

Gardner J. S. British Eocene Aporrhaidae.// The geological magazine, 1884.-
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Folia

by Dr. F. von Hochstetter and Dr. A. Petermann). Hochstetter also published both in German and in English his "Travels in New Zealand" (Stuttgart, 1863). During the Novara Expedition he wrote and sent home reports of his travels which were published in 42 numbers of the "Wiener Zeitung."

Within two months after his return (on the 29th of February, 1860) Hochstetter was appointed Professor of Mineralogy and Geology in the Royal and Imperial Polytechnic Institute in Vienna, a post which he held until 1874. Here he published a Text Book of Mineralogy and Geology, which completed its 5th edition in 1884. In 1869 he was invited to study the geology of the country along the lines of railway then in construction between Constantinople and Belgrade, in company with the engineers and surveyors. The result of his researches, with appropriate maps and sections, appeared in the Jahrbuch der k.k. geol. Reich. Vienna (1870, Bd. xx. and 1872, Bd. xxii.), and was very fully noticed in the GEOL. MAG. Vol. VIII. 1871, pp. 466-473, and Vol. X. 1873, pp. 274-277.

In 1872 Hochstetter undertook with Prof. Toulou a journey through Russia to Boguslow and Turjinsk on the eastern side of the Urals.

He was made president of the k.k. Geological Society of Vienna in 1867, a post which he held until 1882, when he resigned the chair through ill-health.

Hochstetter was selected in 1872 by the Emperor of Austria as tutor in natural history to H.S. Highness the Crown Prince Rudolph.

Some idea may be formed of the versatility of Prof. von Hochstetter's genius from the scientific subjects which are embodied in his publications.

Besides those already enumerated may be cited "Earth-oil and 'Earth-wax' in the Sandecor District, Galicia" (1865), "On the alleged Trachyt-find of Ortler" (1865), "Deep-soundings in the lake of Kärnten" (1865), "On the Slate-quarries of Maria-thal in Hungary" (1866), "On the Eozoon of Kruman," "On the Coal and Iron-works of Anina-Steyerdorf" (1867), "Section through the North side of the Bohemian Chalk Formation from Wartenberg to Turnau" (1868), "Reptilian Impressions in the 'Rothliegende' of Rossitz-Aslawan" (1868), "Rhinoceros-remains from Grassengrün in Bohemia" (1871), "Orthoclase crystal of Koppenstein in the Carlsbad Mountains" (1872), "Remains of *Ursus spelæus* in the Igritzer Cave in Biharer, Hungary" (1875), "*Cervus megaceros* of Nussdorf" (1875), "The Earthquake of Peru on Aug. 13th, 1868," and "The Tide-wave in the Pacific Ocean from 13th to 16th August," "Experiments on the internal structure of Volcanos and on the Miniature Volcanos of Schwefeld" (1870).

In 1876 he was made Superintendent of the k.k. State Natural History Museum in Vienna, and was occupied incessantly in its reorganization until the day of his death, July 18th, 1884.

His loss will be keenly felt by a large circle of friends in Austria and elsewhere, by whom Prof. Hochstetter was warmly appreciated and justly admired.



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ORIGINAL ARTICLES.

I.—BRITISH EOCENE APORRHAIÐÆ.

By J. STARKIE GARDNER, F.L.S., F.G.S., etc.

(PLATE XVII.)

NEARLY ten years ago it was my privilege to describe the British Cretaceous forms of this Family in the GEOLOGICAL MAGAZINE. The Family was seen to be capable of subdivision into at least five well-marked genera, and to these a sixth very singular and remarkable one from Aix-la-Chapelle, and also represented at Blackdown, may be added. It was then that the Family reached its zenith, and in the still later Cretaceous rocks of Europe, as a flame burns brightest near its end, so some species suddenly assumed relatively gigantic proportions, and as suddenly became extinct. A few survived in America down to that much later period, the close of the so-called Cretaceous series on that continent. Only two types lived on to the present day and only one of these has ever since Cretaceous times been represented in our area.

Turritid Gasteropods, with wing-like expansion of the shell, first appear in the Middle and Upper Lias in France, but have not been found in England in any rocks older than the Jurassic. Several species were figured from the latter by Mr. W. H. Hudleston, F.R.S.,¹ showing how remarkably little modification some types reappearing in the Cretaceous had undergone, and carrying our knowledge of the British species back a very considerable stage. We thus see that with the exception of the patelliform, heliciform, and trochiform groups, the present is the most venerable for its antiquity. The present paper will go far towards completing our knowledge of the life-history of the Family in British strata, for in post-Eocene rocks only slight modifications of the still existing species are met with.

The Eocene group is composed of forms differing so slightly from each other, that were the assemblage an existing one, we should hardly hesitate to regard them all as coming well within the range of variation of a single species. All belong to an ancestral type of the living *A. pes-pelecani*, and thus to the true genus *Aporrhais*. For all biological purposes this statement might suffice, but in dealing with fossils, other points have to be considered. They must be so described that the general tendency and direction of the successive

¹ See GEOL. MAG. Dec. II. Vol. VII. 1880, Pl. XVII. Fig. 6, p. 532, and *ibid.*, Dec. III. Vol. I. 1884, Pl. VI. pp. 145-154, and Pl. VII. pp. 193-200.

modifications they have undergone with the lapse of time may be as apparent as possible. Each has its place in the long chain of descent of which the whole Eocene period forms so to speak but a few links. Rightly interpreted, each should form a landmark, assisting us to fix with some show of reason, not only the relative ages and mutual relationship of the subdivisions of the Eocene, but even to form a kind of idea of the time that had elapsed between their several periods of deposition. Bearing these considerations in mind, fossil shells, it will be seen, demand far more minute and critical examination than those that are living. This aspect of the case again forces upon us the question, one becoming more and more pressing and urgent, as to whether the binomial system can be made much longer to suffice. Here is a group of forms, separated by characters that are in themselves not entitled to specific rank, and not of the same value as existing species. We attach therefore a false importance to them, in calling them species, while if we call them varieties or sub-species, we depart from the ordinary practice, and at once introduce a triple nomenclature. Personally I should like to see them written with three names, as *Ap. Sowerbii hantonensis*, etc., a method that would save much definition.

In order to avoid tedious repetition, and to condense the descriptions, I propose to describe one type sufficiently minutely, and to point out in what way the others depart from it. In a group of shells so very closely allied to each other it does not seem likely that this can lead to inconvenience.

The first record of their occurrence in the English Eocenes is in Sowerby's Mineral Conchology, vol. iv. p. 69, plate 349, figs. 1-4. They are described as *Rostellaria Parkinsoni*, and stated to occur always above the Chalk. In the sixth vol. 1827, p. 112, pl. 558, fig. 3, another illustration is given under the same name, but in the systematic index, p. 248, published in 1835, the name is changed to *R. Sowerbii*, Mantell having in the interval, 1829, pointed out that the original *R. Parkinsoni*, Geol. Trans. 2nd ser. vol. 3, p. 203, is a wholly different and a Cretaceous fossil. It was named in compliment to the son, J. de C. Sowerby, who continued the Mineral Conchology, and not, as supposed by Nyst, to the father, who was the author of it. Nothing has been done with the Eocene species in England since, except to transfer them to *Aporrhais*.

At least three of the species to be described were figured in Sowerby under the one name, and it is therefore immaterial to which it becomes definitely attached.

APORRHAÏS SOWERBII, Mantell, sp. 1829. LONDON CLAY.
Plate XVII. Figs. 5 and 6.

The characters are based upon 96 specimens in the Edwards' and other collections in the British Museum.

The maximum dimensions are, length 24 mm., width across wing 20 mm.: the smallest adult shell measured 13 by 11 mm., the wing being thickened in this case to 2 mm. It is never composed of less than 5 or more than 8 whorls, the average being 6. The whorls are

tumid, much wider than high, the proportion being as 6 to 3½. The spire is usually ribbed, the ribs extending right across from suture to suture, more pronounced in the centre, slightly bowed away from the wing, and so close together that one occurs within every half millimetre on the last whorl of the spire (next the body-whorl). The ribs are sometimes entirely absent, and occasionally a varix is present. The spire is always regularly striated, the striæ being well defined and at least 3 to the millimetre. The body-whorl becomes slightly angulated as the wing is approached, and the ribs betray a tendency to separate into two rows of elongated nodes, which gradually coalesce into two ridges or keels as they pass on to the wing. The upper keel is produced into a digit directed upward at an angle of about 40° from the spire, the lower one projects very slightly beyond the margin of the wing. Its general contour is something like the wing of a bat; and inclined to be notched, or to have a sinus close to the canal, which is short. The striæ are continued all over the upper surface of the wing, fanning out, but without becoming more numerous. The wing is sometimes attached to the body-whorl only, sometimes it extends over three, but as a rule it is attached to two whorls. This description only applies to the adult shell, the wing not commencing to be developed until the spire is full-grown. After the wing attains to its full spread, it receives repeated deposits of shell and becomes much thickened. The aperture presents no important characters, but the inner lip is callus, though the callosity is not continued far over the body-whorl. The outermost shelly layer of the spire sometimes peels off in the fossil, carrying away the striæ, and leaving the ribs quite smooth and very distinct.

About 8 shells in the Edwards' collection are separated as "*variety elongata*," the spire being more regularly scalariform, with more strongly-marked ribs. The retention of a separate name for so unimportant a variation seems to me useless. This species abounds at Clarendon, Bognor, Alum Bay, Aldboro, and Southampton, in the Hampshire Eocene Basin, but is not found in the London Basin. One specimen from Southampton is of rather larger size and slightly bridges the distinction between that and the London Clay species to be next described.

It is represented in Figs. 5 and 6 of Plate XVII., the originals being from Clarendon.

APORRHAÏS LABELLATA, sp. nov. LONDON CLAY.

There are but few specimens of this species in the British Museum, only two or three are perfect.

The average length of the shell is 34 and the breadth 27 millims., though one with a longer canal measures 40 mm. The spire is more regularly tapering, formed of 8 or even 9 whorls, less tumid than in the last species, and with the last but one, as well as the body-whorl, slightly angulated. The ribs are coarser, one rib occupying 2 mm., and rather more bent, and separating into two distinct series of rounded nodes on the body-whorl, the upper of which is by far the

most emphasized. The great distinction, however, lies in the form of the wing, which is like the last, but a little more expanded, with a more pronounced upper digit, and also carried upward along the spire to the fourth whorl, where it is truncated and expanded outwards into a quadrate projection of a flag-like form, at an angle of about 60° to the axis of the spire. This flag is continuous with the wing, projects some 12 or 15 mm., and has no supporting keel.

It has been found at Highgate and other localities round North London and at Sheppey, and seems to replace *A. Sowerbii*, Mant., in the London Basin, the latter having been perhaps more littoral in its habit.

APORRHAÏS MARGERINI, De Koninck, 1837. OLDHAVEN BEDS.
Plate XVII. Figs. 7, 8.

This is by far the largest British species, measuring 50 mm. in length, and 40 in breadth. The spire is blunt and composed of 7 tumid whorls, each about twice as wide as high. The ribs are fine, except on the last whorl, not very prominent, and forming on the body-whorl an upper row of strongly-marked rounded nodes, a middle nodose keel, and a lower less-defined and almost simple keel. The striæ are faintly marked or absent. Each row of nodes or nodose keel on the body-whorl is continued into the wing, the upper forming a curved and not very pronounced digit, and the others ending in slighter projections. The canal is short and curved in the direction of the wing. The wing has, roughly speaking, the outline of a shoulder-of-mutton, and is attached to either one or two whorls above the body-whorl; it is immoderately thickened, up to 7 mm. and slightly sinuous.

All the specimens were obtained close together, between tide marks at Herne Bay, west of Oldhaven Gap. The species as here defined is new to the British Eocenes and seems rare or very local. It is almost indistinguishable from the forms found in the *Argille Rupélien de Bazele*—a bed of Oligocene age.

APORRHAÏS TRIANGULATA, sp. nov. OLDHAVEN BEDS. Plate XVII.
Figs. 3 and 4.

This species differs from the last chiefly in its smaller size, the largest measuring but 16 mm. in length by 15 across the wing. It is a reduced almost facsimile of the last, except that the striæ are more distinct and the third or inferior keel on the body-whorl is less pronounced. It is rather more obtuse and relatively shorter, and the wing more triangular or shoulder-of-mutton-shaped than in *A. Sowerbii*, which it agrees best with in size.

This is very abundant at Herne Bay in the same beds, though not actually associated with the last.

APORRHAÏS BOWERBANKII, Morris, sp. 1852. THANET BEDS.
Plate XVII. Figs. 9 and 10.

The length of this species is 36 mm. and the breadth across the wing 25. The spire is very elongated, regular, composed of 8 or 9 rather tumid whorls, higher than wide in the proportion of 9 to 5.

The ribs are prominent, slightly curved, and occupy a space of about 1 mm. each. The striæ are faint or invisible. The body-whorl is slightly angulated, and the ribs break up suddenly into 3 rows of round tubercles, the upper of which is the more prominent. The wing is relatively small, attached to the body and the penultimate whorls only, and with one digit. The canal is very short.

The species is strictly confined to the Thanet Beds at Herne Bay, and the wing is rarely preserved. Hence Professor Morris was led to regard it as a *Scalaria*, though he noticed that the last whorl was carinated, and the ribs broken upon it.—Quart. Journ. Geol. Soc. 1852, p. 266.

APORRHAÏS FIRMA, sp. nov. BROCKENHURST. Plate XVII. Figs. 1 & 2.

This comes next in point of size to the larger Oldhaven species, measuring 40 mm. in length, by at least 32 across the wing. The spire is very blunt, the whorls much wider than high and tumid. The ribs are curved, oblique, strongly marked, fine, but becoming coarser towards the last whorl, and breaking into three rows of nodes on the body-whorl, the upper being far more prominent and rounded than the rest; the striæ are inconspicuous. The body-whorl is more angulated than usual. The wing is short, and is produced into two digits more equal than in the previous species, and is continued to the apex of the spire. The canal is long.

This is a rare shell at Brockenhurst, only a few specimens being preserved in the Edwards' collection in the British Museum.

A small fusiform shell from Hempstead bears the label *Aporrhais* in the same collection, but it possesses none of the characteristics of even the immature shells of the genus.

The study of this Family, limited to its Eocene range, does not carry us far. It will be noticed, however, that the oldest or Thanet Bed species is more like a Cretaceous form, and less like the living than any other, and that the newest or Oligocene form from Brockenhurst approaches in all its characters the most nearly to the late Tertiary *A. pes-pelecani*, in which the ribbed spire has finally given place to a tuberculated and angular one. The gap in succession is also remarkable, for while the genus abounds in all the marine beds of the Lower Eocene, it is wholly wanting in the Bracklesham, and even the Barton series, and only reappears in the Oligocene of Brockenhurst. A precisely similar gap occurs in Belgium. It seems clear that during the Eocene period it belonged to the northern sea, and was absent in parts at least of the southern.

THE FOLLOWING TABLE SHOWS THE RANGE OF THE EOCENE *Aporrhaidæ* IN GREAT BRITAIN.

| | Thanet Beds. | Oldhaven Beds. | London Clay | Bagshot Series. | Headon Series. | Bembridge Series. |
|-----------------------------|-----------------|-------------------|----------------|--------------------|-------------------|----------------------|
| <i>A. Bowerbankii</i> | x | | | | | |
| <i>A. Margerini</i> | | x | | | | |
| <i>A. triangulata</i> | | x | | | | |
| <i>A. Sowerbii</i> | | | x | | | |
| <i>A. labellata</i> | | | x | | | |
| <i>A. firma</i> | | | | | x | |

EXPLANATION OF PLATE XVII.

| | | British Museum | |
|-------------------------|------------------------------------|--------------------|--|
| | | (Natural History). | |
| Figs. 1 and 2. | <i>Aporrhais firma</i> , sp. nov. | Brockenhurst. | |
| „ 3 and 4. | <i>A. triangulata</i> , sp. nov. | Herne Bay. | |
| „ 5 and 6. | <i>A. Sowerbii</i> , Mantell. | Clarendon. | |
| „ 7 and 8. | <i>A. Margeritii</i> , De Koninck. | Herne Bay. | |
| „ 9 and 10. | <i>A. Bowerbankii</i> , Morris. | Reculvers. | |
| All drawn natural size. | | | |

II.—ON THE DISCOVERY OF TRILOBITES IN THE CULM-SHALES OF SOUTH-EAST DEVONSHIRE.¹

By HENRY WOODWARD, LL.D., F.R.S., F.G.S.

ALTHOUGH the ‘Culm,’ or Carbonaceous series, of Devonshire, has long been known and studied, it has been a matter of considerable doubt as to the exact horizon in the Carboniferous formation with which it may properly be correlated.

The Geological Surveyors have, it is true, spent much time in re-examining certain parts of the County; but, owing to the smallness of the scale of the Ordnance Survey Map (only one inch to the mile) and the inaccuracy of the topography, but little detailed work could be done.

Prof. J. Beete Jukes, F.R.S. (Quart. Journ. Geol. Soc. 1866, pp. 320–371), and subsequently Mr. R. Etheridge, F.R.S. (*op. cit.* 1867, pp. 568–698), described the whole of the northern portion of the county afresh, whilst Messrs. Horace B. Woodward, Clement Reid, and W. A. E. Ussher, as representing the Geological Survey, have been engaged upon certain parts in both the northern and southern areas. Added to this, Dr. Harvey B. Holl, F.G.S., Mr. A. Champenowne, F.G.S., and Mr. John E. Lee, F.G.S., have contributed not a little to the elucidation of difficult parts of the Geology of South-Eastern Devon, whilst Mr. Townshend Hall, F.G.S., has done equally useful work in the Northern area.

In 1839 Sir H. T. de la Beche² notices the Culm-formation, and mentions that Prof. Phillips regarded the Shale-fossils as belonging to the Carboniferous Limestone. The list of plants which he gives contains a mixture of species, many being in all probability true Coal-measure plants from Somerset, which do not occur in the Culm.³

In studying the Culm-measures near Chudleigh, De la Beche supposed that the Culm-shales dipped beneath the Devonian Limestone, in consequence of which he was led to include this Limestone in the

¹ See Plate XVI. (in November Number), Figures 6 to 11, pp. 484–489.

² Report on the Geology of Cornwall, Devon, and West Somerset, 1839, pp. 110, 145, and fig. 8, pl. iv. See also Trans. Geol. Soc. 2nd series, vol. iii. p. 163.

³ Mr. R. Kidston, F.G.S., in reply to my inquiry, gives me the following species as determined by him from the Culm:—

| | |
|--|-----------------------------------|
| <i>Asterocalamites scrobiculatus</i> , Schlot. sp. | <i>Lepidophloios</i> , sp. |
| (= <i>Bornia radiata</i> , Brong.) | <i>Halon</i> (fruiting branch of |
| <i>Calamites Roemeri</i> , Göpp. | <i>Lepidophloios</i>) |
| <i>Sphenopteris</i> , sp. nov. | <i>Stigillaria</i> (?) |
| <i>Lepidodendron Rhodeanum</i> (?) | <i>Stigmara fecoides</i> , Brong. |

(To these I may add *Dadozylon*, Sternb. (*Sternbergia*), in Mr. Vicary's collection.) All these plants have (says Mr. Kidston) a “Calcareous Sandstone” facies and are equivalent to the “Culm” of Germany.

Carbonaceous series, and it was originally so engraved and coloured in his sections and in the Geological Survey Map.¹

The subsequent researches of Mr. John Edward Lee² have led to the discovery of *Goniatites intumescens* and *G. multilobatus*, species characteristic of the Upper Devonian of Devon and Cornwall, and of the Rhineland and Westphalia.

In 1840 Prof. Sedgwick and Sir R. I. Murchison, in their memoir “On the Physical Structure of Devonshire, and on the Subdivisions and Geological Relations of the Older Stratified Deposits,”³ devote pp. 669–684 to a consideration of the “Culmiferous Series, its Relation to the other Formations, Structure, and Fossils.” They mention (p. 678) that “in Ugbrook Park, near Chudleigh [in close proximity to Waddon-Barton, where the Trilobites were discovered by Mr. Lee], there is a large development of Culm Sandstone as coarse as Millstone-grit, and passing into a conglomerate form; over it are some beds of thin-bedded grey sandstone, not to be distinguished from a Coal-measure sandstone, and containing very fine vegetable impressions, among which are well-marked *Calamites*. Indeed, through the whole of the upper group we are describing, vegetable impressions, though rarely so perfect as to give anything like specific characters, are extremely abundant. They add, “All the beds are intersected by numerous open joints, which in the coarser contorted beds are very irregular in their directions. But when the beds have a finer flaggy or shaly structure, the joints often become parallel (especially in a direction nearly transverse to the strike) so as to separate the strata into prismatic masses”⁴ (p. 679).

“Among the more calcareous bands some are fossiliferous, containing a great abundance of at least two genera of bivalve shells; one a *Posidonia*” (*Posidonomya Becheri*, Bronn), the other of a genus not ascertained, but regarded as a marine shell. “In the same part of the series are *Goniatites* of at least two species, both of which are unquestionably marine, and (according to Professor Phillips) identical with *Goniatites* of the Yorkshire Coal-field.”

After quoting Prof. Lindley's determinations of the plants (pp. 681–682), the authors conclude: “On the whole, considering that the Culmiferous rocks of Devon form a distinct group, with a peculiar mineral type (unlike the older groups, but nearly resembling the Culmiferous beds of Pembrokeshire)—that they overlie all the other groups, and are overlaid by no rock newer than the New Red Sandstone—that, notwithstanding the paucity of fossils in the black limestone (in which respect it resembles the ‘Calp’ of Ireland), there are in it one or two species not separable from known Mountain Limestone fossils, and, finally, that the flora of the Upper Culms, as far as it has been ascertained, agrees specifi-

¹ See Mr. Clement Reid's paper, GEOL. MAG. 1877, Dec. II, Vol. IV. p. 454–455. (The *Goniatites* are here spoken of as *Clymenia*.)

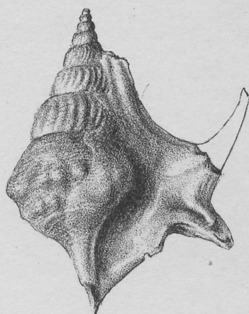
² See Prof. Ferd. Roemer “On the Upper Devonian *Goniatite* Limestone in Devonshire,” GEOL. MAG. 1880, Dec. II, Vol. VII. pp. 145–147, Pl. V.

³ Trans. Geol. Soc. Lond. second series, vol. v. 1840 (read June 14th, 1837).

⁴ This paragraph gives a very exact description of the lithological characters of the beds at Waddon-Barton by Chudleigh, containing the Culm Trilobites.



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2.



5.



3.



6.



4.



7.



8.



9.



10.