucidæ. But since the shape and articulation of the valves offer no resemblance to *Verruca*, it is open to speculation whether an inner porcellanous layer of shell has disappeared, and so obliterated the muscular impressions—a supposition which is, perhaps, supported by the scutum being rough and cancellate internally, seemingly from reproducing the outside ornament. From the tergum and scutum being in juxtaposition, and these valves being only two in number, there is some support for a Verrucian hypothesis; yet from the articulation of the valves conforming to the straight-hinge type of *Balanus*, it is probable that, unless we have here a new family type (as I incline to believe), its place is among the Balanidæ.