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ORIGINAL ARTICLES.

I.—BRITISH LIASSIC GASTEROPODA.

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(PLATE V.)

INTRODUCTION.

THE Gasteropoda, next to the Lamellibranchiate Mollusca, are the most varied class of organisms found in the Lias. The general elegance of their forms, and the frequent beauty of their ornamentation, make these fossils extremely attractive objects; whilst their limited vertical range gives them a by no means inconsiderable stratigraphical importance. Notwithstanding these inducements to their study, the Gasteropoda of the Lias have not received, in this country, anything like the amount of attention which has been given to the other leading classes of organisms derived from that formation. On the Continent, on the other hand, considerable progress had been made in the investigation of this interesting group of fossil mollusca more than thirty years ago. The elaborate Memoirs of Münster (in Goldfuss's "*Petrefacta Germaniæ*"), D'Orbigny (in the "*Paléontologie Française*"), Deslongchamps the elder, Dunker and Terquem, Chapuis and Dewalque, furnish the basis of our knowledge of the Gasteropoda of the Lias, whilst in later years Messrs. Eudes Deslongchamps, Stoliczka and Piette, Jules Martin and Dumortier, have each and all contributed a large amount of very valuable information in this department of Palæontology. The above difference, to our disadvantage, is perhaps to be explained, in part at any rate, by the more localized distribution of Gasteropodous Mollusca in the English Lias, by their prevailing small size, and the comparative rarity of the more conspicuous forms, such as the *Pleurotomariæ*, and finally, by their generally more highly mineralized condition, and the consequent greater difficulty there is, in this country, in extracting these fossils in anything like perfect condition.¹ During recent years, however, an increasing amount of attention has been given to the palæontology of the English Lias. In this work a number of earnest students are now actively engaged, chiefly in the Midlands, a district which had previously been greatly neglected, and one of

¹ In the Lias of Luxembourg and Hettange, several Gasteropods have been found, which are not only perfect in form, but even retain the original colours and markings of the shells. (See Terquem, "*Paléontologie de Hettange*," *Mem. Soc. Geol. France*, 2nd ser. vol. v. pp. 219-343, pl. xii.-xxvi.)

the results of their labours has been to materially add to our knowledge of the Gasteropoda of the Lias formation.

The following summarized account will serve to illustrate the progress which has been made in this branch of Palæontology in recent times. In the Catalogue of British Fossils (2nd edition), published by the late John Morris in the year 1854, only six species of Gasteropoda are quoted from the Lias formation, viz. *Pleurotomaria Anglica*, *Pl. compressa*, *Pl. expansa*, *Trochus imbricatus*, *Turbo undulatus*, and *Dentalium giganteum*. In 1872, twenty-three species had been obtained from the Lias of Yorkshire, but in 1876 this number was, through the labours of Messrs. Tate and Blake, increased to 89 (see "Yorkshire Lias," p. 331). Mr. E. C. H. Day in 1863 obtained 40 species of Gasteropoda from the Middle Lias of Dorsetshire, many of which were new to this country, and appear to be confined to that district (Q.J.G.S. vol. xix. p. 278, and vol. xxxiii. p. 167). One of the most indefatigable students of the palæontology of the Lias at this period was the late C. Moore, who chiefly worked in the Somersetshire and S. Wales areas. The fruits of the labours of that very capable geologist are to be seen in the splendid "Moore Collection" of Lias fossils in the Bath Museum. This collection, which is, I believe, richer in Lias Gasteropoda than any other in England, contains 180 named British species, including no less than 90 type forms, many of which are unique both in their interest and rarity.¹ In 1871 Prof. Ralph Tate, in his "Census of the Marine Invertebrate Fauna of the Lias," enumerated 269 species representing 32 genera of British, as compared with 650 species representing 43 genera of Continental Liassic Gasteropoda (GEOL. MAG. Vol. VIII. 1871, p. 4). Mr. R. Etheridge, F.R.S., in his Presidential Address to the Geological Society in 1882, "On the Analysis and Distribution of the British Jurassic Fossils," quotes 388 species, which are classed by him under 51 genera, from the Lias of Great Britain. Of this large number only six² species are stated to pass up into the Inferior Oolite, viz. *Actæonina pulla*, *Amberleya capitanea*, *Cerithium papillosum*, *Natica adducta*, *Onustus pyramidatus*, and *Pleurotomaria princeps*, one of which (*A. capitanea*) survived into the Forest Marble (Q.J.G.S. vol. xxxviii. p. 165). In reference to the foregoing account I would observe, without in any way questioning the general accuracy of the figures given by my esteemed friend Mr. Etheridge, or the validity of the conclusions founded thereon, that the number both of the species and of the genera appear rather too high for what they respectively represent. It was admitted, for instance, that the 136 Middle Lias names represented only 118 true species, and this, apart from any similar deduction for duplicated nomenclature in the

¹ See Quart. Journ. Geol. Soc. vol. xxiii. p. 449, pl. 14-16; Proc. Somerset Arch. and Nat. Hist. Soc. vol. xiii. p. 119, pl. 4-6. It is unfortunate that these types should have been so indifferently delineated. Moore's sketchy figures give but a poor idea of the beauty of these fossils, and, in several instances, are so inaccurate as to be positively misleading as to their form. Students of this group should therefore beware of too readily trusting to identifications founded solely on comparisons of their specimens with these figures.

² This number is certainly capable of increase.

other two divisions of the Lias, would reduce his gross total to 370. Then again we find some of the genera repeated under different names: '*Amberleya*,' '*Eucyclus*,' and '*Tectaria*,' for example, are cited as three instead of as one only, and similarly the synonymous *Actæonina* and *Orthostoma* are apparently counted as two.

I have recently drawn up lists of the British Liassic Gasteropoda which, exclusive of those now described, comprise 425 species, distributed provisionally under 51 genera. In these lists care has been taken to avoid the reduplication of names, but it is probable that a small number of the species have been counted twice under different synonyms. These last, however, will, I believe, be more than balanced by the various new forms now awaiting description. The number of genera on the other hand is almost certainly too great. The 425 species are very unequally distributed among the genera. The dominant Liassic genera are *Trochus*, *Turbo*, *Cerithium*, and *Pleurotomaria*. Taking with the last the sub-group *Cryptænia*, each of these genera would comprise about 50 species, or together nearly a moiety of the whole number. Next comes *Chemnitzia* with some 30 species, and then *Amberleya* (= *Eucyclus*) *Actæonina* (= *Orthostoma*), *Turritella*, and *Patella*, with from 10 to 16 each. The following genera are represented by an average of 6 species each: *Actæon* (= *Tornatella*), *Alaria*, *Dentalium*, *Discohelix*, *Eulima* (= *Niso*), *Littorina*, *Natica*, *Neritopsis*, *Phasianella*, *Pitonillus* (= *Rotella*), *Solarium*, *Straparolus* and *Trochotoma*; whereas *Cylindrites*, *Cryptaulax*, *Delphinula*?, *Euomphalus*?, *Kilvertia* (= *Exelissa*), *Monodonta*, *Nerita*, *Neritina*, *Onustus*, *Purpurina*, *Rimula* and *Rissoa* are represented by 1 to 3 species each only. The remaining genera, which are mostly founded on extremely few forms, and in some cases on single and imperfect or on minute and immature specimens, cannot be considered to be satisfactorily established at present. These are *Chiton*, *Conus*, *Fusus*, *Nerinea*, *Pterocera*, and *Pyrula*, one if not both of Moore's genera *Pleuratella* and *Pterocheilos*, and the following terrestrial and freshwater types:—*Ampullaria*, *Helix*, *Hydrobia*, *Melania*, *Planorbis*, *Proserpina*, *Valvata*, and *Vertigo*. Some of the foregoing are pretty sure to break down as Liassic genera under closer scrutiny and the acquisition of more satisfactory material. Indeed, it is very questionable whether any one of the first six of the above genera can be maintained; and, before accepting any land or freshwater form, as coming from a formation so essentially marine as the Lias, we must require in each case the most clear and convincing evidence. The net result of a future revision will probably be to reduce the number of generic types given above, whereas the species are probably capable of an appreciable and immediate increase.

The enumeration of 425 species of British Liassic Gasteropoda in 1886 as compared with the trivial number of six only in 1854, is a striking illustration of the progress which has been made in Palæontology in this country during the last thirty years.

Without further preface, I proceed to the main object of the present communication, which is to describe thirteen species of Gasteropoda. These are mostly new to science, and all are new to the British Lias.

For a full moiety of the material on which the following species are founded I am indebted to Mr. W. D. Crick, of Northampton, who has very generously placed a number of interesting specimens at my disposal for the above purpose, and has also furnished me with much valuable information as to their precise geological position. I am under a considerable obligation to the Rev. H. H. Winwood, M.A., F.G.S., for the facilities he has kindly given me for examining the specimens in the Bath Museum, to Mr. H. E. Quilter, of Leicester, for assistance with specimens from that county, and to Mr. T. Beesley, F.C.S., of Banbury, and Mr. B. Thompson, F.G.S., of Northampton, for useful information on the general subject.

Note.—In the following descriptions, the “sutural angle” is the greater angle which the suture makes with the side of the spire; and the “length of the last whorl” is measured axially, and posteriorly when practicable, from the anterior extremity of the aperture to the last preceding suture.

DESCRIPTION OF NEW SPECIES.

TROCHUS DALBIENSIS, spec. nov. Pl. V. Figs. 1, 1a, 1b, 1c.

Description.—Shell conical, as broad as high; imperforate; spiral angle concave, apex acute; whorls 7, slightly concave, separated by deep sutures, last whorl very large relatively, squarely angulated at the periphery. The ornamentation of this very pretty little shell is as follows:—Numerous slender radial costæ commence close to the posterior suture in a row of fine granulations, apparently formed at the junctions of the costæ with a fine encircling thread, and are continued forwards rather obliquely across two rows of larger rounded tubercles, similarly occurring at the decussations of the costæ with fine encircling threads; these two granulated lines occupy the anterior third of the whorls, and the anterior one of the two, which is the most prominent, gives a distinct angulation thereto; from each of the tubercles of this anterior row two fine threads pass downwards obliquely across the deep sutural groove, and terminate in a finely-granulated encircling thread close to the anterior suture. Base of shell almost flat, very slightly convex, with 12 or more very finely-crenulated concentric threads, which are closer together towards the centre and circumference, and wider apart in the intermediate area. Aperture trapezoidal, transverse and oblique. Outer lip boldly arched, inner lip almost straight and effuse over the columellar border.

Dimensions.—Length, 8 millimètres; diameter, 8 mm.; length of last whorl, 5 mm.; spiral angle, 70° ; sutural angle, 128° .

Affinities.—This species is somewhat closely related to *Tr. Thetis*, Mün. (Goldfuss, Petr. Germ. pl. 179, figs. 10a, b: and Plate V. Figs. 2a, b, c). It differs therefrom by its finer ornamentation, the double row of anterior tubercles, the fine granules over the suture, and the more numerous concentric striæ on the base, also by its greater spiral angle, larger number of whorls, and more acuminate apex. Judging by the specimens of this latter species found at Dalby associated with the foregoing form, Münster's figure (*loc. cit.*) errs in showing unduly straight costæ, want of tubercles on the keel,

a roundly-furrowed instead of a sharply-ribbed base, and an apparent and large umbilicus.

Note.—*Trochus Thetis* seems to be a difficult form to delineate. It has several times been re-figured, but never drawn with perfect accuracy. The figures I give (Pl. V. Figs. 2, 2a, b, c) are an advance on most of the previous figures, but the appearance of an umbilicus is fallacious.

Geological Position and Locality.—Lower Lias, zone of *Am. oxynotus*, Railway-tunnel, Old Dalby, Leicestershire.

TROCHUS CRICKI, spec. nov. Pl. V. Figs. 3, 3a, 3b.

Description.—Shell conical, imperforate; spiral angle regular, very slightly concave, apex acute; whorls 5-6, quite flat; sutures linear, only slightly inclined; last whorl obtusely angulated at the circumference; base almost flat, very slightly convex; columella prominent, massive and vertical; outer lip imperfect, but the aperture when complete appears to have been rhomboidal and only a little wider than high. The whorls are covered with close-set spirals of small rounded tubercles, the spiral lines and the individual tubercles being respectively closer together than their interspaces; on the penultimate whorl there are 5-6 spirals; the tubercles of the most anterior row of these are a little the largest, and give a slight tabulation to the whorls, the row next behind are nearly equally large, then there is a very fine row, and behind these two rather coarser rows; on the last whorl 4 rows of coarser tubercles occupy the angular border, posterior to which are 4 rows of finer tubercles; on the base immediately within the 4 coarse granular lines are 3 finer lines, of which the outer one only is granular; the rest of the base is smooth.

Dimensions.—Length, 5 millimètres; diameter, 4 mm.; length of last whorl, 3.25 mm.; spiral angle, 65°; sutural angle, 130°.

Affinities.—This small shell appears to have rather close affinities with certain small Oolitic Trochi having granulated spires and smooth bases, such as *Tr. monilitectus*, Phil., and its allies *Tr. Scarburgensis*, Hudl., and *Tr. strigosus*, Lyc., figured and described by Mr. W. H. Hudleston, M.A., F.R.S., in his "Palæontology of the Yorkshire Oolites" (GEOL. MAG. Dec. III. Vol. II. 1885, p. 121, *et seq.*). It does not, however, appear to be absolutely identical with any of these.

Obs.—I name this fossil after Mr. W. D. Crick, of Northampton, whose valuable work on the palæontology of the Lias of that district has already been acknowledged.

Geological Position and Locality.—Middle Lias, zone of *Am. margaritatus*, Daventry, Northamptonshire.

TROCHUS SAGENATUS, spec. nov. Pl. V. Figs. 4, 4a.

Description.—Shell conical, turritid, imperforate; spiral angle regular; whorls 8 probably (the apex being lost in my sole specimen), a little concave and slightly imbricating. Each whorl bears 3 equidistant encircling raised lines one a little in advance of the posterior suture, the second a little in front of the middle of the whorl, and the third forming a slight keel directly overhanging the

deeply cut but very narrow suture; these are crossed by numerous slender, slightly oblique, radial costæ, forming with the spiral lines a neat meshwork, having little nodules at the decussations; the radial costæ are more slender and more closely set on the last whorl. Base almost flat, bearing numerous fine encircling threads with nearly equal interspaces; the radial costæ are continued over the angular border of the last whorl, to which they give a fine crénation, and then rapidly die away. Aperture depressed, lunate and oblique, outer lip somewhat thickened, columella inconspicuous.

Dimensions.—Length (restored), 6.75 millimètres; diameter, 4 mm.; spiral angle, 35°; sutural angle, 110°.

Affinities.—This form appears to be related to *Trochus Holwellensis*, Moore, a fossil derived from the Liassic deposit contained in fissures of the Mountain Limestone near Frome (Q.J.G.S. vol. xxiii. p. 554, pl. 17, figs. 1, 2). The types of this species should be in the Bath Museum, but they are unfortunately missing. Comparison of our specimen with Moore's figure, however, shows that whilst the two fossils agree in general form and ornamentation, *Tr. Holwellensis* had a more elongated spire, the whorls of which, instead of imbricating each other, were separated by wide and deep sutures, and bore fewer and coarser radial costæ, making prominent "bosses" on the margin of the last whorl. Moore's type appears also to have had a small umbilicus. These points of difference seem quite sufficient to distinguish the two forms specifically.

Geological Position and Locality.—Upper Lias (transition-bed to Middle Lias), L. and N. W. Railway, Watford, Northamptonshire.

TRUCHUS NORTHAMPTONENSIS, spec. nov. Pl. V. Figs. 5, 5a.

Description.—Shell conical, imperforate; apex acute; spiral angle, regular or slightly convex; whorls 7, concave; a prominent and acute crenulated ridge or carina encircles the anterior portion of the whorls, and a similar but much less prominent ridge encircles the whorls close to the posterior suture; between these there is a concave area occupying two-thirds of the width of the whorl; from the anterior carina the surface of the whorl falls vertically to the anterior suture, this portion occupying about a third of its width; the last whorl is tricarinated, having two anterior crenulated carinæ, the posterior of which is the more prominent; broad undulating costæ run somewhat obliquely from the spinose points of the posterior to those of the anterior carina, beyond which they are continued vertically to the anterior suture, and on the last whorl, after connecting the spinose points of the two anterior carinæ, are continued in more or less prominent serpentine ridges from the circumference to the centre of the base. A few faint encircling lines are discernible in the concave portions of the whorls. The whole shell is covered with fine close-set radiating flexuous lines, which pass over the costæ and their interspaces, the carinæ and the base. The base is only slightly convex, but prominent in the centre, and marked with numerous concentric lines, which are either equally distinct and

spaced from circumference to centre, or are much more distinct and more widely spaced towards the circumference, in addition to the radial serpentine lines and ridges above mentioned. Aperture transverse, outer lip thin, with an irregular outline; inner lip concave, with a broad expansion over the massive, axial and somewhat obliquely produced columella.

Dimensions.—Height, 10·75 millimètres; diameter, 9 mm.; length of the last whorl, 6·75 mm.; spiral angle, 60°; sutural angle, 125°.

Note.—Figs. 5 and 5a, being drawn from a laterally compressed specimen, show a rather greater breadth and spiral angle, and a more transversely elongated aperture than this form really possesses.

Affinities.—In its general form and ornamentation this shell appears almost identical with one (viz. fig. 6) of the figures of D'Orbigny's *Turbo subduplicatus* (Pal. Fr. Terr. Jur. vol. ii. p. 339, pl. 329, figs. 1–6), a species which, according to that authority, is synonymous with *Trochus duplicatus*, Sow., *Turbo duplicatus*, Goldfuss, *Turbo plicatus*, Goldfuss, and *Turbo Palinurus*, D'Orb. We are, however, confronted with the fact that the Northamptonshire fossil is certainly not a *Turbo*, but a *Trochus*.

The aperture of the particular form (*l.c.* pl. 329, fig. 6) which is so like our specimens is not shown, but the author defines its character in this very variable species of his as "round, with a broad thickening over the columella." The question arises, was the aperture of this particular shell (*l.c.* pl. 329, fig. 6) hidden or imperfectly shown, and has D'Orbigny mistaken its genus in consequence, or has he and Goldfuss also (Petr. Germ. vol. iii. p. 95, pl. 179, fig. 2) misinterpreted the character of this portion of these shells generally, and thus of the genus, from having had to deal with imperfectly-preserved specimens?¹ The description and figure of *Trochus duplicatus*, Sow., which give the aperture as quadrangular (Min. Conch. vol. iii. p. 181, t. 181, fig. 5), indicate that Sowerby's type was a genuine *Trochus*. The species *Trochus duplicatus*, Sow., is therefore good, and must stand. If Goldfuss and D'Orbigny were correct in their respective *specific* identifications of *Turbo duplicatus*, and *Turbo subduplicatus*, with Sowerby's type, they have both erred in their *generic* appellation. However this may be, I consider the Northampton fossil distinct from all these, with the probable exception of the particular shell figured by D'Orbigny as *Turbo subduplicatus* (*l.c.* pl. 329, fig. 6), which—relying upon the vertically truncated whorls and spinose and widely-channelled double-keel—I consider distinct from the other forms figured by that author (*l.c.* pl. 329, figs. 1–5).

Geological Position and Locality.—Upper Lias, zone of *Am. communis*, New Railway, Weedon and Dodford, near Daventry, Northamptonshire.

¹ The matter is complicated by D'Orbigny describing a typical *Trochus duplicatus*, Sow., in another part of the Pal. Franc. (Terr. Jur. Gast. ii. p. 275, pl. 313, figs. 5–8) under that name.

TROCHUS NIORTENSIS, D'Orb. Pl. V. Figs. 6, 6a, 6b.

1850. D'Orb. Pal. Franc. Ter. Jur. vol. ii. Gast. p. 282, pl. 315, figs. 5—8.

I recently obtained a little shell from the Marlstone Rock-bed of Downcliff, near Bridport, Dorset, which in all essential respects agrees with *Tr. Niortensis*, described by D'Orbigny as having been derived from the étage bajocien (Inferior Oolite) of Niort (Deux Sèvres).

Description.—The following is a translation of that author's description:—"Shell conical, much longer than broad, imperforate. Spire formed of a regular angle, composed of whorls very much hollowed out, striated longitudinally, and marked in the lower portion with oblique costæ tuberculated *below* (i.e. posteriorly). The last whorl is convex, striated concentrically above and angular over the sides. Aperture a little depressed and angular. Spiral angle, 49° . Length, 10 mm.; breadth, 8 mm." (D'Orbigny, Pal. Fr. *l.c.* p. 282).

Affinities.—My specimen has a less elevated spire than D'Orbigny's type, being only a little higher than broad, 6:5, with a decidedly greater spiral angle, viz. 60° ; the three apical whorls and the spiral angle are a little convex; the costæ, too, are more strongly nodulated at their *anterior* ends and prominent on the upturned keel; the base shows radial as well as encircling striæ; and the aperture is more squarely angulated than in D'Orbigny's figure. These differences are of detail rather than of essence, and not more than might reasonably be expected between individuals of the same species derived from such widely-separated horizons as the Middle Lias and the Inferior Oolite. D'Orbigny speaks of the aperture of his *Tr. Niortensis* as "angular," and in this the description is probably more correct than the delineation, which, like that of too many of the figures in the Paléontologie Française, appears to have received an artistic rounding off or restoration not strictly true to nature.

Obs.—The occurrence of this fossil in the English Lias is of special interest from its being one of those that range into the Oolite.

Geological Position and Locality.—Middle Lias, Conglomeratic Marlstone, zone of *Am. spinatus*, Down Cliff, near Bridport, Dorset.

AMBERLEYA CALLIPYGE, spec. nov. Pl. V. Figs. 7, 7a.

Description.—Shell turbate, thin, imperforate; spiral angle regular; whorls 6–7, only slightly convex, the greatest diameter of the whorl is attained a little behind the anterior suture, whence it falls rapidly thereto, thus giving a slight tabulation; sutures narrow, but clearly defined; last whorl relatively large, long and inflated; base very convex; aperture broadly ovate; outer lip thin, with its inner margin very finely crenated; inner lip slender, extending somewhat over the columella, vertical, but arching forwards towards its angular junction with the outer lip at the anterior margin, which at this point is patulous and a little effuse. The ornamentation of this handsome shell is elaborate, the whole surface being covered with close-set spirals of small rounded tubercles. On the first 4–5 whorls these granular tubercles are much finer than on the

last 2. The third whorl bears only 4 of these spirals. The penultimate whorl bears 7 granular spirals; of these the sixth from the posterior suture lies on and determines a faint angle, and the seventh is close to the anterior suture; these two rows consist of rather coarser tubercles, and speaking generally the granules get smaller towards the posterior suture; the spirals are separated by about their own breadth from one another, and the individual beads of a spiral from a little less up to rather more than their own width. On the last whorl very finely granulated lines are seen setting in between the rows of coarser granules; there are eight or nine of each series counting from the periphery, whilst the base shows a like number of the coarser spirals (which are more closely set and somewhat finer than those posterior to the periphery), with indications of fine alternating spiral lines.

Dimensions.—Length, 8 millimètres; diameter, 5.75 mm.; length of last whorl, 5.75 mm.; spiral angle, 68° ; sutural angle, 125° .

Geological Position and Locality.—Middle Lias, zone of *Am. margaritatus*, Daventry, Northamptonshire.

MONODONTA (TURBO) HUMILIS, spec. nov. Pl. V. Figs. 8, 8a, 8b.

Description.—Shell small, smooth, spire greatly depressed; whorls 4, flattened and embracing, with linear sutures and scarcely exsert (Fig. 8), but occasionally the whorls are a little convex, the sutures distinct, and the spire slightly raised (Fig. 8a). A shallow sulcus encircles the whorls posteriorly; this depressed area is most apparent on the last whorl, and occasionally becomes so marked as to hollow out its whole upper surface, and give an angulated instead of the prevailing obtusely rounded border to the shell; the columella is very short and twisted, it terminates by uniting with a prominent bluntly triangular tooth, which originates at the edge of the inner lip in advance of and reflected over the minute umbilicus. Aperture transversely ovate, rather small and not quite continuous, directed obliquely forwards, and having its outer border slightly constricted by the sulcus. Base almost flat, very slightly convex, more or less wrinkled towards the centre. Under a lens the shell shows numerous close-set lines of growth.

Dimensions.—Height, 2.50 millimètres. Diameter 3 mm.

Geological Position and Locality.—Lower Lias, zone of *Am. oxynotus*, common in the Tunnel waste heaps, Old Dalby, Leicestershire.

MONODONTA (TURBO) LINDECOLINA, spec. nov. Pl. V. Figs. 9, 9a, 9b.

Description.—Shell small, thick, transversely ovate; imperforate; spire scarcely exsert, and apex obtuse; whorls 5–6, convex, embracing with scarcely visible linear sutures, the last whorl inflated; a shallow sulcus bounds the posterior suture; base slightly convex; the umbilical region, which appears to be covered by a thin shelly callus, is encircled by a more or less prominent semicircular ridge which runs nearly from the posterior to the anterior inner margin of the aperture; aperture almost exactly circular, oblique, the last whorl slightly

disjoined from the penultimate posteriorly at the aperture; columella very short, and twisted horizontally, terminating in a prominent bluntly-pointed tooth, in front of which is a narrow groove. The shell is smooth and shining, but under a strong lens its whole surface up to the basal ridge above referred to is seen to be covered with numerous fine encircling striæ, and still finer curved radial striæ.

Dimensions.—Height, 4 millimètres; diameters, 5 mm. and 5.75 mm.

Geological Position and Locality.—Upper Lias, zone of *Am. serpentinus*, Lincoln.

EXPLANATION OF PLATE V.

- FIG. 1, a, b, c. *Trochus Dalbiensis*, sp. n.—Lower Lias, zone of *Am. oxynotus*, Old Dalby. Back and front views and base enlarged twice, penultimate whorl enlarged six times.
- „ 2, a, b, c. *Trochus Thetis*, Mün.—Lower Lias, zone of *Am. oxynotus*, Old Dalby. Back and front views and base enlarged twice, penultimate whorl enlarged six times.
- „ 3, a, b. *Trochus Cricki*, sp. n.—Middle Lias, zone of *Am. margaritatus*, Daventry. Back and front views enlarged three times, penultimate whorl enlarged six times.
- „ 4, a. *Trochus sagenatus*, sp. n.—Upper Lias, Watford. Back and front views enlarged three times.
- „ 5, a. *Trochus Northamptonensis*, sp. n.—Upper Lias, zone of *Am. communis*, Weedon. Back and front views enlarged twice.
- „ 6, a, b. *Trochus Niortensis*, d'Orb.—Middle Lias, zone of *Am. spinatus*, Down Cliff. Front and basal views enlarged three times, penultimate whorl enlarged six times.
- „ 7, a. *Amberleya Callipyge*, sp. n.—Middle Lias, zone of *Am. margaritatus*, Daventry. Front and back views enlarged three times.
- „ 8, a, b. *Monodonta humilis*, sp. n.—Lower Lias, zone of *Am. oxynotus*, Old Dalby. Front, back, and apical views enlarged four times.
- „ 9, a, b. *Monodonta Lindecolina*, sp. n.—Upper Lias, zone of *Am. serpentinus*, Lincoln. Back and front views enlarged twice, portion of penultimate whorl enlarged six times.
- „ 10, a. *Cerithium trigemmatum*, sp. n.—Lower Lias, zone of *Am. oxynotus*, Old Dalby. Back and front views enlarged six times.
- „ 11, a. *Actæonina ferrea*, sp. n.—Middle Lias, zone of *Am. spinatus*, Tilton. Back and front views enlarged three times.
- „ 12, a. *Cylindrites æqualis*, sp. n.—Middle Lias, zone of *Am. spinatus*, Tilton. Front and back views enlarged twice.
- „ 13. *Alaria Hudlestoni*, sp. n.—Lower Lias, zone of *Am. Bucklandi*, Bitton. Front view enlarged three times.
- „ 14. *Alaria semicostulata* ? Piet et Eug. Desl.—Upper Lias, zone of *Am. serpentinus*, Dodford. Back view enlarged twice.
- „ 15. „ „ ?—Upper Lias, Chipping Warden. Front view enlarged twice.

(To be continued.)

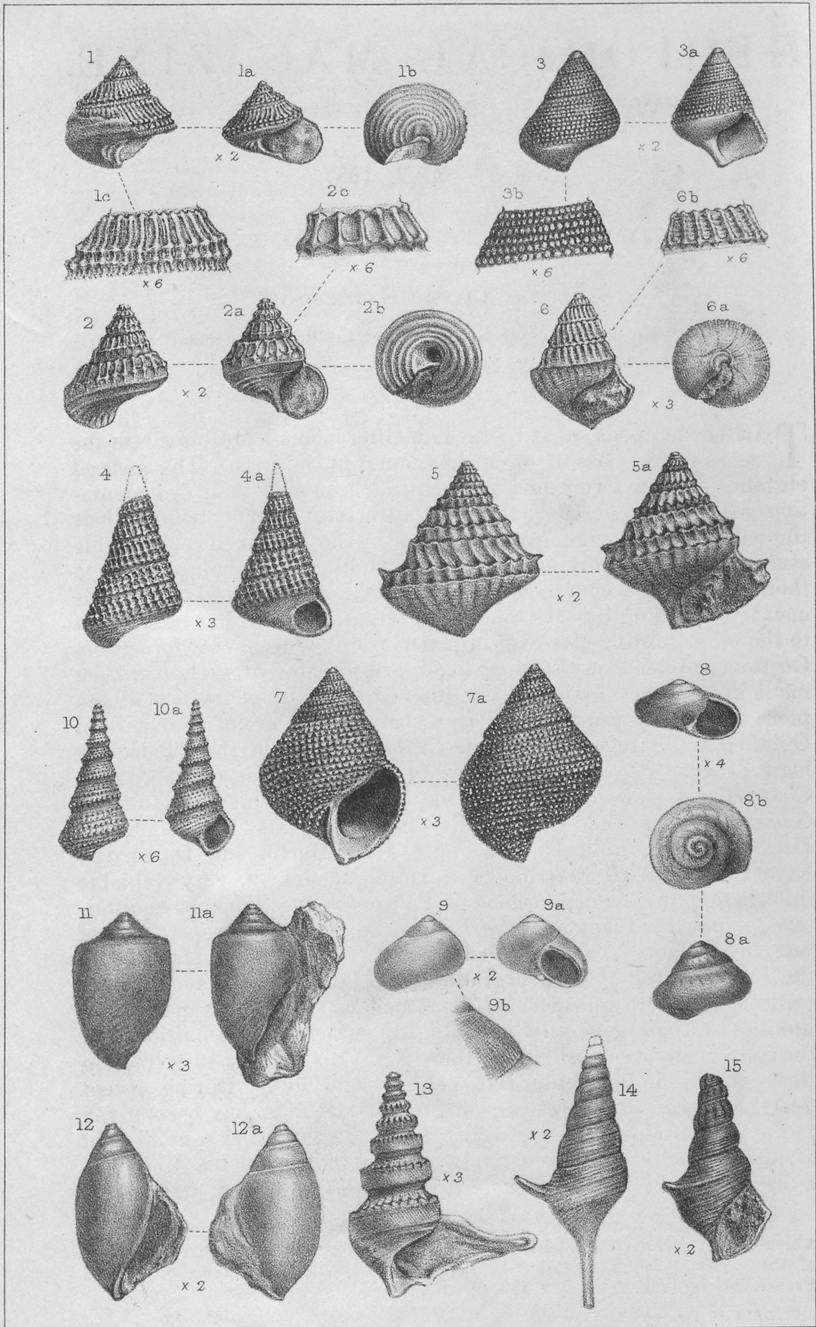
II.—THE WATER-SUPPLY OF EAST KENT, IN CONNECTION WITH NATURAL SPRINGS AND DEEP WELLS.

(Being the substance of a Paper read before the East Kent Natural History Society.)

By GEORGE DOWKER, F.G.S.

THE numerous demands made upon our underground water-supply, both for sewage and sanitary as well as brewing purposes, render the subject of my paper a matter of deep and serious importance.

I shall set forth in the first place the rise and course of the rivers,



III.—BRITISH LIASSIC GASTEROPODA.

By E. WILSON, F.G.S.; Curator of the Bristol Museum.

(Concluded from p. 202.)

CERITHIUM TRIGEMMATUM, spec. nov. Pl. V. Figs. 10, 10a.

Description.—Shell conical, turritid; apex acute; spiral angle regular, whorls 8–9, angularly carinated anteriorly; sutures wide and deep; each whorl bears 3 spiral rows of equally spaced but unequal neatly rounded tubercles; the anterior of these, which are much the largest, are set on the carina; the middle row consists of fine granules, whilst the nodules of the posterior row, which adjoin the posterior suture, are intermediate in size and half-way between the other two. Fine, close-set curved striæ of growth cross the whorls transversely, but are scarcely discernible even with a lens, except on the last whorl of well-preserved specimens. Last whorl bicarinated by a fourth very finely granular raised line, between which and the coarsely nodulated carina is a plain encircling thread; base flattish, bearing a few concentric raised lines. The aperture is imperfect in all the specimens I have examined, but is roundly ovate in form, and occasionally shows slight indications of the commencement of an anterior canal. I therefore assign this species to the genus *Cerithium*.

Dimensions.—Length, 7·5 millimètres; diameter, 2·5 mm.; spiral angle, 22°; sutural angle, 97°.

Geological Position and Locality.—Lower Lias, zone of *Am. oxynotus*, Railway-tunnel, Old Dalby, Leicestershire.

ACTÆONINA FERREA, spec. nov. Pl. V. Figs. 11, 11a.

Description.—Shell pyriform, smooth and shining; spire depressed near the shoulder of the last whorl, but presenting a small pyramidal elevation in the centre; this portion of the shell is badly preserved, but the total number of the whorls appears to be 5; a narrow groove encircles the shoulder of the last whorl above (posterior to) the rectangulated keel. The aperture is almost entirely concealed in my sole specimen, but it widens out somewhat towards the anterior extremity, and the inner lip is thin with a sharp edge anteriorly, without any fold or thickening over the columellar region. A few (5 or 6) fine encircling striæ are discernible on the anterior portion of the last whorl.

Dimensions.—Length, 7·5 mm.; diameter, 5 mm.; length of last whorl, 6·75 mm.

Geological Position and Locality.—Middle Lias, Marlstone Rock, zone of *Am. spinatus*, East Norton Embankment, derived from Tilton, Leicestershire.

CYLINDRITES ÆQUALIS, spec. nov. Pl. V. Figs. 12, 12a.

Description.—Shell ovately and regularly fusiform; spire moderately elevated, obtusely conical; apex acute; whorls 5, slightly convex, embracing, with narrow ill-defined sutures. A narrow impressed line

encircles the whorl a little in front of the suture, between which there is a narrow raised encircling band; the aperture is, unfortunately, not well shown; it occupies five-sixths of the length of the last whorl, the anterior extremity is acutely angulated, with thickened margins, and there is a distinct spiral fold on the columellar border anteriorly. The shelly matter has disappeared, but the surface appears to have been originally smooth.

Dimensions.—Length, 11·5 millimètres; diameter, 5·75 mm.; length of last whorl, 10 mm.

Geological Position and Locality.—Middle Lias, Marlstone Rock, zone of *Am. spinatus*, East Norton Embankment, derived from Tilton, Leicestershire.

BRITISH LIASSIC ALARIÆ.

It has often been supposed that the section of winged shells *Aporrhaidæ*, and genus termed *Alaria* by Lycett, but more clearly defined by Piette, did not appear in the British area until the commencement of the Oolitic period. This is certainly a mistake. Although extremely rare in the Lias, there are undoubted instances of the occurrence of *Alariæ* even in the Lower division of that formation. Messrs. Tate and Blake do not record this genus from the Yorkshire Lias. In his valuable "Contributions to the Palæontology of the Yorkshire Oolites," Mr. W. H. Hudleston, F.R.S., referring specially to the Yorkshire area, observes that "It was in the Lower Oolite that the genus *Alaria* first began to flourish, and we find that it became tolerably well represented as low down as the Inferior Oolite or Bajocian subdivision" (GEOL. MAG. Dec. III. Vol. I. p. 145, 1884). In the year 1867 the late Charles Moore described three species of *Alaria* from the Upper Lias of Somersetshire, viz. *A. unispinosa*, Moore; *A. coronata*, Moore, and *A. angulata*, Moore. The first of these certainly, and the last two probably, are true *Alariæ*. Since then other examples of this genus have been found in different portions of the English Lias. Mr. T. Beesley, F.C.S., whose valuable labours in the Lias of Oxfordshire are widely known, informs me that he has obtained the moulds of two *Alariæ*, which he takes to be *A. coronata* and *A. angulata*, from the Upper Lias shales (lower portion of zone of *Am. communis*?) of Bloxham, Oxon. Mr. E. A. Walford, F.G.S., of Banbury, records an *Alaria* (*A. unispinosa*, query *A. semicostulata*) from the Upper Lias of Chipping Warden, Northamptonshire. Mr. B. Thompson, F.G.S., has shown me imperfect specimens of an *Alaria*, which may be *A. unispinosa*, from the Upper Lias (zone of *Am. serpentinus*) of Alderton, Gloucestershire, and Mr. W. D. Crick has recently forwarded me specimens from the Upper Lias of Chipping Warden, and of Burrow Hill, Dodford, Northamptonshire, which are very closely allied, if not, indeed, identical with *A. semicostulata*, Piet. et Eug. Desl. Last year I had myself the good fortune to find a single well-marked example of this genus in the Lower Lias of Bitton, near Bristol, Gloucestershire.

In his classical paper on "Abnormal Secondary Deposits in the

West of England," the late Charles Moore described two incomplete shells from the Lower Lias coralliferous conglomerate of Brocastle, Glamorgan, under the names *Alaria rudis*, Moore, and *A. fusiformis*, Moore (Q.J.G.S. vol. xxiii. p. 566, pl. xiv. figs. 24, 25). Having lately examined these specimens in the Bath Museum, I would question very seriously the generic appellation given to these fossils. In their general proportions both these shells are very unlike typical *Alariæ*, and seeing that they show no distinct canal or trace of digitation, their identification as such must be considered doubtful. On the other hand, there are a few forms in the "Moore Collection" at Bath, at present ascribed to other genera, which may eventually be shown to belong to the genus *Alaria*. For the present, the little shell from the Lower Lias of Bitton, Gloucestershire, must, I believe, be considered the earliest definitely established British *Alaria*, if not indeed the earliest known example of that genus.

ALARIA HUDLESTONI, spec. nov. Pl. V. Fig. 13.

Description.—Shell turritid, scalariform; apex acute; spiral angle slightly concave; whorls 8–9, quadrangular and rectangulately bicarinated, with wide and deep sutures; the carinæ each bear a finely-granulated thread over the angle, the posterior of which is rather more prominent, and causes this keel to project a little more than the anterior one; the posterior carina is encircled anteriorly by a narrow impressed line; the whole of the spire and apparently also the base is covered with fine oblique radial lines; in the earlier whorls the anterior carina is submedian and much more prominent, and is coronated over the angle by vertical costæ, whilst the posterior carina is much less prominent; the base of the shell is almost flat, it bears 3 or 4 widely-separated concentric raised lines. The wing consists of a single digitation, which has a general direction at right angles to the axis of the shell; this is wide at its origin, directly below the anterior carina of the last whorl, after proceeding a short distance it suddenly narrows, and then soon tapers away to its rather blunt and slightly recurved extremity. Canal unknown, the canal-sheath being broken off at its origin.

Dimensions.—Length of shell without the canal, 7·5 millimètres; diameter of last whorl, 4 mm.; breadth of same, with wing, 8 mm.; spiral angle, 30°; sutural angle, 105°.

Obs.—I name this interesting fossil after Mr. W. H. Hudleston, M.A., F.R.S., who has contributed so largely to our knowledge of the Gasteropoda of the British Oolites.

Geological Position and Locality.—Lower Lias, zone of *Am. Bucklandi* (lower portion), Stout's Hill, Bitton, near Bristol, Gloucestershire.

ALARIA SEMICOSTULATA? Piet. et Eug. Desl. Pl. V. Figs. 14 & 15. 1864. *Alaria semicostulata*, Piet. et Eug. Desl. Pal. Fr. Terr. Jur. Gast. vol. iii. p. 18, plate i. figs. 7–9.

The following description of the more perfect of Mr. Crick's specimens will be found to agree pretty closely with that given by Piette (*l.c.*).

Description.—Shell turritid, fusiform; spiral angle regular; whorls 9 or thereabouts, convex, very feebly carinated a little anterior to the middle line, and ornamented by several fine spiral threads of unequal thickness. In one specimen (Fig. 14), which is the more complete of the two, but is imbedded in the rock so as not to show the aperture, there are on the penultimate whorl 11–12 threads. Of these four are coarser than the rest; two of those which are most prominent and subcentral in position determine the faint keel; the other two are anterior to these; between the second and third, and also between the third and fourth, of these coarser threads, counting from the anterior suture, there is a fine line; posteriorly to the fourth coarse thread there are two threads of medium coarseness with a fine thread between them, and there are two or three more fine threads between the last of these and the posterior suture. Crossing these are numerous inconspicuous curved radial lines of growth. The earlier whorls are badly preserved, but enough remains to show that they bear strong straight radial costæ; these costæ disappear on the later whorls, and there are no signs of them on the last two or three. The canal-sheath, uniformly slender from its origin, is prolonged in a straight line axially to its termination; it is striated by fine oblique lines. (In Piette's type the canal was broken off short, so that the character of its termination could not be given.) The aperture and ultimate wing (l'aile définitive) are not shown, but the character of the latter is indicated by a single longish slender spine, which originates from the posterior line of the keel, making an angle of 68° with the axis of the spire.

Dimensions.—Height, including the canal, 19 mm.; height, without the canal, 14 mm.; greatest breadth of last whorl, exclusive of the wing, 8 mm.; spiral angle, 25° ; sutural angle, 115° .

Geological Position and Locality.—Upper Lias, zone of *Am. serpentinus*, Burrow Hill, between Dodford and Norton, Northamptonshire.

The other specimen (Fig. 15) is much less perfect, but it agrees pretty closely with the foregoing in its general form and ornamentation. The whorls, however, appear to be more convex, with deeper sutures, and are even less perceptibly carinated; they are crossed by widely spaced slender curved radial costæ, which taper away towards the sutures, and almost disappear on the later whorls; a short spinous process remains at the opposite side to the aperture, from which point a single angular and moderately prominent keel is continued forwards: the base as well as the apex of the shell having suffered considerably, we cannot say for certain whether any more spinous processes were developed on the keel or what were the characters of the canal and the wing.

Dimensions.—Spiral angle, 25° ; sutural angle, 120° .

Geological Position and Locality.—Upper Lias (transition-bed to Middle Lias), Chipping Warden, Northamptonshire.

Obs.—There are minor differences in form, and in the number and arrangement of the spiral lines, between the above shells and between each of them and Piette's figure of *Alaria semicostulata*. The shell from Burrow Hill (Fig. 14) evidently does not

exhibit its full growth, so that it is impossible to say whether an angular carina sets in on the last whorl or not. Judging by its general agreement with our other specimen, I am inclined to think it would, and in that case the chief difference between this shell and *Alaria semicostulata* disappears. Again, in the Chipping Warden specimen (Fig. 15) the whorls are more rotund and more deeply sutured than in the enlarged figure of *A. semicostulata*, given by Piette, or in the first above-described specimen. Slight variations in the convexity of the whorls, in the depth of the sutures, spiral angle, and arrangement of the spiral lines, are not by themselves characters of specific value amongst otherwise similar *Alariæ*; so that in face of the general agreement of these shells with *A. semicostulata*, and failing definite proof of any important distinction in the keel, the carinal spines, or the canal, I consider it safest to relegate both of the above specimens to that type.

[For the Plate and the Explanation thereof, see the May Number, p. 202.]

IV.—THE GLACIAL DEPOSITS OF SUDBURY, SUFFOLK.

By J. E. MARR, M.A., F.G.S.,

Fellow of St. John's College, Cambridge.

THE accumulations of drift in the vicinity of the town of Sudbury have been described by Mr. Whitaker in the Geological Survey Memoir upon the N.W. part of Essex and N.E. part of Herts, etc.; and additional notes are given by the same author in the Memoir upon the Geology of Ipswich, etc. Since the appearance of these memoirs the sections have altered considerably, and one of the exposures is of such interest, that a record of it seems to me desirable, as in a few years it will be doubtless destroyed, and one more link in the chain of facts which have to be considered in attempting to account for the mode of formation of these drifts will have disappeared.

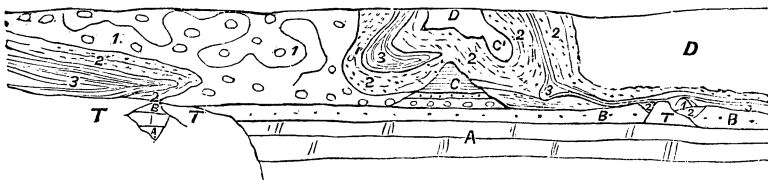
I wish to express my indebtedness to Dr. J. S. Holden, F.G.S., who has kindly accompanied me to the principal exposures, and furnished me with much information.

FIG. 1.—Section in Mr. Green's Pit N.E. of Sudbury.

S.

Length of Section about 100 feet.

N.



A. Chalk.

1. Boulder-clay.

D. Gravel dug over and filled in.

B. Thanet Sands.

2. Gravel and sand.

T. Talus.

C. Red Crag.

3. Loam.

C'. Red Crag caught up in drift.

The section to which I would call special attention is seen in Mr. Green's pit, about a quarter of a mile N.E. of Sudbury Town Hall. The accompanying Figure (Fig. 1) shows its appearance at the