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Wilson E., Crick W. D. The Lias marlstone of Tilton, Leicestershire.// The geological magazine, 1889.- N. S., dec. 3, vol. 6, №8.- p. 337-342, pl. 10. <08.1889>

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II.—The Lias Marlstone of Tilton, Leicestershire.

By E. Wilson, F.G.S., and W. D. Crick,
With Palæontological Notes by E. Wilson, F.G.S.

(PLATE IX.)

WHEN the new railway from Nottingham to Market Harborough was made, several instructive sections in the Upper and Middle Lias series were opened out between the latter place and Tilton. Most of these are now covered up and grass-grown, but one of the best is still partially laid bare in the deep cutting at Tilton Station. This Tilton section has become one of considerable interest to the geologists of the Midland district, from the complete and characteristic exposure which it gives of the Marlstone Rock of Leicestershire in its fully developed and unweathered form, and also on account of the rich fauna which that rock, and in particular its top or 'Transition Bed,' has here yielded.

The main purpose of this note is to present a list of these fossils with a detailed description of a few of them which are either new to the British Lias, or which have not hitherto received an adequate description. Before entering upon this part of our task, a very brief account of the stratigraphy of the district referred to will be desirable. A little to the south of Tilton Station the following section is exposed:—

	Ft.	in.
Upper Lias Shales: concealed in grass-grown slopes of the cutting, yielding a few fossils, e.g. *Harpoceras serpentinum*, *Stephanoceras crassum*, *Turbo Theodori*, *Trochus Northamptonensis*, *Leda ovum*, and *Belemnites* ... ... about	30	0
Middle Lias: *Marlstone Rock.* "Transition Bed" (Middle to Upper Lias); flaggy limestone, containing *Harpoceras acutum*, *Amaltheus spinatus*, *Stephanoceras commune*, *St. annulatum*, etc., *Nautilus truncatus*, *Belemnites elongatus*, *B. paxillosus*, etc., *Lima pectinoides*, *Pecten æquivalvis*, etc., many Gasteropods, *Pleurotomaria rustica*, *Cryptænia expansa*, *Trochus lineatus*, *Tr. ariel*, *Cerithium* (?) *confusum*, *C. ferreum*, etc. *Rhynchonella tetrahedra* var. *Northamptonensis*, *Terebratula punctata*, and fragments of fossil wood 0 9 to	0	6
Bluish-green ferruginous limestone, finely oolitic; *Harpoceras acutum*, *Stephanoceras commune*, *Pecten æquivalvis*, *P. lunularis*, *Terebratula punctata*, and *Belemnites*, in two blocks	4	3
Bluish-green finely oolitic ferruginous limestone with irregular seams of encrinital fragments; *Pecten æquivalvis*, *P. lunularis*, and *Belemnites*, in three blocks	4	2
Bluish-green rock, becoming locally a "jack"; [1] *Pecten æquivalvis*, *Rh. tetrahedra*, *T. punctata* and *Belemnites*	1	6
Greenish arenaceous rock with a "jack" in upper portion and nodular below; *Rh. tetrahedra*, *T. punctata* and *Belemnites*	4	6
Greenish arenaceous rock with "jack" in upper half, and nodular below; *Amaltheus margaritatus*, *Gresslya lunulata*, *G. intermedia*, *Pleuromya* sp., *Rh. tetrahedra*, and *T. punctata*	3	6
	18	5
Middle Lias Shales with bands of sandstone and scattered limestone nodules, etc., *Am. margaritatus*, *Protocardium truncatum*, *Monotis cygnipes*, *Avicula inæquivalvis* and *Leda complanata*, etc. ... about 13 feet exposed, increasing, as the beds rise, to the north.	13	0

[1] "Jack," a quarryman's term for a bed of marlstone made up of an agglomeration of the shells of *Rhynchonella tetrahedra* and *Terebratula punctata*.

The Marlstone Rock in the Tilton railway-cutting, lying beneath a thick capping of Upper Lias Shales, is a hard massively-bedded grey ferruginous limestone, in appearance something like the Marlstone Ironstone of the Cleveland district of Yorkshire, but more finely-grained and duller looking, and containing also a much less percentage of iron. The rock is traversed by numerous joints, and along these and also along the bedding-planes to the depth of a few inches on either side the carbonate of iron has been changed, under the influence of percolating waters, into the hydrated ferric oxide. Coincidently with this chemical change the greenish-grey stone has assumed a rusty-brown colour, so that, when first opened out, the face of the rock presented a very prettily checked appearance. A few years' exposure to the atmosphere, however, has gone far towards toning down this variegation and covering the whole face of the Marlstone Rock with a uniform dull brown tint.

So far as the Leicestershire area is concerned, the "Transition Bed," at the top of the Marlstone Rock, appears to be confined to this single locality. This bed is remarkable for the numerous and varied organisms which it contains. Of these *Harpoceras acutum* is especially abundant, and characteristic of this horizon. Several Ammonites usually confined to the Upper Lias are here found associated with other forms characteristic of the Middle Lias, so that palæontologically the "Transition Bed" must be considered as really transitional between those two series, notwithstanding that it possesses the mineral characters of, and is welded to the Marlstone Rock. We have not therefore hesitated to apply to this bed the name given by Mr. E. A. Walford[1] and Mr. B. Thompson[2] to a similar bed which lies at the top of the Marlstone Rock in Oxford and Northamptonshire. It is mainly, if not solely, from this thin stratum that the Ammonites, as well as the Gasteropods, which are so numerous at Tilton, have been obtained. The "Transition Bed" may be examined *in situ* on a narrow ledge which projects a little from beneath the Upper Lias shales on the west side of the railway-cutting, and the best way to work it is to turn over and break up the slabs with a pick in wet weather, when the stone is softer and works much more readily. A small dip—about 1° S.E.—carries this bed and the Marlstone Rock beneath the line towards the south end of the cutting.

The material taken from the Tilton cutting has been used to construct the embankment at East Norton, about three miles to the south. Here blocks of the Tilton Marlstone lie about in great numbers. Under the action of the weather during the ten or twelve years which have elapsed since the line was made, the hard grey Marlstone Rock has been changed superficially into a comparatively soft brownish arenaceous ironstone, a change of the same kind, if not carried to the same degree, as that which, in the course of ages,

[1] "On some Middle and Upper Lias Beds in the Neighbourhood of Banbury," by Edwin A. Walford, F.G.S., Proc. Warwick Nat. and Arch. Field Club, 1878.

[2] "Notes on Local Geology," by B. Thompson, F.G.S., part x. "The Junction Beds of the Middle and Upper Lias," Journal Northants. Nat. Hist. Soc. vol. ii, p. 239, 1883.

has converted this dense grey ferruginous limestone into a porous and friable rusty brown ironstone over such large areas, where it forms the surface rock, in Leicestershire and Rutland.[1] This softening process has made it possible to extract a large number of fossils in a fairly complete state of preservation.

The list of Tilton fossils here given is in large measure founded upon specimens thus obtained. It is therefore in many cases impossible to say with absolute certainty from what part of the Tilton section these fossils came; but as we find that the chief repository for the cephalous mollusca, at any rate, at Tilton, is the top or "Transition Bed," we shall probably be pretty safe in assuming that most if not all of the similar organisms found in the Marlstone blocks of the East Norton embankment have been derived from that horizon.

Going south from Tilton, the Marlstone Rock rapidly dies away. In the railway-cutting near East Norton Station it can still be traced as a concretionary bed two or three feet in thickness, whilst between Keythorpe and Hallaton it is less than one foot thick; and nearing Market Harborough, it locally disappears altogether.

In the East Norton railway-cutting the grey clays of the "Communis zone" of the Upper Lias are exposed, and have yielded the following characteristic Upper Lias fossils:—

Stephanoceras commune, Sow.
,, *crassum*, Y. & B.
Harpoceras bifrons, Brug.
Belemnites subtenuis, Simpson.
Nortonia (*Purpurina*) *Patroclus*, d'Orb.
Inoceramus dubius, Sow.
Nucula Hammeri, Defrance.
,, *claviformis*, Sow.
Serpula tricristata, Goldfuss.

Palæontological Notes, by E. Wilson, F.G.S.

Although it has fallen to my lot to undertake the critical palæontology connected with the subject, I have to acknowledge very considerable assistance from my colleague in this department of our joint work. Mr. Crick has not only collected the great majority of the fossils mentioned in the Appendix, but he has also identified the whole of them, with the exception of the Gasteropoda and the species which I have described. The success attending Mr. Crick's researches in the neighbourhood of Tilton will be understood when I mention the fact that five years ago the total number of species which had been derived from the Marlstone Rock of the Leicestershire district, including Rutland and S.W. Leicestershire, did not exceed sixty, and that it is chiefly through his labours that this total has been increased to one hundred and ten.[2] Seeing that scarcely anything has been found in the Leicestershire district which has not also been found at Tilton, the Marlstone fauna of this single locality may be considered to fully represent that of the larger area referred to.

[1] As an illustration of the effect of atmospheric action in producing this change, it may be mentioned, that under the railway bridges where the Marlstone ballast has been protected from the rain, the rock remains in practically the same hard state as that in which it was first quarried.

[2] We are indebted to Mr. B. Thompson, F.G.S., of Northampton, for the privilege of inspecting his collection, and also for the loan of some of the most interesting of the fossils here described.

Without further preface I proceed to the consideration of certain of these fossils which are either new to science, or to the British Lias, or which call for more complete description or revised nomenclature. These fossils have all been derived from the Marlstone Rock of Tilton, Leicestershire, with the exception of the remarkable form first noticed, which is from the Upper Lias of East Norton, Rutland, and the peculiar interest of which must be my apology for noticing it in an essay not strictly dealing with Upper Lias palæontology.

NORTONIA (PURPURINA) PATROCLUS, D'Orbigny, 1847, Plate IX. Figs. 1*a*, 1*b*.

1847. *Turbo Patroclus*, d'Orbigny, Prodrome de Paléontologie, vol. i. p. 248.
Syn. 1850. *Purpurina Patroclus*, d'Orb., Pal. Franç. Terr. Jur. vol. ii. Gast. pl. 329, fs. 9–11.
? ,, *Purpurina Philiasus*, d'Orb., Pal. Franç. Terr. Jur. vol. ii. Gast. pl. 329, fs. 12–14, as *Turbo Philiasus* in the Prodrome, vol. i. p. 248.
1856. *Littorina Patroclus*, d'Orb. sp. Piette, Bull. Soc. Géol. France, 2nd ser. vol. xiii. p. 587.
1860. *Eucyclus Patroclus*, d'Orb. sp. Eudes Desl. Bull. Soc. Linn. Norm. vol. v. p. 138. Ibid. Eug. Desl. op. cit. p. 135.
non *Purpurina subangulata*, Mü. sp. Oppel, "Der Jura," p. 386.[1]
nec *Turbo subangulatus*, Münster, Goldfuss, Petref. Germ. vol. iii. p. 98, pl. 124, f. 5.

Description.—Shell thin, elongate, conical, apex acute; whorls 9, angular, screw-like, with a very prominent acute and crenulated keel, situated about two-fifths of the breadth of the whorl from the anterior suture; the whorls slightly concave and gently sloping from the keel to the posterior suture, more deeply excavated and steeply inclined inwards to the anterior suture; the sutures are bounded posteriorly by a raised simple spiral, anteriorly by a finely granulated one; the base is convex and fairly inflated, bearing five equidistant raised granulated spirals, between the middle three of which are two simple ones; the whole surface of the shell is covered with very fine spirals; the posterior border of the last whorl rises near its termination at the aperture, so as to slightly embrace the penultimate whorl: aperture ovate, a little oblique, the outer lip has its inner border considerably expanded, and its outer edge is thickened by a very narrow rim, and digitated by the keel and basal spirals; columellar border with a thin shelly deposit, columella outwardly twisted anteriorly; a narrow umbilical slit; anterior canal a broad shallow groove directed obliquely outwards, and effuse in front; posterior canal a narrow groove concealed beneath the overlapping portion of the last whorl. Length, 16 mm. Greatest diameter, 9 mm. Spiral angle, 37° Sutural angle, 125°. Proportion of last whorl to whole shell, 7 to 16.[2]

[1] Oppel was evidently mistaken in considering *Turbo Patroclus*, d'Orb., as the equivalent of *Turbo subangulatus*, Mü.

[2] Figs. 1*a*, 1*b*, accurately represent this form, except that in Fig. 1*a* the shelly callus on the inner lip should have been shown to continue as far as the end of the posterior canal.

Affinities.—D'Orbigny, in his Prodrome, gives a short diagnosis of a fossil, which appears to be rather widely distributed in the Upper Lias (étage Toarcien) of the centre and east of France, under the name *Turbo Patroclus*, and the same form appears in the "Paléontologie Française" as *Purpurina Patroclus*. Although no description is given in the latter work of this or indeed of any other *Purpurina*, it is obvious, from the illustrations in the atlas, that we have here our Rutland fossil. Yet the figure in the "Pal. Franç." is remarkable in this, that with the identical form and ornamentation of the English fossil, it presents apertural characters which are very different. Instead of the contracted aperture, thickened outer lip, and anterior and posterior canaliculation, possessed by our shell, we see depicted a large oval aperture with rounded margins and without the trace of a groove or canal. Evidently whilst the body of the shell of *Purpurina Patroclus*, D'Orb., is correctly delineated, the aperture is a beautiful but imaginary restoration; and the same observation will probably apply to *Purpurina Philiasus*, D'Orb., which is probably only a more highly ornate variety of *P. Patroclus*. It is true there are other Jurassic Gasteropods which have a spire and ornamentation extremely like *P. Patroclus*, and which nevertheless belong to different groups, *e.g. Alaria* and *Pseudalaria*; but the points of agreement between the fossil here figured and the illustration in the Pal. Franç. are, I hold, too precise to leave the above identification in doubt. It is to be noted also, that the name *Purpurina* given by D'Orbigny, implies that he considered these shells siphonostomatous, and this is expressed also in the original diagnosis of the genus, by that author in his "Cours élémentaire de paléontolgie,"—"Ouverture pourvue en avant d'un très étroit sillon qui remplace l'echancrure des Purpura." It will not be necessary to give, at this point, the history of *Purpurina*, the more so as this subject was not very long ago treated in some detail by my esteemed friend Mr. W. H. Hudleston, F.R.S., in the pages of the Geological Magazine,[1] and still more recently in the first part of his valuable Monograph on the Inferior Oolite Gasteropoda.[2] It is sufficient for my purpose to point out that, whilst Jurassic palæontologists have rightly followed Deslongchamps and Piette in restricting the genus *Purpurina* to forms possessing the general characters of *Purpurina bellona*, D'Orb., continental authors have been generally misled in their identification of *P. Patroclus*, D'Orb. as one of the Littorinidæ (an *Eucyclus*=*Amberleya*, or a *Littorina*), by the inaccurate figures in the Paléontologie Française. What then are the true affinities of the shell under consideration? In the aggregate of its characters—the rather elongate spire, the aperture with an expanded outer lip, slightly enveloping last whorl, outwardly twisted columella and clearly defined anterior and posterior canaliculation—this peculiar form seems to fall under the Cerithiidæ. It will scarcely, however, come within the genus *Cerithium* or any other established genus of that family. In certain details of form and

[1] Geol. Mag. Dec. II. Vol. IX. (1882), p. 11.
[2] Pal. Soc. British Jurass. Gast. pt. i. p. 8, and p. 83.

ornamentation *Purpurina Patroclus*, D'Orb., is remarkably like, and is probably related to, the type of Mr. Hudleston's new Jurassic genus *Pseudalaria* (*Alaria*) *Etheridgii*, Tawney, but the characters of the aperture are sufficiently different in these two shells to bring them under distinct generic groups. I believe it will be best to found a new genus for the reception of this remarkable Rutland fossil. I therefore, suggest for it the name *Nortonia*, in reference to the only British locality, East Norton, where it has at present been found. *Nortonia* might be briefly defined as a *Cerithium* with a very shallow anterior canal, and with eucycloid spire and ornamentation.[1] *Nortonia Patroclus* is perhaps one of those "common forms" which serve to link together several very diverse genera, such for example as *Cerithium* and *Pseudalaria* on the one hand, and *Amberleya* and *Purpurina* on the other.

I am indebted to Mr. Beeby Thompson, F.G.S., of Northampton, for the opportunity of examining this extremely interesting fossil.

Geological Horizon and Locality.—Upper Lias Shales, Railway-cutting, East Norton, Rutland.

Cerithium (Cerithinella?) confusum, Tate, 1875. Plate IX. Figs. 2, 2*a*.

1875. *Cerithium confusum*, Tate, Geol. Mag. Dec. II. Vol. II. p. 205.

I have several specimens of a highly elongate conical shell from East Norton, which answers to the description given by Tate of the above type. The state of preservation of these fossils is not sufficiently good to indicate with certainty their generic position. No figure accompanied the original description. I therefore give illustrations from our Leicestershire specimens.

Marlstone Rock, Tilton (East Norton embankment).

Cerithium ferreum, Tate, 1875. Plate IX. Figs. 3*a*, 3*b*, 3*c*.

1875. *Cerithium ferreum*, Tate, Geol. Mag. Dec. II. Vol. II. p. 205.

A number of shells have been obtained from the Marlstone Transition-bed of Tilton, and from the East Norton embankment, which correspond with Tate's type. No figures of this form having yet been published, I give illustrations from Tilton specimens to supplement the original description in the Geological Magazine.

Marlstone Rock, Tilton (East Norton embankment and Tilton).

Cerithium costulatum? Desl. 1842. Plate IX. Figs. 4, 4*a*.

1842. *Cerithium costulatum*, Desl. Mém. Soc. Linn. Norm. vol. vii. p. 199, pl. xi. figs. 12, 13.

There is a single imperfect specimen from East Norton, of an elongate conical shell, which appears to represent the above type of

[1] As a general principle, no doubt, it is not safe to found a genus or even a species on a single specimen, and this prevents my giving a more precise diagnosis of *Nortonia*. In justification of the above genus-making however, it may be said, that the characters of *N. Patroclus* are exceedingly well defined, that our solitary specimen is apparently an adult shell, and is exceptionally well preserved, and that there is evidence of its maintaining its characters constant over a wide geographical area.

Deslongchamps. The original illustrations are far from satisfactory: but the figured shell has a spire which is identical in its form and proportions, and apparently also in its ornamentation, with the above type, and I therefore make this identification with some confidence in its accuracy.

Marlstone Rock, Tilton (East Norton embankment).

CERITHIUM ILMINSTERENSIS, Moore, 1866. Plate IX. Figs. 5*a*, 5*b*, 5*c*.

1865–6. *C. Ilminsterensis*, Moore, Proc. Somerset Arch. and Nat. Hist. Soc. vol. xiii. p. 200, pl. iv. s. 12, 12*a*.

There are a number of specimens of a shell which agrees in its general characters with Moore's type. These shells are twice the length of the type, with the same number of whorls, and also differ from *C. Ilminsterensis*, Moore, agreeing with *C. Dayii*, Tate, in having four rows of subspinous encircling costulæ instead of three in each whorl. These small points of difference do not, however, seem to me to be characters of specific value.

Marlstone Rock, Tilton (East Norton embankment).

PSEUDOMELANIA (CHEMNITZIA) BRANNOVIENSIS, Dumortier, 1869. Plate IX. Figs. 6, 7.

1869. *Chemnitzia Brannoviensis*, Dumort. Etudes Pal. sur les Dépôts Jurass. du Bassin du Rhone, pt. iii. p. 218, pl. 27, f. 11.

The Marlstone blocks on the East Norton embankment have yielded us a number of shells which, although of much smaller dimensions, seem to agree with this type of Dumortier's. Seeing that this fossil has not hitherto been recorded from the British Lias, the following description and the illustrations here given may be of interest to the students of the English Jura. I adopt the generic designation of Pictet and Campiche as applicable to this form. *Description*:—"Shell conical, short, imperforate; spiral angle regular; whorls eight, flat or very slightly convex, covered with transverse lines of growth, forming thick irregular obscure plicæ, which give origin close to the suture posteriorly, to a series of nodules, slightly scalariform. Aperture high, oval, very oblique, without callosity over the columella. The last whorl occupies nearly half the total height. Length to width 32 : 17. Spiral angle 43°."

East Norton specimens give: Height 22 mm.; Diameter 11 mm.; Spiral angle 42°.

Marlstone Rock, Tilton (East Norton embankment).

PSEUDOMELANIA (PHASIANELLA) TURBINATA, Stoliczka, 1861. Plate IX. Figs. 8, 9.

1861. *Phasianella turbinata*, Stol., Gast. und Aceph. der Hierlatz-Schichten, Jahrbuch der k. k. Reichsanstalt (Wien), vol. xliii. p. 177, pl. iii. fs. 1. 2.

Like *Ps. Brannoviensis*, this is fairly common at Tilton. The genus *Pseudomelania* is suggested as a more fitting generic appellation for this form also.

Marlstone Rock, Tilton (East Norton embankment).

TURBO RUGIFERA, Moore, 1867. Plate IX. Figs. 10*a*, 10*b*, 11.

1867. *Turbo rugifera*, Moore, Middle and Upper Lias, Proc. Somerset Arch. and Nat. Hist. Soc. vol. xiii. p. 209, pl. vi. figs. 23, 24.
Syn. ,, *Turbo coronatus*, Moore, Ibid. p. 209, pl. vi. figs. 21, 22, 22*.
Syn. ,, *Pleurotomaria costulatum*, Moore, Ibid. p. 205, pl. v. figs. 12, 13.

Fresh description.—Shell turbinated, conical, umbilicated, apex acute; whorls 6-7, convex, narrow, with a broad flattened area bounding the sutures anteriorly, ornamented by sharply raised spiral lines, of which there are six or seven on the penultimate whorl, crossed by numerous fine, regular, close-set oblique radial lines, which raise the spirals into neat granulations at their decussations; base very slightly convex, umbilicus deep and generally large, with a squarely angulated and crenulated edge; aperture nearly round and nearly free from the last whorl; outer lip thin, inner lip with a lunate shelly expansion anteriorly. A few fine spirals may mark the circumference of the base, and very faint concentric striæ are sometimes discernible between these and the centre of the base, over which the fine radial lines are continued in flexuous curves. Height 9 mm.; Diameter 8 mm. to 9 mm.; Spiral angle 60° to 92°.

Note.—There is evidently considerable variation within the limits of this species, and different appearances are presented by different individuals according as the spire is more raised or depressed, and according as the varying relative strength of the spirals gives a rounded or an angulated appearance to the whorls. It is not therefore surprising that the late Charles Moore made three species out of the three variable specimens of *Turbo rugifera* which he obtained from the Middle Lias Marlstone of Ilminster. The specimens collected by Mr. Crick at East Norton serve to link these three forms together, and indicate that *Turbo rugifera* is the true type. Having carefully examined the type of *Pleurotomaria costulatum*, Moore, in Bath Museum, I see no reason for considering that shell a *Pleurotomaria*. It shows no trace of a sinus-band, and appears to be only a highly granular and somewhat squarely-keeled example of *Turbo rugifera*, Moore. *Turbo coronatus* also is only a more fully grown shell of the same type, with the difference that the greater prominence and coarseness of one of the spirals gives its whorls a coronated aspect.

Marlstone Rock, Tilton (East Norton embankment).

TROCHUS ROTULUS, Stoliczka, 1861. Plate IX. Figs. 12*a*, 12*b*, 12*c*.

1861. *Trochus rotulus*, Stol., Gast. und Aceph. der Hierlatz-Schichten, Jahrbuch. der k. k. Reichsanstalt (Wien), vol. xliii. p. 173, pl. ii. f. 7.

In the Journal of the Northampton Natural History Society for 1883[1] Mr. E. A. Walford, F.G.S., quotes this fossil from the Marlstone Transition-bed of Aston-le-Wall and Appletree, and gives an illustration (loc. cit. fig. 5), which can however hardly be considered a satisfactory representation of this very elegant little shell. I trust the figures here given may be more successful. *Trochus*

[1] Journ. Northants Nat. Hist. Soc. vol. ii. (1883) p. 296, pl. fig. 5.

rotulus, Stol., must not be confounded with *Trochus Pethertonensis*, Moore, from which it is quite distinct.

Marlstone Rock, Tilton (East Norton embankment).

PLEUROTOMARIA HELICINOIDES, Roemer, 1836. Plate IX. Figs. 13*a*, 13*b*.

1836. *Trochus helicinoides*, Roemer, Die Verstein. des Ool.-Gebirges, p. 150. pl. xi. f. 13.

Syn. 1867. *Trochus carinatus*, Moore, "Middle and Upper Lias of the South-West of England," Proc. Somerset Arch. and Nat. Hist. Soc. vol. xiii. p. 207, pl. 4, fs. 24, 25.

non *Turbo canalis*, Münster, nec *Pleurotomaria helicinoides*, Roemer, of Tate.

Whilst agreeing with Mr. Ralph Tate, F.G.S.,[1] that *Trochus carinatus*, Moore, is a *Pleurotomaria*, and (in all probability) identical with *Trochus* (not *Turbo*) *helicinoides*, Roemer, I cannot go so far as to admit that these are the same as *Turbo canalis*, Münster—a *Pleurotomaria* truly, but a different species I maintain, to the above. The figure entitled *Pleurotomaria helicinoides* in the Yorkshire Lias is, I consider, an illustration of '*Turbo*' *canalis*, Mü., and not of '*Trochus*' *helicinoides*, Roemer.

The following descriptions and the accompanying figures of Tilton specimens will indicate the chief points of difference between these two forms.

Pleurotomaria helicinoides, Roemer (assuming this to be the equivalent of *Trochus carinatus*, Moore), is a smooth and even polished shell, with very clean cut and angular sculpturing; the whorls have an acute keel anterior to the middle line; on this keel is placed the sinus-band, which is bounded by a single rather widely-spaced raised line on each side; from the sinus-band the whorl falls vertically in front to the anterior suture, and slopes gently back in a single concave sweep to a raised line or faint keel close to the posterior suture; the last whorl bears a third angulated keel anteriorly, bounding the broad vertical area below (*i.e.* anteriorly); the shell is covered with very fine curved lines of growth; the base is only slightly convex, smooth, but bearing a few very fine acute concentric lines either limited to the outer part or continuous to the centre; there is a very small umbilicus; the aperture is transversely ovate, with ill-defined columella. Height, 8 mm.; greatest diameter 7 mm.; Spiral angle convex, about 70°.

Marlstone Rock, Tilton (East Norton embankment).

PLEUROTOMARIA (TURBO) CANALIS, Münster, 1848. Plate IX. Fig. 14.

1848. *Turbo canalis*, Münster, Goldfuss, Petref. Germ. vol. iii. p. 95, pl. 193, figs. 12*a*, *b*.

Syn. 1878. *Pleurotomaria helicinoides*, Roem. sp. Tate, non Roemer, "The Yorkshire Lias," p. 338, pl. x. figs. 7*a*, 7*b*.

Whilst possessing the same general form of *Pl. helicinoides*, as above described, this shell presents rounded instead of angular contours, is far from smooth, and differs in its proportions as well as in its ornamentation. In *Pl. canalis* the keel bearing the sinus-band is situated posteriorly rather than anteriorly to the middle line,

[1] "The Yorkshire Lias," by Tate & Blake, p. 338, pl. x. fs. 7, 7*a*.

and is less angular, and the sinus-band is bounded by two much more closely set lines than in *Pl. helicinoides*. There is indeed a similar broad vertical and nearly smooth area below (anterior to) the sinus-band; but, excepting this, the whole shell from the apex of the spire to the centre of the base is covered with regular and prominent rounded spiral lines; two of these spirals situated in the middle of the sloping posterior portion of the whorls are more raised than the rest, and make the whorls appear more convex; the periphery of the last whorl also is rounded. Very slender curved radial lines may be discerned throughout the shell with the aid of a lens; but these are fainter than in *Pl. helicinoides*, and almost concealed by the spirals. The base is slightly convex; a very small, if any umbilicus; columella indistinct, and the aperture generally very like that of *Pl. helicinoides*. Height 8·5 mm.; width, 7 mm.; Spiral angle convex, about 75°.

Marlstone Rock, Tilton (East Norton embankment).

EXPLANATION OF PLATE IX.

FIG. 1. *Nortonia Patroclus*, d'Orb., Upper Lias, Railway cutting, East Norton, Rutland. *a*. Front view; *b*. back view. Enlarged twice.

,, 2. *Cerithium* (*Cerithinella* ?) *confusum*, Tate, Marlstone Rock, Tilton (East Norton Embankment). Enlarged one and a half times. *a*. Whorl further magnified.

,, 3. *Cerithium ferreum*, Tate, Marlstone Rock, Tilton. *a*. Front view; *b*. back view. Enlarged one and a half times. *c*. Whorl further magnified.

,, 4. *Cerithium costulatum* ? Desl., Marlstone Rock, Tilton (East Norton embankment). Enlarged one and a half times. *a*. Whorl further magnified.

,, 5. *Cerithium Ilminsterensis*, Moore, Marlstone Rock Tilton (East Norton Embankment). *a*. Front view; *b*. back view. Enlarged one a half times; *c*. Whorl further magnified.

,, 6. *Pseudomelania Brannoviensis*, Dumort., Marlstone Rock, Tilton (East Norton embankment). Front view. Enlarged one and a half times.

,, 7. *Ibid.* From another specimen. Back view, similarly enlarged.

,, 8. *Pseudomelania turbinata*, Stol., Marlstone Rock, Tilton (East Norton Embankment). Front view. Enlarged one and a half times.

,, 9. *Ibid.* From another specimen. Back view, similarly enlarged.

,, 10. *Turbo rugifera*, Moore, Marlstone Rock, Tilton (East Norton Embankment. *a*. Front view; *b*. back view. Enlarged twice.

,, 11. *Ibid.* Base, from another specimen, with an exceptionally large umbilicus. Similarly enlarged.

,, 12. *Trochus rotulus*, Stol., Marlstone Rock, Tilton (East Norton Embankment). *a*. Front view; *b*. back view. Enlarged twice. *c*. Whorl further enlarged.

,, 13. *Pleurotomaria helicinoides*, Roemer, Marlstone Rock, Tilton (East Norton Embankment). *a*. Front view; *b*. back view. Enlarged four times.

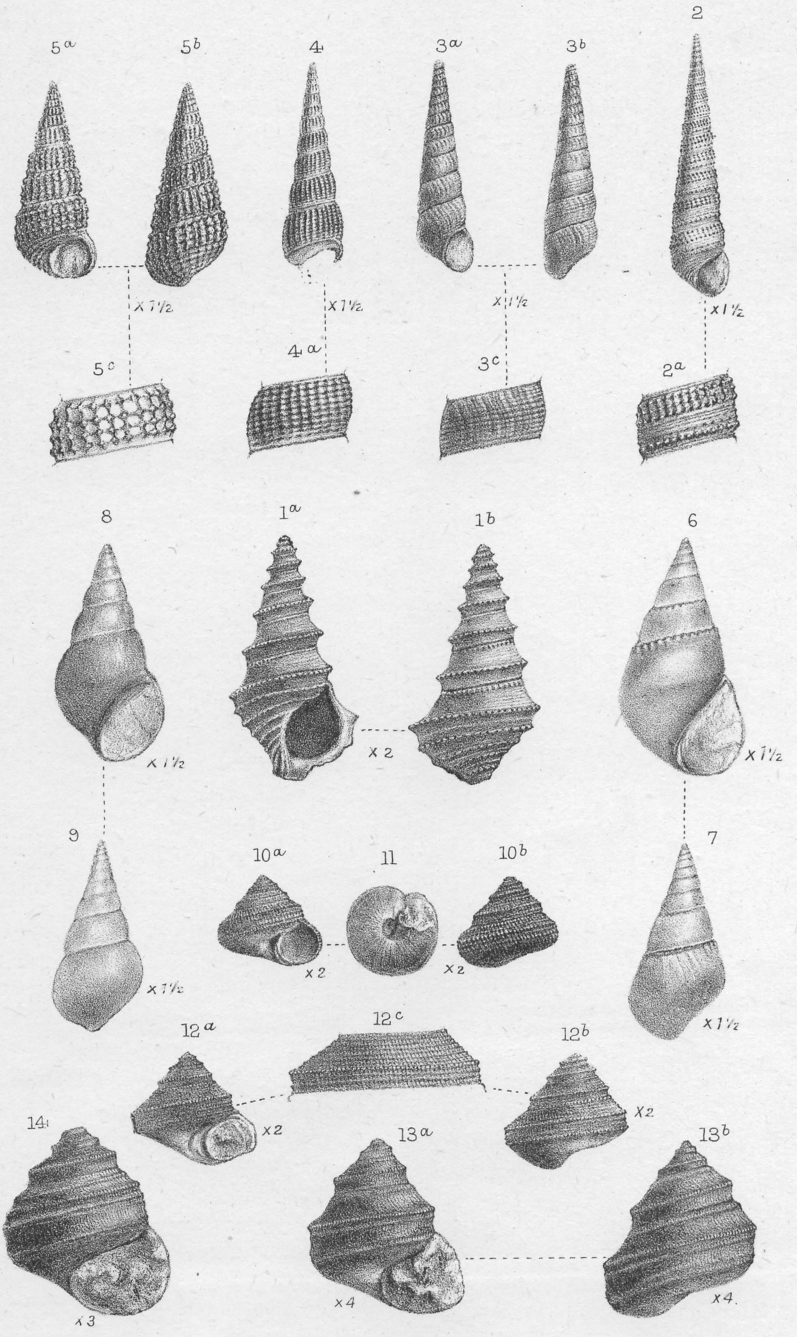
,, 14. *Pleurotomaria canalis*, Münster, Marlstone Rock, Tilton (East Norton Embankment). Enlarged three times.

(*To be continued.*)

III.—WAS THERE AN ARCTIC OCEAN IN THE MAMMOTH PERIOD?

By H. H. HOWORTH, Esq., M.P., etc., etc.

THE convergence of opinion is now so strong that the climate of Siberia in the Mammoth age was sufficiently temperate to enable trees to grow where only the bare tundra is at present found (if it does not necessitate our extending the forest zone at least as far north as the Liachof Islands), that it becomes at once interesting



A. S. Foord del. et lith. West, Newman imp.

Lias Marlstone Rock, Transition-Bed & Upper Lias Gasteropoda.

Tilton, Leicestershire

THE

GEOLOGICAL MAGAZINE.

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No. VIII.—AUGUST, 1889.

ORIGINAL ARTICLES.

I.—The Lias Marlstone of Tilton, Leicestershire.

By E. Wilson, F.G.S., and W. D. Crick,
With Palæontological Notes by E. Wilson, F.G.S.

(PLATE X.)

(*Concluded from the July Number, p.* 305.)

Cardinia Slatteri, Walford, 1878. Plate X. Figs. 1, 2.

1878. *Isocardia*? *Slatteri*, Walford, "On some Middle and Upper Lias Beds in the Neighbourhood of Banbury," Proc. Warwick Nat. and Arch. Field Club, 1878, p. 49. 1879. *Isocardia*, sp. in reprint of same paper, pp. 16, 20, fig. 5 in plate.

Description.—Shell trigonal, thick; umbones large, angulated and terminal, ending in acute points, which curve downwards, forwards, and a little outwards; the sides of the shell, triangular in form, slightly excavated and highly inclined to the areas, are bounded by prominent carinæ, an acute carina separating the side from the slightly concave triangular area in front, and a more rounded carina separating it from the slightly convex triangular area behind. The valves are marked with strongly defined and somewhat sinuous sub-imbricating lines of growth at wide and fairly regular intervals, between which may be discerned numerous fine lines of growth. Lunule small and deep. Cardinal tooth elongated, oblique and prominent in the right valve, small and triangular in the left. Anterior lateral tooth of right valve obtusely conical and very prominent, received into a deep socket in the corresponding valve, immediately above the impression of the anterior adductor muscle; posterior lateral tooth in left valve elongated, longitudinally grooved and attenuated towards the umbo; muscular impressions deeply sunk into the substance of the shell, the anterior triangularly ovate, the posterior oval-oblong; pallial line not discernible in specimens examined; ligament external, groove for its insertion elongated, shallow and curved concentrically with the dorsal margin of the shell. Height of shell, 18 to 25 mm.; breadth, 21 to 29 mm.

Note.—This shell has somewhat the form of an *Opis*, and is very like *Opis Ferryi*, Dumortier (Dépôts Jurassiques, pt. 3, p. 264, pl. xxx. fs. 4–6); but it differs from that shell by its more strongly curved outlines, absence of longitudinal ribs, and larger size. Possibly that form, as well as certain other trigonal bicarinated shells having imbricating growth layers—and the hinge characters

of which have not been noticed—may eventually be found to fall under the genus *Cardinia*.

This fossil was first discovered by Mr. E. A. Walford, F.G.S., in the Marlstone and Middle Lias Transition-bed of Aston-le-Wall and Appletree, Northamptonshire, and referred to in this author's paper above cited, and figured but not described in the reprint of same, under the name *Isocardia Slatteri*, Walford. At that time the hinge characters had not been made out, and consequently the generic identification was made with some diffidence. Mr. Crick has since found an almost perfect left valve of this shell on the East Norton embankment, and Mr. Walford has kindly lent me a right valve, in which also, now that the matrix has been cleaned out, the hinge characters are clearly displayed (see Pl. X. Fig. 2). These hinge characters are essentially those of a *Cardinia*, as also is the mode of growth, and to that genus I therefore without hesitation refer this shell, and in this view Mr. Walford concurs.

Marlstone Rock, Tilton (East Norton embankment).

PINNA TILTONENSIS, sp. nov. Plate X. Fig. 3.

Shell elongated, lanceolate, anterior and posterior borders with nearly straight edges, but slightly convex; with concentric longitudinal plicæ, which towards the umbo become broken up and mammillated; the posterior half of each valve is ornamented with slender radial costæ, which are regular and equally spaced except the two lower or median ones, which are more slender and wider apart; about half only of the radial costæ reach the ventral border of the shell; these radial striæ, where they cross the plicæ of growth, form a neat meshwork, and are as a series interrupted at intervals, where they take an oblique direction for a short distance so as to present a distorted appearance. We have two examples of this shell; both are incomplete, and the best-preserved specimen which is figured is very much compressed; hence the materials for founding a species are not the most satisfactory, and the above name must be considered therefore as provisional.

Marlstone Rock, Tilton (East Norton embankment).

INOCERAMUS, sp. Plate X. Figs. 4, 4*a*.

Shell markedly inequivalve, moderately inflated, longer than broad, broadly flattened posteriorly in the left valve, acuminated towards the umbones, which are prominent, pointed, approaching and recurved; the valves are marked with irregular longitudinal ridges and furrows, and finer concentric lines of growth, and by rather ill-defined and irregular radial striæ, which at their intersections give an irregularly mammillated and pitted aspect to portions of the shell. This shell differs in its form and markings from all the Jurassic *Inocerami* with which I am acquainted; but having only a single and incomplete specimen, I hesitate to impose a new name. Should it eventually appear that we have here a new species, the name *Inoceramus Tiltonensis* might be given to it.

Marlstone Rock, Tilton (East Norton embankment).

EODIADEMA GRANULATA.

The beautiful specimens of this Middle Lias Echinoid belong to a new genus, the description of which will be found in "A Revision of the Genera (Fossil and Recent) of the Echinoidea," Journ. Linn. Soc. vol. xxiii. 1889, by Prof. P. Martin Duncan, F.R.S., etc. The following is the diagnosis.

Genus *Eodiadema*, Dunc. 1889.

Test small, thin, circular in tumid marginal outline, sub-conical dorsally, tumid and reentering actinally, broader than high. Apical system moderate in size, ovoid or elliptical in outline at the periproct: five large basal plates, four in contact, but the fifth or posterior separated from the others on either side by radial plates, which thus enter the ring. Ambulacra narrow, straight, wider than the interradia at the peristomial margin, narrower elsewhere; poriferous zones narrow, pairs of pores numerous, in single, simple, vertical series, barely any crowding near the peristome; plates all low broad primaries; interporiferous areas rather broad, crowded with blunt granules dorsally, some larger granules near the poriferous zones, and giving place at the ambitus to some very small crenulate perforated tubercles, which diminish actinally. Interradia broad, plates not numerous, broader than high; two vertical rows of perforate, crenulate and scrobiculate tubercles in each area, a few large at the ambitus, and all becoming rapidly small and almost obsolete dorsally, or replaced there by granulation, diminishing also actinally. Scrobicules of the ambital tubercles large, usually coalescing. A large blunt granulation occurs beyond the scrobicular circles, except on angular median spaces contiguous with the basal plates where there are no granules. Peristome decagonal, sunken, small, with well-marked branchial incisions.

The position of this genus is in the family Diadematidæ and in the sub-family Orthopsinæ.

EODIADEMA GRANULATA, sp. nov. Plate X. Figs. 5, 5*a*, 5*b*, 5*c*.

Test small, sub-conical above the tumid ambitus, circular in ambital outline. Apical system with granulated basal plates, with large perforations; the posterior radial plates large, separating the fifth basal plate and entering the periprocteal ring; the others smaller, triangular and excluded. A raised rim around the periproct. Poriferous zones somewhat sunken; all plates simple primaries; tubercles very small in two vertical rows. Dorsal surface of interradia, except in the median lines down to varying distances towards the ambitus, very boldly granulate; in the triangular spaces, from the basal plates along the median lines there is but slight granulation or it may be absent.[1] About five large primary tubercles in each interradium at the ambitus, perforate, crenulate, and with coalescing scrobicules. Peristome reentering; with branchial incisions limited by raised lines. Height, 6 mm.; breadth, 12 mm.

Marlstone Rock, Tilton (East Norton embankment).

[1] The otherwise faithful drawing, Fig. 5*a*, should have fewer granules upon the interradial plates close to the basal plates.

ONYCHITES, sp. Plate X. Fig. 6.

Two of the peculiar bodies known by this name were obtained by Mr. B. Thompson, F.G.S., from the East Norton embankment.

The specimen here figured may be described as follows: Cylindrical curved hollow body tapering to a point at each end, somewhat constricted in the middle (3 mm. in diameter) and expanded towards the ends (4 to 5 mm. in diameter), and flattened and with acute edges towards one end; this body is bow-shaped, the points curving towards the same side, but in planes considerably inclined to each other; the pointed ends are about 4·5 centimetres apart; the shelly covering is thin, smooth and apparently structureless, but under a high-power lens its external surface appears to be finely punctated; the shell is separated from the surrounding matrix by a uniformly narrow hollow space about ·5 mm. broad, indicating apparently the former presence of a soft investing organic layer, which has disappeared in the process of fossilization. At first sight these hollow cylindrical bodies look as if they might have belonged to tubicolar Annelids; but it is to be observed that their tubes are closed at *both* ends, and that, as we have just seen, there are indications of their having been internal and not external structures.

Thirty years ago, Quenstedt described several of these curious bodies in "Der Jura."[1] At one time it appears they were taken for "compressed crabs-claws"! Dr. Fraas considered them to be the acetabular hooks of Cephalopods, referring them to *Onychoteuthis*, and in this view Quenstedt concurred. Messrs. Tate and Blake state in 'The Yorkshire Lias'[2] that they met with these pointed organisms in the 'Jamesoni beds' at Peak, agreeing with the *Onychites numismalis*, of Quenstedt, but they avoided any speculation as to their true nature. I am inclined to accept the explanation suggested by Fraas and Quenstedt.

Marlstone Rock, Tilton (East Norton embankment).

EXPLANATION OF PLATE X.

FIG. 1.	*Cardinia Slatteri*, Walford.	Marlstone Rock, Tilton (East Norton embankment). Left valve, exterior. Nat. size.
,, 2.	*Ibid.*	Marlstone Rock, Transition-bed, Appletree. Right valve, interior. Nat. size.
,, 3.	*Pinna Tiltonensis*, sp. nov.	Marlstone Rock, Tilton (East Norton embankment). Nat. size.
,, 4, 4*a*.	*Inoceramus*, sp.	Marlstone Rock, Tilton (East Norton embankment). Right and left valves. Half nat. size.
,, 5.	*Eodiadema granulata*, sp. nov.	Marlstone Rock, Tilton (East Norton embankment). Side view, enlarged twice.
,, 5*a*.	*Ibid.*	Apical system. Same locality. Enlarged six times.
,, 5*b*.	*Ibid.*	Mouth opening. From another specimen, enlarged three times.
,, 5*c*.	*Ibid.*	Ambulacrum and interambulacrum, enlarged six times.
,, 6.	*Onychites*, sp.	Marlstone Rock, Tilton (East Norton embankment).

[1] "Der Jura," p. 201, pl. 24, fs. 59–62, and pp. 246–7, pl. 34, fs. 2–5.
[2] "The Yorkshire Lias," p. 448.

APPENDIX.

LIST OF FOSSILS FROM THE LIAS MARLSTONE (including the "Transition Bed") of Tilton, Leicestershire.

REPTILIA.

Ichthyosaurus, sp. vertebræ.

CEPHALOPODA.

Amaltheus margaritatus, De Montf.
,, *spinatus*, Brug.
Harpoceras acutum, Tate.
,, *ovatum*, Young and Bird.
,, *serpentinum*, Rein.
Stephanoceras annulatum, Sow.
,, *commune*, Sow.
,, *semicelatum*, Simpson.
Belemnites apicicurvatus, Blainv.
,, *breviformis*, Voltz.
,, *clavellatus*, Bean.
,, *paxillosus*, Schloth.
Nautilus truncatus, Sow.

GASTEROPODA.

Actæonina fragilis, Dunker.
,, *ferrea*, Wilson.
,, *Ilminsterensis*, Moore.
,, *sinemuriensis*, Martin.
Amberleya(*Trochus*)*Gaudryana*, d'Orb.
,, ,, ,, a var.
Cerithium confusum, Tate.
,, *costulatum* ? Desl.
,, *ferreum*, Tate.
,, *Ilminsterensis* ? Moore.
,, *liassicum*, Moore.
,, *reticulatum* ? Desl.
Chemnitzia (?) *Periniana*, d'Orb.
,, (?) (*Turritella*) *undulata*, Benz.
Cryptoenia expansa, Sow.
,, *rotellæformis*, Dunker.
,, *solarioides*, Sow.
Cylindrites æqualis, Wilson.
Monodonta bullata, Moore.
Pseudomelania (*Chemnitzia*) *Brannoviensis*, Dumort.
,, (*Phasianella*) *turbinata*, Stol.
,, sp.
Pleurotomaria (*Turbo*) *canalis*, Mü.
,, (*Trochus*) *helicinoides*, Roemer.
,, *rustica*, Desl.
,, *similis* (=*anglica*), Sow.
Trochus ariel, Dumort.
,, *Fidia*, d'Orb.
,, *lineatus*, Moore.
,, *Pethertonensis*, Moore.
,, *rotulus*, Stol.
Turbo cyclostoma, Benz.
,, *rugifera*, Moore = *T. coronatus*, Moore = *Pl. costulatum*, Moore.
,, *latilabrus*, Stol.

LAMELLIBRANCHIATA.

Anomia numismalis, Quenst.
Astarte striato-sulcata, Roemer.
Cardinia concinna, Sow.
,, (*Isocardia*) *Slatteri*, Walford.
Ceromya bombax, Quenst.
Goniomya heteropleura, Ag.
Gresslya intermedia, Simpson.
,, *lunulata*, Tate.
Hinnites abjectus, Phillips.
,, *velatus*, Münster.
Inoceramus, sp.
Lima eucharis, d'Orb.
,, *Hermanni*, Voltz.
,, *pectinoides*, Sow.
Limea acuticosta, Münster.
,, *Juliana*, Dumort.
Macrodon Buckmanni, Buckm.
Modiola numismalis, Oppel.
,, *ornata*, Moore.
,, *scalprum*, Sow.
Monotis inæquivalvis, Sow.
Ostrea (*Gryphea*) *cymbium*, var. *depressa*, Lam.
,, *submargaritacea*, Brauns.
Pecten acutiradiatus, Goldfuss.
,, *æquivalvis*, Sow.
,, *calvus*, Goldfuss.
,, *dentatus*, Sow.
,, *lunularis*, Römer.
,, *priscus*, Schloth.
,, *textorius*, Schloth.
Pinna Tiltonensis, n.sp.
Plicatula spinosa, Sow.
Protocardium truncatum, Sow.
Tellina gracilis, Dumort.
Unicardium subglobosum, Tate.

BRACHIOPODA.

Discina reflexa, Sow.
Rhynchonella acuta, Sow. var. *bidens*, Phill.
,, *Amalthei*, Quenst.
,, *fodinalis*, Tate.
,, *tetrahedra*, Sow.
,, ,, var. *Northamptonensis*, Walker.
Spiriferina rostrata, Schloth.
Terebratula punctata, Sow.
,, ,, var. *Edwardsii*, Dav.
,, ,, var. *Havesfieldensis*, Dav.
,, *punctata*, var. *Radstockensis*, Dav.
,, *Walfordi*, Dav.
Waldheimia indentata, Sow.
,, *numismalis*, Lam.
,, *resupinata*, Sow.
,, *sub-numismalis*, Dav.

BRYOZOA.

Diastopora oolitica, Vine.
,, *stomatoporoides* ? Vine.

ANNELIDA.

Ditrupa capitata, Phil.
,, *etalensis*, Piette.
,, *quinquesulcata*, Münster.
Serpula tetragona, Desl.
,, *tricristata*, Goldfuss.

ECHINODERMATA.

Eodiadema granulata, n.sp.
Pentacrinus lævis, Miller.

ACTINOZOA.

Thecocyathus, sp.

INCERTA SEDIS.

Onychites, sp.

II.—Subaërial Deposits of the Arid Region of North America.

By Israel C. Russell,
of the United States Geological Survey; Washington D.C., U.S.A.

Part II.

(*Concluded from p.* 295.)

A COMPARISON of adobe with the loess of China forms the concluding part of this paper; but as no analyses of the Chinese deposit are known to me, a few analyses of the loess of the Mississippi Valley are inserted, not with the assumption, however, that the deposits bearing the same name in these two regions are identical. A comparison of this table with the one showing the composition of adobe is instructive, as it indicates that these two yellow earths have a very similar composition. There are other respects in which they bear a close resemblance to each other; but as my acquaintance with the loess of the Mississippi Valley is limited, this comparison will not be carried further.

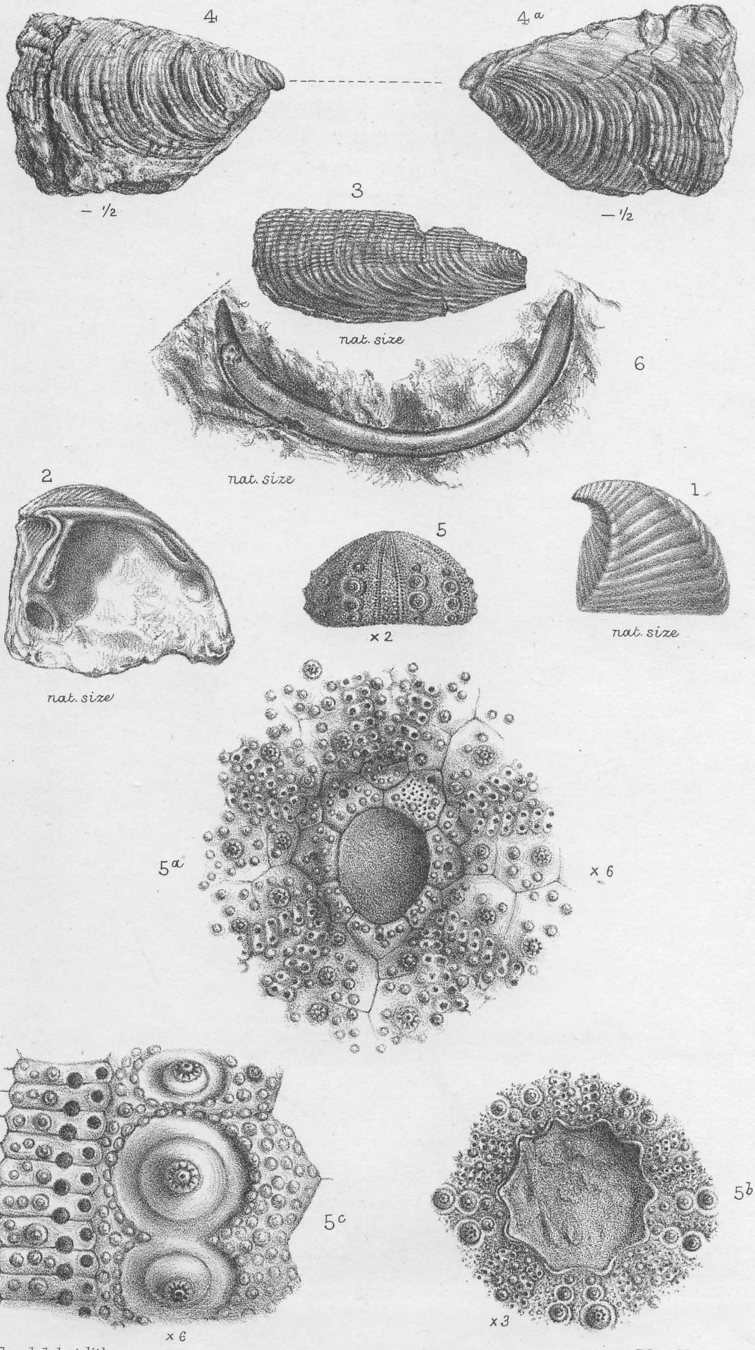
Analyses of the Loess of the Mississippi Valley.[1]

Constituents.	No. 1.	No. 2.	No. 3.	No. 4.
SiO_2	72·68	64·61	74·46	60·69
Al_2O_3	12·03	10·64	12·26	7·95
Fe_2O_3	3·53	2·61	3·25	2·61
FeO	·96	·51	·12	·67
TiO_2	·72	·40	·14	·52
P_2O_5	·23	·06	·09	·13
MnO	·06	·05	·02	·12
CaO	1·59	5·41	1·69	8·96
MgO	1·11	3·69	1·12	4·56
Na_2O	1·68	1·35	1·43	1·17
K_2O	2·13	2·06	1·83	1·08
H_2O	*a*2·50	*a*2·05	*a*2·70	*a*1·14
CO_2	·39	6·31	·49	9·63
SO_3	·51	·11	·06	·12
C	·09	·13	·12	·19
	100·21	99·99	99·78	99·54

a Contains H of organic matter, dried at 100° C.

Organic Remains.—The fossils occurring in adobe, so far as I have been able to ascertain, are confined almost entirely to two classes, namely, land-shells and the bones of land-animals. Freshwater-

[1] From "The Driftless Area of the Upper Mississippi Valley," by T. C. Chamberlin and R. D. Salisbury, Sixth Ann. Rep. U.S. Geol. Surv. 1884–1885, p. 282.



A. S. Foord del. et lith. West, Newman imp.

Lias Marlstone Rock and Transition Bed Fossils.

Tilton, Leicestershire