

THE
GEOLOGICAL MAGAZINE.

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ORIGINAL ARTICLES.

- I. NOTES ON BRACHIOPODA FROM THE PEBBLE-BED OF THE LOWER GREENSAND OF SURREY; WITH DESCRIPTIONS OF THE NEW SPECIES, AND REMARKS ON THE CORRELATION OF THE GREENSAND BEDS OF KENT, SURREY, AND BERKS, AND OF THE FARRINGTON SPONGE-GRAVEL, AND THE TOURTIA OF BELGIUM.

By C. J. A. MEYER, Esq.

[Plates XI. and XII.]

THE pebble-bed of the Lower Greensand of Godalming has been already referred to ('Geologist,' vol. vi. pp. 53,54) as a singular deposit, underlying the Bargate-stone series of that neighbourhood, remarkable alike on account of its peculiar organisms and its (probable) relation to other distant, though somewhat similar, beds; its position in the Greensand is fortunately well-marked, being immediately at the base of Fitton's 'Upper or Ferruginous division;' or, following the nomenclature of the Geological Survey, at the base of the 'Folkestone Beds.' In composition, it may be roughly described as a mixture of sand and small subangular pebbles, either loosely bedded or variously concreted. Its thickness at Godalming varies considerably, thinning out rapidly to the south of the town, but increasing on the north, in approaching the Hogsback, to a thickness of 8 or 10 feet; occasionally passing into, and alternating with, the lower layers of the Bargate-stone.

Hidden, for the most part, at its outcrop by surface-soil, or by the débris of the upper deposits, the pebble-bed around Godalming is but rarely to be seen unless by chance cut through in some quarry or lane-section. It is in this manner exposed in an old quarry or sand-pit on the side of a lane at Tewsley, to the south of Godalming, where it occurs as a band

of brownish sand and pebbles, varying from 8 inches to 2 feet in thickness. This bed has, by careful search, afforded me a singular series of organisms, amongst which fragments of the casts of *Ammonites* (Oolitic) are the most abundant; casts of small Univalve and Bivalve Shells, teeth of Saurians, teeth and scales of Fishes—*Lepidotus*, *Gyrodus*, *Hybodus*, *Acrodus*, and *Lamna* (?), occurring less frequently, and rarely indeed teeth of *Saurichthys*. It is not, however, to the occurrence of derivative fossils in the pebble-bed that I would now refer; but to that of such fossils as, by their appearance and state of preservation, are evidently proper to the bed in question. These consist of twelve or more species of *Brachiopoda*, three or four small forms of *Exogyra*, *Pecten orbicularis*, a *Pecten* in markings most nearly resembling *P. Raulinianus*, D'Orb., *Avicula pectinata*, *Serpula*, and fragments of *Bryozoa*. I propose on the present occasion to confine my observations to the *Brachiopoda*.

The Brachiopod most frequently to be met with in the pebble-bed of Godalming is a species of *Terebratella*, which, in some of its variations, might be mistaken for a small variety of *Terebratula oblonga*, Sow. (M. C. pl. 535, figs. 4-6); and such indeed I had long considered it to be; but, after meeting with specimens of *T. oblonga* in the same deposit, in its ordinary form, I began to doubt the identification of the smaller species; and a closer examination of the pebble-bed shell tended to convince me that it was not only distinct from Sowerby's *T. oblonga*, but also from two other (foreign) Cretaceous species which it somewhat nearly resembles, namely *T. semistriata*, Defr. (D'Orb. Ter. Crét., iv. pl. 508, figs. 1-11), and *T. Beaumonti*, D'Arch. (Mém. S. G. Fr., 2 sér. pl. 21, figs. 12-14). I am still, however, in doubt whether the imperfect specimen figured and described in Dr. Fitton's Memoir 'On the Strata below the Chalk' (Geol. Trans. 2nd ser. vol. iv. pl. 14, fig. 9), under the name of *T. quadrata* is not the same as this Godalming shell. Yet, while considering the present species as specifically distinct from *T. oblonga*, it seems unadvisable to retain for it a name by which it would still be confounded with that species. I propose therefore to describe the pebble-bed shell under the specific name of *Fittoni*, in honour of one who, if not the original discoverer of the species, has done so much for our Cretaceous geology.

1. TEREBRATELLA FITTONI. Spec. nov. Pl. XI, figs. 1 to 10.
Terebratula quadrata (?), Sow. in Fitton, Geol. Trans., 2 ser. vol. iv. p. 338, pl. 14, fig. 9.

Shell ovate or irregularly pentagonal, its greatest width and

thickness occurring usually near the middle of the shell. Beak rather obtusely pointed or rounded in outline, and more or less recurved; beak-ridges sharply defined, with a flattened, slightly concave, false area between them and the hinge-line. Foramen small, entire; rounded above, pointed below where completed by the deltidial plates, which it indents. Deltidium shallow, broadly triangular, in two pieces, and bordered at the sides by a narrow depressed line.

Valves unequally convex; the larger or dental valve much the deepest, the smaller valve being usually somewhat flattened towards the front. Socket-valve in young shells sometimes wider than long, in old specimens irregularly oval; surface of the valves ornamented by a variable number of plaits, rounded in outline, either simple or bifurcated, the central plaits conspicuously larger; the number on each valve varying from 7 to 15, usually 11. In old specimens the two or three central plaits on the dorsal valve are elevated into a mesial fold (see Pl. XI., fig. 1). The spaces between the ribs often exceed the width of the ribs themselves; which appears to be rarely the case in *T. oblonga*. Lines of growth, in well-preserved specimens, numerous and prominent. Margins of the shell slightly curved at the sides, and more or less elevated in front. Loop of moderate length (extending nearly two-thirds the length of the shell), doubly attached, first to the hinge-plate, and then to lateral processes, which are given off at right angles by the moderately elevated mesial septum; the base and, from the continual growth of the shell, the disused portions of these processes may be seen extending as a curved rib down the sides of the septum to its commencement beneath the hinge-plate. Shell-structure largely punctuated. Dimensions variable:—

Length $7\frac{1}{2}$, width 5, depth 4 lines; largest of 50 specimens.

„ 6, „ $4\frac{1}{2}$, „ $3\frac{1}{2}$ lines; average size.

Localities.—This species occurs abundantly in the pebble-bed at Tewsley and a few other places around Godalming. In the British Museum there are three specimens of this shell from Dorking.

Terebratella Fittoni may be most readily distinguished from *Terebratula oblonga*, Sow, by its diminutive size, and by the smaller number and inequality of the plaits on either valve; it differs also from *T. oblonga* in the ventral valve being less pointed towards the beak, and in the beak itself being more strongly recurved. In *T. semistriata*, Defr., the foramen is rounder and of larger size, and the beak is more abruptly truncated. In *T. Beaumonti*, D'Arch., the beak is shorter and also more abruptly truncated, while the smaller valve is more inflated near the hinge-line. So much for external differences; it remains yet to be decided, however, whether the loop in either of these species was doubly attached as in *T. Fittoni*.

2. WALDHEIMIA MOUTONIANA, D'Orb., Pl. XII., figs. 12–14.

Associated with the foregoing species there occurs a shell which, from its outward form and elongated internal loop, can be no other

than a variety of *Terebratula Moutoniana*, D'Orb., a species which has been recently added to our list of Cretaceous Brachiopoda by Mr. E. R. Lankester ('Geologist,' vol. vi. p. 314). The lowest layers of the pebble-bed at Tewsley also afford examples of two elongated species of Brachiopoda, one of which is an undescribed form of *Terebratula*, for which, for want of a better designation, I propose the name of *T. extensa*; the other I am inclined to consider as probably identical with *T. Boubei*, D'Arch. (Mém. S. G. Fr. ii., pl. 19, fig. 11. The first of these species requires a short description.

3. TEREBRATULA EXTENSA, Spec. nov. Pl. XII., figs. 1-4.

Shell unequally oblong-ovate, square in front, somewhat pointed towards the beak. Valves unequally convex, smooth, without either mesial fold or sinus; showing only a few, concentric lines of growth. Ventral valve much the deepest and curved upwards in front. Dorsal valve flattened and slightly elevated in front, much depressed at the sides, and inflated near the hinge-line. Most of my specimens show also on the dorsal valve a central, longitudinal depression (see Pl. XII., fig. 3), which, commencing near the hinge, extends to about the centre of the valve.* Beak short, very slightly recurved, and abruptly truncated by a large circular foramen, which is formed chiefly from the beak, and completed by the deltidial plates. Deltidium in two pieces, wide, but extremely shallow (see Pl. XII., fig. 4), and almost hidden by the (apparent) encroachment of the smaller valve upon the hinge-area; beak-ridges but little defined; margin of the valves flexuous. Shell-structure minutely punctuate. Loop short and simple.

Dimensions.—The two largest of my specimens measure:—

Length 13, width 7, depth 6 lines.

„ 11, „ 7, „ 5½ lines.

Approaching to *T. pralonga*, Sow., in its elongated form, and in its large and circular foramen, *T. extensa* differs from that species in the shortness of its beak, the greater comparative breadth of the dorsal valve near the hinge-line, and in the absence of biplication in front.

4. Of the shell which resembles *Terebratula Boubei*, D'Arch., I have obtained many single valves from the pebble-bed around Godalming, about a dozen specimens (from a similar position in the series) from the Lower Greensand between Folkestone and Sandgate, and a few single valves from the Sponge-gravel of Farringdon. See Pl. XII., figs. 5-7. The specimens from these three localities have a general outward resemblance to each other, and appear to be all equally distinct from *T. Celtica*, Morris, and *T. pralonga*, Sow., to both of

* A somewhat similar depression may be occasionally seen in specimens of *Waldheimia Celtica*, and would usually perhaps afford evidence of an internal septum; this species, however, as is proved by casts and single valves in my collection, had no trace of an internal septum.

which species this form somewhat nearly approaches; I am not, however, prepared to say that they are specifically identical with *T. Boubei*, D'Archiac, and must therefore be content, for the present, merely to notice their occurrence in our Lower Greensand.

Some uncertainty appears to exist with regard to the specific value of the two or more forms of *Terebratula* which, under the name of *T. Tornacensis* and varieties, are so abundant at Farringdon; for I find that M. D'Orbigny (Prodrome de Paléontologie, vol. ii. p. 172) includes the following—*TT. Tornacensis, Bouei, crassa, Robertoni, crassificata, rustica, Boubei, Virleti, revoluta, subpectoralis*, and *Keyserlingii*, of D'Archiac, amongst the varieties of *T. biplicata*, Brocchi; while Mr. Davidson (Monogr. Cretac. Brachiop. pt. 2), on the contrary, appears to consider *T. Tornacensis*, D'Arch., to be a well established species, perfectly distinct from *T. biplicata*, and of which the following—*TT. Roemeri, Bouei, rustica, crassa, crassificata*, and *Murchisoni*, are varieties; admitting *T. Robertoni, T. subpectoralis*, and perhaps *T. Virleti* and *T. revoluta*, to be specifically distinct from *T. Tornacensis*. Whether owing to distorted growth in certain individuals, or to any other cause, it is certain that the forms attributed to *T. biplicata* and *T. Tornacensis*, in the Farringdon Sponge-gravels, vary greatly in size, form, and general outward appearance; so much so indeed as to render it difficult, amongst a large number of specimens, to determine whether there are two, or four, or more species present; and, as in these specimens the loop is never (?) or very rarely preserved, it is the more to be regretted that so little dependence can be placed on those surface-markings of the shell ('striés d'accroissement') by which M. D'Archiac has distinguished several of his (*Tourtia*) species,—among others *T. Boubei*, but which, in the Farringdon specimens, appear to be of too fleeting and variable a character to be of any appreciable value. That Mr. Davidson is right in distinguishing *T. Tornacensis* from *T. biplicata* there can be little doubt; the former being even more closely allied to *Terebratula sella*. Some examples of this last species, indeed, in the form which prevails in the upper beds of the Lower Greensand at Shanklin are scarcely to be distinguished from M. D'Archiac's figures of *T. Tornacensis* (Mém. S. G. Fr., 2nd. sér. ii. pl. 18, fig. 3). Whether or not *T. Boubei* should therefore be regarded as a distinct species, or included among the varieties of *T. Tornacensis*, future researches must decide.

In addition to those already mentioned the pebble-bed has afforded me more or less perfect examples of the following species:—

Terebratella Menardi, Lam.—A few single valves from the pebble-bed, and from the Bargate-stone near Guildford.

Terebratulina striata, Wahl.—Several specimens from the pebble-bed at Tewsley and Hurtmore; it occurs more frequently in the Bargate-stone near Guildford. *T. striata* does not appear to have been heretofore met with below the Gault.

- Terebratula oblonga*, Sow.*—Occurring sparingly in the pebble-bed, but more frequently in the Bargate-stone near Guildford, in the form represented Pl. XI. figs. 12-14.
- T. Tornacensis*, var. Roemeri, *D'Archiac*.—A few single valves from the pebble-bed near Guildford.
- T. Robertoni* (?) *D'Archiac*.—Several imperfect specimens, answering most nearly to the description of *T. Robertoni*, have been met with in the pebble-bed at Hurtmore near Godalming, and also near Guildford. See Pl. XII. figs. 10, 11.
- T. depressa* (?), *Lam*.—Fragments of a large *Terebratula*, which may possibly represent *T. depressa*, have been obtained from the pebble-bed near Godalming. The specimen represented on Pl. XII. figs. 15*a*, *b*. is from the Lower Greensand of Shanklin.
- Waldheimia tamarindus*, Sow.—Occurring sparingly at Tewsley. At Hurtmore, SW. of Godalming, it occurs in the sand immediately beneath the pebble-bed.
- Rhynchonella latissima*, Sow.—Single valves only, from the pebble-bed near Guildford; rare.
- Rh. depressa* (?), Sow.—Single valves only, Godalming and Guildford; rare.
- Rh. Gibbsiana*, Sow., var.—Single valves, Tewsley and Hurtmore, &c.; rare.

Figures of several of the above-mentioned species are given in the accompanying Plates XI. and XII., in consequence of the infrequency of their occurrence in beds of undoubted Lower Greensand.

In the May Number of the 'Geologist' (vol. vii. No. 77, p. 166), there was given a description of a new species of *Terebratella* from the Bargate-stone, under the name of *T. trifida*, drawings of which were to have appeared in the following Number; but, in consequence of the somewhat sudden discontinuance of that periodical, they were inadvertently omitted: these figures are therefore introduced on the present occasion. See Pl. XI. figs. 17-23.

In the foregoing remarks mention has been made more especially of the pebble-bed of Godalming as a local deposit; yet, though in one sense local, it should not properly be so considered; the same band of pebbly strata being more or less traceable in the Greensand along the whole of the North Downs,—as at Guildford, Dorking, Nutfield, and Sevenoaks; it may also be observed at Folkestone and Shanklin; in all these places holding exactly the same position in the series. So that, although perhaps in part a local, as well as a littoral,

* I regret that I am unable, partly for want of space, to enter into a minute comparison of the varieties of *T. oblonga*, some of which, as is shown by Mr. Davidson (Mon. Cret. Brach., pt. 2, pl. 2. figs. 29-32), and still more by M. D'Orbigny, differ widely from the typical form; yet all, if I mistake not, within such limits as completely to separate them from *Terebratella Fittoni* described above.

deposit, its presence should rather be regarded as affording evidence of some slight elevation or depression of the sea-bed or adjacent land-surface at a particular period, affecting more or less the whole of our Greensand area.* Viewed thus, the pebble-bed becomes at once serviceable as marking a distinct horizon or boundary-line in the Cretaceous series, and one which might possibly be found to afford a more correct boundary between the faunas of the Lower and Upper Greensand formations than the Gault itself; few of the characteristic fossils of the Lower Greensand passing above this line, while it is the starting-point of many of the common forms of *Testacea* which range upwards through the Gault and Upper Greensand.

In the present state of our knowledge, however, it is still difficult to determine the exact relation of the pebble-beds of Kent and Surrey to those somewhat similar deposits to the west of the Wealden area, namely the Sponge-gravels of Farringdon, &c., excepting upon palæontological evidence; and even this admits of much difference of opinion. Thus we find, for instance, that those species of *Brachiopoda* which are common at Farringdon (*T. Tornacensis*, var., *T. depressa*, &c.), are of such rare occurrence within the Wealden area as to have been overlooked by nearly all collectors; and their supposed absence in typical Lower Greensand deposits has led many Geologists to consider the Farringdon Sponge-gravels as wholly distinct in age from the Lower Greensand. It is a question, however, how far the abundance of a particular species in one locality and its scarceness in some other should be admitted as a proof of difference in the age of the deposits in which such species occurs; for one cannot but notice in the case of living *Mollusca* how much irregularity exists in the range and abundance of almost every known species.

The occurrence, then, though ever so rarely, in a well defined position in the Lower Greensand of such forms as *Terebratella Menardi* and *Terebratula Tornacensis*, at Godalming, or *T. depressa* at Shanklin,—species which may be regarded as highly characteristic of the Farringdon Sponge-gravels, is very interesting; and the more so as tending to confirm the opinion now generally entertained with regard to the age of these last-mentioned deposits; an opinion which the natural distribution of our British Cretaceous Brachiopoda surely tends to uphold. For in granting the Sponge-gravels to be of Lower Greensand age we restore and restrict to that formation such characteristic

* Possibly the commencement of the Wealden axis of elevation; for there it evidence at Godalming, and I imagine also at Folkestone, of slight unconformity between the lower and the upper beds of the Lower Greensand.

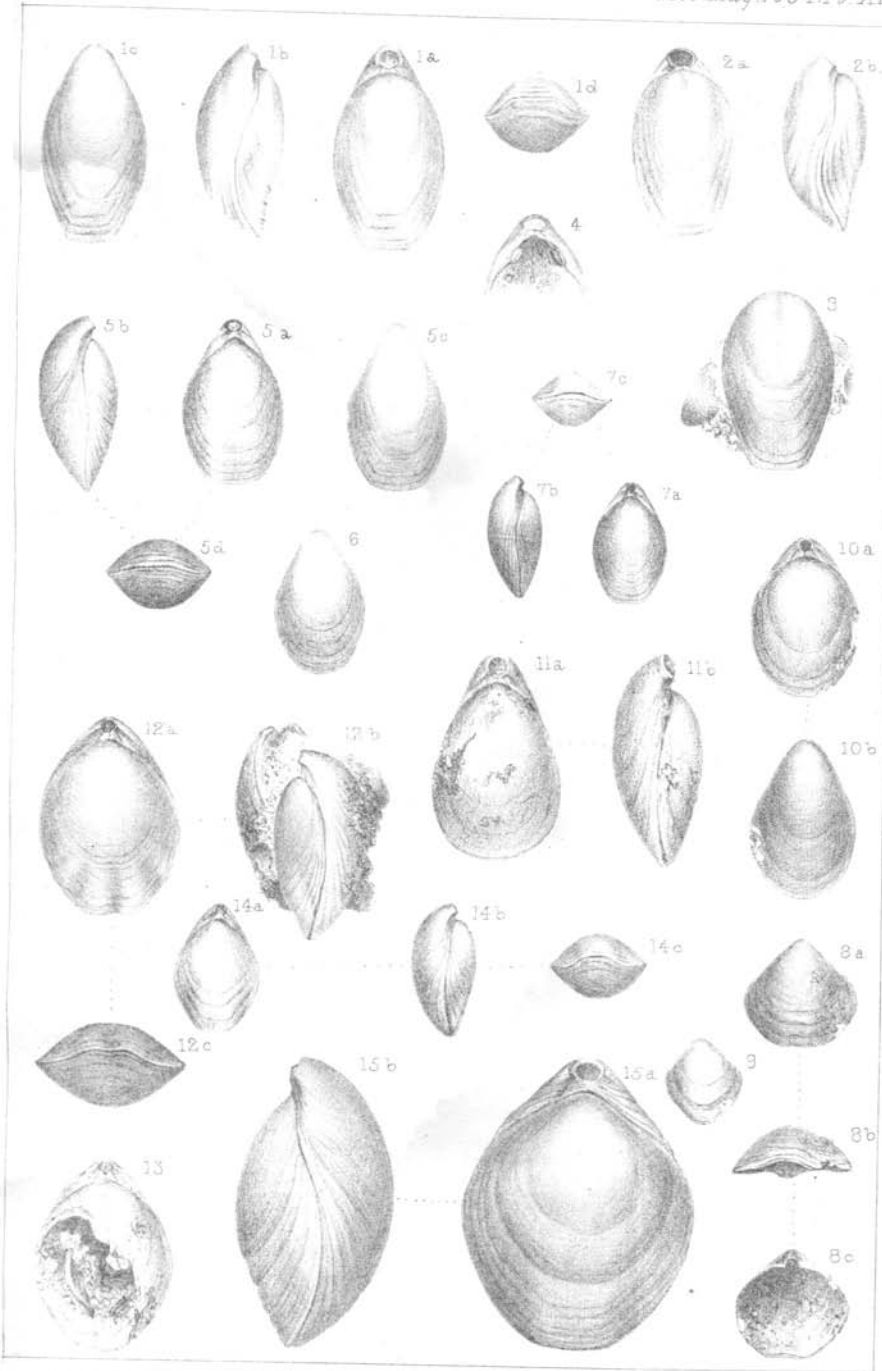
species as *Terebratula oblonga*, *T. tamarindus* and *Lingula truncata*; and, at the same time, limit those of the Upper Greensand, with the single exception of *T. capillata*, D'Archiac, to such species as are common to Warminster, to Cambridge, and a few other typical Upper Greensand localities.

Is then the evidence so fully conclusive with respect to the 'Tourtia' (the supposed foreign equivalent of our Farringdon Sponge-gravels), as to leave no doubt as to its position in the Cretaceous series? Are we to regard that also as possibly a Lower Greensand deposit? or may the presence of Lower Greensand species in that bed be accounted for by the known, but scarcely recognized, difference between the lateral extension of species and their vertical range?

EXPLANATION OF PLATES XI. AND XII.

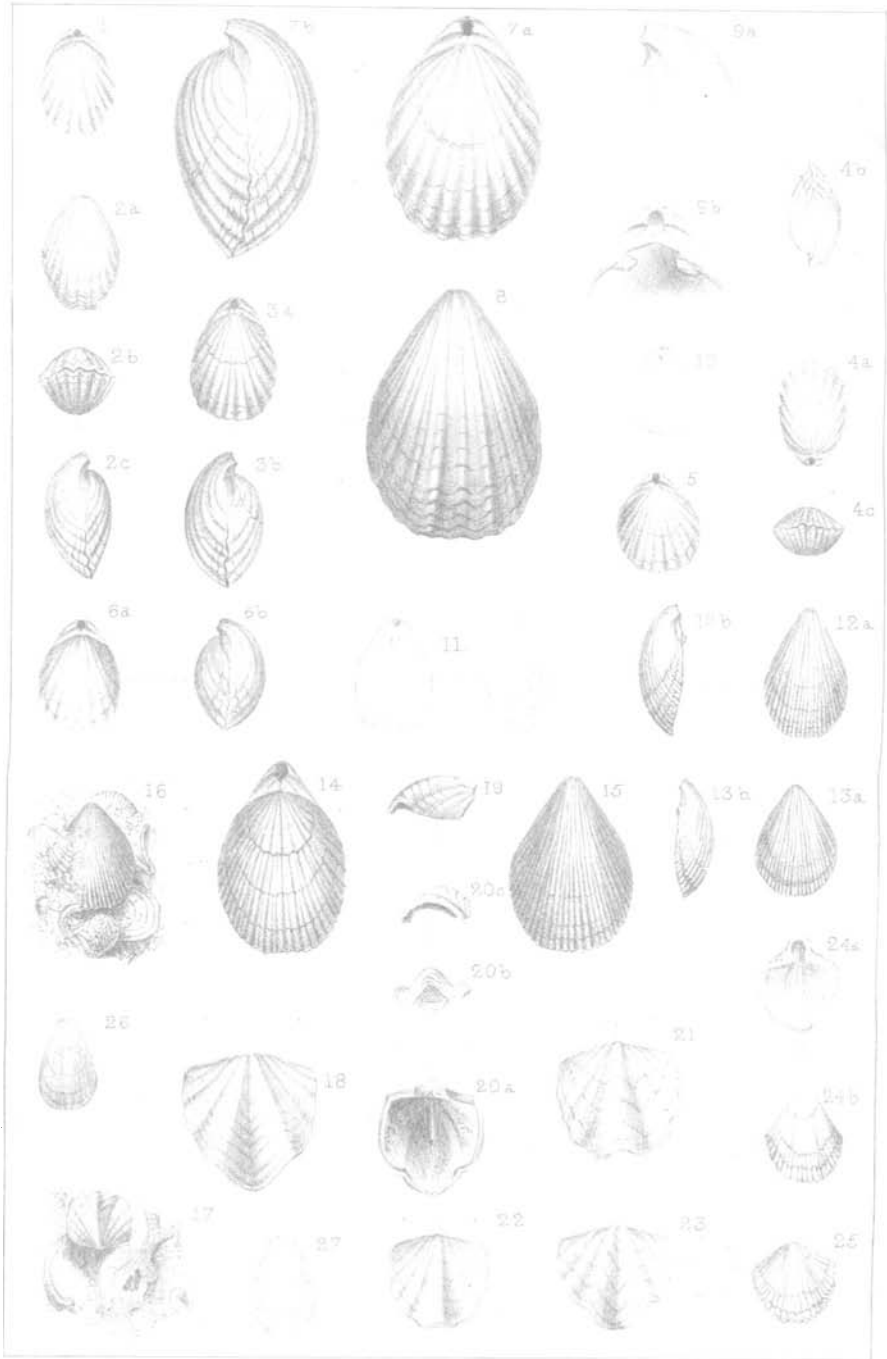
PLATE XI.

- Fig. 1. *Terebratella Fittoni*, sp. nov. An adult specimen, of the most usual form and size; from the pebble-bed at Tewsley, near Godalming.
- 2 a, b, c. *T. Fittoni*. Another specimen, with lines of growth strongly marked.
- 3 a, b. *T. Fittoni*. A fine specimen, from Hurtmore, W. of Godalming; the largest in my collection.
- 4 a, b, c. *T. Fittoni*. A specimen of the form that approaches to *T. Beaumonti*, D'Archiac.
- 5 & 6 a, b. *T. Fittoni*. Specimens with few ribs; greatly resembling *T. quadrata*, Sow.
- 7 a, b, 8 & 9 a, b. *T. Fittoni*. Enlarged figures, to show the style of marking and other features.
10. *T. Fittoni*. Internal cast.
11. *Terebratula quadrata*, Sow. Outlines of the original figures, introduced for comparison with the above.
- 12 a, b. *T. oblonga*, Sow. Ventral valve, from the pebble-bed.
- 13 a, b. *T. oblonga*. Ventral valve, from the Bargate-stone; a young shell.
14. *T. oblonga*. A specimen from the pebble-bed, enlarged.
15. *T. oblonga*. Ventral valve, from the Kentish Rag of Maidstone; of the natural size.
16. *T. oblonga*. A specimen from the Red Sponge-gravel of Badbury Hill, near Farringdon, accompanied by *T. Tornacensis*, var., and *T. Menardi*.
17. *Terebratella* (?) *trifida*, sp. n. (Described in the 'Geologist' for May, 1864.) Dorsal valve, on a fragment of Bargate-stone, together with a single valve of *Terebratulina striata*.
18. *T.* (?) *trifida*. Exterior of a ventral valve, enlarged.
19. *T.* (?) *trifida*. Side-view of the same, slightly enlarged.
- 20 a. *T.* (?) *trifida*. Interior of a dorsal valve, enlarged, showing the medial septum.
- 20 b. *T.* (?) *trifida*. Front view.
- 20 c. *T.* (?) *trifida*. Side view.
- 21, 22. *T.* (?) *trifida*. Exteriors of dorsal valves, enlarged.
23. *T.* (?) *trifida*. Ventral valve, enlarged.



C. J. A. Meyer del. & lith.

M & N Haschart imp.



C. J. Meyer del. & lith.

H. A. Richard imp.

BRACHIOPODA FROM THE LOWER GREENSAND OF SURREY

- Fig. 24 *a, b. T. Menardi*, Lam. A ventral valve, from the pebble-bed of Godalming.
 25. *T. Menardi*. Dorsal valve, from the Bargate-stone of Guildford.
 26, 27. *Terebratulina striata*, Wahl. Single valves, from the pebble-bed of Godalming.
 — (The vertical lines indicate the length of the specimens.)

PLATE XII.

(All the figures in this Plate are represented of the natural size.)

- Figs. 1 *a, b, c, d,* & 2 *a, b. Terebratula extensa*, sp. nov. Specimens from the pebble-bed at Tewsley, near Godalming.
 Fig. 3. *T. extensa*. A dorsal valve, on which the central, longitudinal depression is strongly marked.
 4. *T. extensa*. Portion of a ventral valve, showing the form of beak and its deltidium.
 5 *a, b, c, d. T. Boubei* (?), D'Archiac. A specimen from Folkestone.
 6. *T. Boubei* (?). From the Sponge-gravel of Farringdon.
 7 *a, b, c. T. Boubei* (?). From the pebble-bed at Tewsley, near Godalming.
 8 *a, b, c. T. Tornacensis*, D'Archiac, var. Dorsal valve, from the pebble-bed near Guildford.
 9. *T. Tornacensis*. Ventral valve from Godalming.
 10 *a, b. T. Robertoni* (?), D'Archiac. From the pebble-bed at Hurtmore, near Godalming.
 11 *a, b. T. Robertoni* (?). From the pebble-bed near Guildford.
 12 *a, b, c. Waldheimia Moutoniana*, D'Orb. A specimen from the pebble-bed at Shanklin, Isle of Wight.
 13. *W. Moutoniana*. A specimen from Shanklin, with part of the dorsal valve removed, showing a portion of the elongated loop.
 14 *a, b, c. W. Moutoniana*. From the pebble-bed of Godalming.
 15 *a, b. Terebratula depressa*, Lam. A fine specimen from the Lower Greensand of Shanklin, Isle of Wight.

II. OUTLINE OF THE RHÆTIC FORMATION IN WEST AND CENTRAL SOMERSET. By W. BOYD DAWKINS, B.A. OXON., F.G.S.; of the Geological Survey of Great Britain.

CONTENTS:—I. Introduction; II. White Lias, or Upper Rhætic; III. *Avicula contorta*-series, or Middle Rhætic; IV. Lower Rhætic (Marls).

I. **T**HE identification of the Rhætic Formation in Britain, previously discovered to be intercalated between the Keuper Marls and Lower Lias Shales in Germany, we owe to the labours of Dr. Wright, F.G.S., and Mr. Charles Moore, F.G.S., In the year 1860, the former published an account of the strata beneath the Lias, characterized by the occurrence of *Avicula contorta*; the latter, in the following year, showing in a most valuable paper the true relation of the sandstones, shales, and limestones to the White Lias above and the Keuper below, added upwards of twenty-eight new species to the list of British Fossils. The White Lias, which Dr. Wright incorporated with the group of beds characterized by *Ammonites planorbis*, Mr. Moore considered to belong to, and to constitute an upper member of, the Rhætic Formation. Lastly, in 1861, after a