7. *On the STRATIGRAPHICAL POSITIONS of the TRIGONIAE of the LOWER and MIDDLE JURASSIC BEDS of NORTH OXFORDSHIRE and adjacent DISTRICTS.* By EDWIN A. WALFORD, Esq., F.G.S. (Read November 19, 1884.)

[PLATE I.]

A WELL-defined family of the Mollusca making its appearance and attaining its maximum development within a limited geologic period must necessarily be of exceptional interest to the palaeontologist. Such a family, the Trigoninae, though from their irregular dispersion and less vagrant habit inferior to the Ammonites as stratigraphical guides, supply nevertheless no unimportant evidence thereon, finding, as they do, a birthplace in the lower beds of the Lias, and in the Inferior Oolite leaping into such numerical luxuriance that Dr. Lycett has well described it as "a very metropolis of the Trigoninae." Though fairly represented in the higher Jurassic series, yet with gradually diminishing importance notwithstanding a brief Neocomian revival, they range through the Mesozoic period, and now in Australasian seas linger as the remnant of a once dominant race.

In wealth of individual forms as well as in number of species the narrow Jurassic area of North Oxfordshire stands prominent. As elsewhere, the Lias species are few.

LIASSIC SPECIES.

TRIGONIA LINGONENSIS, Dumort.—In the zone of *Ammonites Henleyi* of the Middle Lias of Banbury a doubtful cast of this species has been found. I have recorded it also from the zone of *Ammonites spinatus** at Kings Sutton and Aston-le-Wall, localities on the borders of Northamptonshire. At Preston Capes, in Northamptonshire also, it has been collected by Miss Baker†.

TRIGONIA NORTHAMPTONENSIS, nov. sp. (Pl. I. figs. 4–7.)

The few immature forms of this species which had come under my notice until quite recently caused me to refer them with some degree of hesitancy to the Yorkshire shell *T. literata*, Y. & B. The adoption of a new name has seemed necessary under the additional light thrown by the acquisition of a better-developed series of examples and by an expression of opinion from a palaeontologist of wider experience than myself. Though perhaps the differences between the two forms may to some extent be due to regional variation, yet we have to remember that in the course of the Lias from Yorkshire through Lincolnshire and Leicestershire, no connecting link seems to have been met with.

* "On some Middle and Upper Lias Beds in the Neighbourhood of Banbury," by E. A. Walford (Proc. Warwicksh. Nat. & Arch. Field Club, 1878).

† "On the Middle Lias of N. Gloucestershire," by the Rev. F. Smythe, M.A. (Proc. Cott. Nat. Club).

Shell ovately trigonal, moderately convex, umbones erect, pointed and antero-mesial. The specimen (fig. 5, Pl. I.) measures in height $1\frac{1}{2}$ inch, breadth $1\frac{5}{8}$ inch, depth through both valves $\frac{1}{8}$ inch. Anterior side produced and curving somewhat steeply to meet the lower border; superior border slightly convex, making but a faint angle with the lower-area border. Inferior margin of the shell rather straightened. Escutcheon concave and lengthened. Area convex, occupying about a quarter of the surface of the shell. Marginal carina depressed and not prominent; mesial line of the area indistinct; area covered with fine transverse lines. The nearly perpendicular costæ, about ten in number, proceed from the marginal carina downwards, beginning near to the umbones; they are boldly marked until they reach the transverse subtuberculate costæ proceeding from the anterior margin. The transverse costæ dip gently downwards from the anterior border. Traces of transverse striæ cover the better-preserved portion of the surface.

The example described is much less convex than *T. literata*, and in the ornamentation the perpendicular costæ are not prominent over more than a third of the surface, whereas in *T. literata* that series occupies its larger portion.

A second group of shells (figs. 4, 6, 7, Pl. I.) presents many points of divergence from the form just described. In some of them, as in figs. 6 & 7, the outline is more oblique, and the anteal costæ are either reduced to insignificant proportions, or are apparently absent. This condition much resembles the type of shell figured by Lycett (pl. xiv. fig. 4, Brit. Foss. Trigonæ), who speaks also of the very variable ornamentation of *T. literata*. The perpendicular costæ of this variety of *Trigonia northamptonensis* enlarge as they pass downwards from the marginal carina, and cross towards the anterior or lower border.

Fig. 4 presents an intermediate stage between the forms represented by figs. 5 & 6. The anterior tuberculate costæ are seen curving slightly downwards, transversely, towards the postæal series, the space between the two series being occupied by a few scattered tubercles.

Trigonia navis, Lamk., has a more trigonal contour, and a nearly vertical anterior border. The Northamptonshire shells appear to be local representatives of the group Scaphoidæ, finding a place somewhere between *T. navis*, Lamk., on the one hand, and *T. literata*, Y. & B., on the other. Their state of preservation is far from satisfactory: the soft test has peeled off more or less by adhesion to the tenacious blue clays in which the shells are imbedded, and this has in nearly every case destroyed the beauty and prominence of the ornamentation. Perhaps the finding of better examples may ultimately allow the two varieties figured to be recognized as species.

I am indebted for my specimens to Mr. B. Thompson, F.G.S., of Northampton, who has been describing the Lias deposits of the county. The *Trigonia* were obtained from Moulton, near Northampton, and rough casts have also been found at Bugbrook in the

same county. The interest of the discovery is further enhanced by the recognition of the exact horizon of the fossil, at nearly the top of the Upper Lias and below Mr. Sharp's stage E of the Northampton Sand. Mr. Thompson's notes on its position agree with my own. He writes, "The shelly band, a few inches in thickness, is about two feet below the junction (with the Inferior Oolite) where now working; but the men say it dips so rapidly on *each side* of its present position that they had met with it in the same pit thirteen feet below the junction." The associated fossils are *Ammonites bifrons*, Brug., *Gresslya donaciformis*, Phil., *Inoceramus dubius*, Sow., *Protocardium substriatulum*, d'Orb., *Cucullea*, sp., &c.

TRIGONIA PULCHELLA, Ag.—This also, an Upper Lias form, has been recorded from the neighbourhood of Northampton, though only as a Drift fossil*. Probably ere long we may hope to have a record of the discovery of the species *in situ*, as a layer containing small univalves (*Cerithium*, &c.), similar to those found by Mr. W. D. Carr, in the Upper Lias of Lincoln † associated with *T. pulchella*, has already been noted by Messrs. Thompson and Crick. The Lincolnshire horizon of *T. pulchella* appears to be much lower than that of *T. northamptonensis*, the former being at the base of the *Leda-ovum* beds, the latter towards the top.

INFERIOR OOLITE SPECIES.

The Trigoniae of the Northampton Sand have been catalogued by Mr. R. Etheridge, F.R.S.‡, and by Mr. Sharp, F.G.S. § It should, however, be borne in mind that the Inferior Oolite of Oxfordshire neither satisfactorily agrees with the "Northampton Sand" on the one hand, nor allows of easy correlation with the Cotteswold type on the other. Inasmuch as the latter series has presented many points of relationship, I have attempted a comparison ||, and have summarized the matter in the following table, here slightly altered:—

* "On the Drift deposits of Wymington," by W. D. Crick (Northampton Nat. Hist. Soc. Proceed. 1883).

† "On the Lincoln Lias," by W. D. Carr (Geol. Mag. April 1883).

‡ Appendix to Prof. Judd's Geol. Rutland, by R. Etheridge, F.R.S. (Mem. Geol. Surv. 1875).

§ "Oolites of Northamptonshire," by S. Sharp, F.G.S. (Quart. Journ. Geol. Soc. vol. xxvi. p. 388).

|| "On the Relation of the so-called 'Northampton Sand' of North Oxfordshire to the Clypeus-grit," by Edwin A. Walford, F.G.S. (Quart. Journ. Geol. Soc. vol. xxxix. p. 224).

Table of Divisions of the Inferior Oolite of North Oxfordshire.

STRATUM.	HORIZON.	LOCALITY.	FOSSILS.	TRIGONIDÆ.
E. Cream-coloured or grey Limestone, often siliceous and sandy (Chipping-Norton Limestone)	Fuller's Earth and Inf. Oolite? ..	Chipping Norton, Rollright	<i>Am. arbutigerus</i> , <i>Patella</i> , <i>Neera</i> , <i>Natica</i> .	<i>Trigonia signata</i> , <i>T. denivelata</i> , <i>T. producta</i> , <i>T. Lycettii</i> .
D. Sandy and marly Limestones and Marls		Hook Norton, Rollright, Chipping Norton	<i>Am. Parkinsoni</i> , <i>Astarte minima</i> , <i>Lima cardifor- mis</i> .	
O ² . Clypeus-grit	<i>Am. Parkinsoni</i>	Fawler, Rollright, Chipping Norton ..	<i>Am. Parkinsoni</i> , <i>Clypeus Plottii</i> , <i>Terebratula globata</i> , <i>Lima gibbosa</i> .	<i>Trigonia costata</i> , <i>T. v- scripta</i> ?
O ¹ . Clypeus-grit basement-bed = Lower Trigonia-grit		Fawler, Rollright, Chipping Norton ..	<i>Astarte minima</i> , <i>Rhynchonella subtetraedra</i> , <i>Litho- domi</i> , Corals.	<i>Trigonia angulata</i> , <i>T. pro- ducta</i> , <i>T. costata</i> .
C. Rubbly and ironshot Limestones and Marls	<i>Am. Parkinsoni</i> or <i>Am. Humphreianus</i>	Hook Norton, Otley Hill	<i>Rhynchonella spinosa</i> , <i>R. angulata</i> , <i>Astarte minima</i> , <i>Isastrea Congbeari</i> , <i>Litho- domi</i> .	<i>Trigonia angulata</i> , <i>T. pro- ducta</i> , <i>T. Gussæ</i> , <i>T. gem- mata</i> , <i>T. signata</i> , <i>T. pullus</i> , <i>T. Windoesi</i> , <i>T. Moretoni</i> , var. <i>oxoniensis</i> .
B ² . Oolitic cream-coloured Limestones with corals	<i>Am. Murchisonæ</i>	Coombe Hill	<i>Natica cincta</i> , <i>Am. Sower- byi</i> ?, <i>Ostrea Marshii</i> , <i>Thamnastrea Wrightii</i> .	<i>Trigonia Beesleyana</i> , <i>T. pullus</i> .
B ¹ . Sandy blue-hearted Limestone	<i>Am. Murchisonæ</i>	Hook Norton, Otley Hill, Milcombe ..	<i>Am. Murchisonæ</i> , <i>A. laevis- culus</i> , <i>A. corrugatus</i> , <i>Astarte elegans</i> .	<i>Trigonia Brodiei</i> , <i>T. striata</i> , <i>T. sculpia</i> , <i>T. spinulosa</i> ?, <i>T. costata</i> ?
A. " " "	<i>Am. jurensis</i> ? ..	Hook Norton, Otley Hill	<i>Rhynchonella cynocephala</i> , <i>R. suldecornata</i> , <i>Terebratula trilineata</i> , <i>Am. jurensis</i> ?	<i>Trigonia Brodiei</i> .

As far eastward as Chipping Norton and Fawler, in N.W. Oxfordshire, the continuity of the upper beds of the Inferior Oolite of the Cotteswold type (the Ragstones or Clypeus-grit) is easily traceable. North-eastward of these points, however, so widely different are the conditions of deposit that Mr. Hudleston has well said *:—"The beds of this region have a type of their own, and it is no use trying to force them into the ready-made clothes of other districts."

The bed (C¹) at the bottom of the Clypeus-grit (C²) at Fawler, and that at the base of C at Hook Norton are similar lithologically, and both contain an abundance of concretionary and derived fragments. Associated with these in each locality are corals of similar species, blocks of limestone covered with oysters and pierced with *Lithodomi*, numerous shells such as *Astarte minima*, *Ostrea Marshii*, *Isocardia*, sp., *Trigonia producta*, *T. costata*, and *T. angulata*. With so many features in common, it will be safe to assume the connexion of the seas of these areas with each other at the time of the deposition of the bed, whilst the irregularity of its occurrence at Fawler, where the bed rests, as at the Duckpool-Farm cutting, near Hook Norton, upon the Upper Lias, points also to long and continued erosion in the antecedent period. The classification of these beds with the zone of *Ammonites Parkinsoni* on the one hand, or the zone of *Ammonites Humphresianus* on the other, will depend much upon whether we look to the Cotteswold or to the Dorset types for comparison. The fauna is that of the Lower Trigonia-grit, a division, according to Dr. Wright, of the zone of *Ammonites Parkinsoni*, but placed by Mr. Witchell † in the zone of *Ammonites Humphresianus*. If the remains of the bored bed represent, as seems to be probable, the well-known Upper Freestone bed, then it would point to the destruction of that stratum prior to the formation of the lowest bed of series C.

The 'Supplementary Monograph on the British Fossil Trigoniæ,' by the late Dr. Lycett, published in 1883 by the Palæontographical Society, has done much to increase our knowledge of the stratigraphical position as well as of the species of the Oxfordshire Lower Oolites. Some additional information accumulated since the materials were sent to Dr. Lycett in the early part of the year 1882 has induced me to proffer these notes to the Society.

TRIGONIA BRODIER, Lyc., a pretty little local species, is not uncommon in the Lower Inferior Oolite beds A and B¹. Its occurrence in any higher stratum is doubtful. It is nearly allied to *T. formosa*, Lyc., of which it may possibly be a local development. The prominent distinguishing feature between the two species consists in the more vertical position of the lower costæ of *T. formosa*. The beds A and B seem to represent the zones of *Am. jurensis* and *Am. Murchisonæ*.

* "Report of the Excursion of the Geologists' Association to Chipping Norton," by W. H. Hudleston, M.A. (Proc. Geol. Assoc. vol. v. no. 7, p. 9).

† 'Geology of Stroud,' by E. Witchell, F.G.S., p. 57. Stroud: 1882.

TRIGONIA FORMOSA, Lyc.—Though it may appear unsatisfactory to class *T. Brodiei*, *T. formosa*, and *T. striata* from the same horizon and locality, yet certain well-developed shells of the “*Brodiei*” type pass away into forms which agree so well with moderate-sized examples of *T. formosa* that it seems to be necessary either to make *T. Brodiei* a variety, or to admit the former into the Oxfordshire list. Locality: Hook Norton, beds A and B¹.

TRIGONIA STRIATA, Miller, is found sparingly and in an indifferent state of preservation in the beds A or B¹ of Otley Hill. In Gloucestershire, according to Wright*, it occurs in the “*Cynocephala* stage,” whilst Lycett records it from the zone of *Am. Humphresianus* only, referring the shell from the lower zone to *T. formosa*. *T. striata* is catalogued as common in the Lincolnshire Limestone. Other Survey Memoirs † quote it from the Great Oolite.

TRIGONIA SIGNATA, Ag.—The four varieties of this species figured by Dr. Lycett in his Supplementary Monograph, occur in an admirable state of preservation in the higher divisions of the Inferior Oolite of North Oxfordshire. In the beds C of Hook Norton the first forms appear associated with *Astarte minima*, *Rhynchonella spinosa*, and many other species of mollusca, but they become the dominant fossils in the superior stages of other localities. The matrix of the latter stages is either sandy or an intensely hard compact siliceous limestone, from which the extraction of the shells is exceedingly difficult. A bored bed occurs above the Upper Trigonina-layer at Hook Norton. Some undescribed forms of *Trigoninae*, to which I shall presently allude, were procured by me some years since from the Trigonina-bed at Sharpshill near Hook Norton. At the Priory Farm by Chipping Norton and at Grayton Quarry near Whichford numerous specimens of the several varieties may yet be obtained, but in other localities they are now rare. *T. signata*, var. *Stutterdi*, and var. *decurtata*, have both been found in C of Hook Norton and Otley Hill; and though Dr. Lycett has referred the former to the superior beds, probably it would be better to restrict the varietal name to the shell of the lower beds (figs. 9 and 10, pl. ii. Foss. Trig., Supp. 2), which is like those found at Cold Comfort near Cheltenham, and distinct from its allies of the later deposits. *T. signata*, vars. *Zietenii*, *rugulosa*, and *decurtata*, occur in the higher series.

Though in Yorkshire *T. signata* belongs to the zone of *Ammonites Humphresianus*, in the south-west of England Lycett gives the Upper Trigonina-grit as its only horizon.

TRIGONIA SPINULOSA?, Young and Bird.—A solitary and, unfortunately, imperfect example from bed B¹ of Hook Norton has many points of resemblance to the shell figured by Lycett (pl. iii. fig. 6, Brit. Foss. Trigoninae). The tubercles are more distinct than in any

* ‘A Monograph of the Lias Ammonites,’ by Dr. T. Wright, F.R.S., p. 146 (Mem. Pal. Soc. 1879).

† ‘On the Geology of the country around Banbury,’ by E. Hull, F.G.S., pp. 24, 25 (Mem. Geol. Surv. 1864).

Yorkshire specimen in my cabinet. There is also a general tendency to an upward curvature of the rows of costæ, which places it in near relationship to *T. formosa*, from which, however, it differs in the marked isolation of the tubercles anteally and their evanescence in its lower half.

TRIGONIA MORETONI, var. OXONIENSIS, MOR. & LYC., seems to be confined to the beds C of Hook Norton and Otley Hill. Young forms of *T. angulata* are difficult to distinguish from this little shell. *T. Moretoni*, according to Etheridge, is found rarely in the Collyweston Slate, and in the lower zone of the Great Oolite it seems to be well known generally.

TRIGONIA ANGULATA, SOW., occurs not uncommonly in and immediately above the coral bed (C) at Hook Norton and Otley Hill, and also at the bed at the base of the Clypeus-grit (C') at Fawler and Bright Hill. The ornamentation of the species is very variable. Lycett and Witchell cite it from the Oolite Marl, and also from the various beds of the zone of *Ammonites Parkinsoni* in Gloucestershire. *Trigonia clapensis* of Terquem and Jourdy*, from the "*Parkinsoni*" zone of the basin of the Moselle, appears to resemble very closely some Oxfordshire forms I have classed as varieties of *T. angulata*. According to Lycett *T. clapensis* is a synonym for *T. Moretoni*.

TRIGONIA GUISEI, LYC., appears to belong only to the base of C. I have a large specimen, measuring three inches in height, found *in situ* in the bottom bed of the Duckpool-Farm cutting, where the lower zone of the Inferior Oolite is wanting. This caused Dr. Lycett to refer it in error to the "lower beds of the formation." Its Oxfordshire horizon is in reality that of the Lower Trigonia-grit. The species is allied to *T. Parkinsoni*, Ag., and *T. angulata*, Lyc. Mr. Witchell's specimens, which I think should scarcely be classed with the Oxfordshire shell, are from the Clypeus-grit.

TRIGONIA PRODUCTA, LYC., finds its home in the Hook-Norton area. Though appearing in the Coral bed, it is better shown in a higher band of ironshot limestone (no. 22 of my detailed section†), also in series C. At the base of the Clypeus-grit (C') at Fawler, at Bright Hill near Long Compton, and in the siliceous limestone of the Trigonia-bed at Sharpshill it occurs also. Under a modified form it again appears at the base of the Fuller's Earth‡ in a railway-cutting near Bourton-on-the-Water, Gloucestershire. The test there is thinner than that of the Oxfordshire *T. producta*, and in its ornamentation as well as contour it approaches *T. Painei*, Lyc., an abundant shell in the stratum on which the clays of the Fuller's Earth rest.

* "Monographie de l'étage Bathonien dans le département de la Moselle," par O. Terquem et E. Jourdy. Mém. Soc. Géol. de France, 1869.

† "On the Relation of the so-called 'Northampton Sand' of North Oxfordshire to the Clypeus-grit" (Quart. Journ. Geol. Soc. vol. xxxix. p. 230).

‡ Derived probably from the stratum below. Forms more nearly referable to *T. subglobosa*, Lyc., are there associated with *T. Painei*. A similar shell occurs in series C at Hook Norton.

The abundance of rolled nodules, covered often by fine colonies of *Serpulæ*, and also pierced by boring shells, point to a pause in sedimentation prior to the deposition of the clays of the Fuller's Earth. In the south-west of England *T. producta* is confined to the Trigonian-grit.

TRIGONIA approaching *v-costata*, Lyc.—Both *T. v-costata* and *T. conjungens* must be catalogued as doubtful species of the North Oxfordshire area. The former is common in the lowest bed of the Inferior Oolite at Moulton near Northampton, and is found also in the Lincolnshire Limestone of the Midlands. In Yorkshire it occurs in the Dogger, and in Gloucestershire in the Oolite Marl and Trigonian-grit. *T. sharpiana*, Lyc., with which this species is often associated in the Dogger and Northampton Sand, I have failed to recognize in Oxfordshire, though in the "Cynocephala stage" of Yeovil Junction, I have collected what appear to be but slightly diverging forms.

TRIGONIA ARDUENNA, R. & S.—The fragment from Hook Norton, figured by Lycett in the last supplement, is, so far, the only record of this early Bathonian species of Rigaux and Sauvage.

TRIGONIA LYCETII, nov. sp. (Pl. I. figs. 1 & 2.)

Shell ovately trigonal, convex, height of full-sized specimen $1\frac{7}{8}$ inch, breadth $1\frac{1}{8}$ inch, width of area $\frac{9}{16}$ inch. Umbones slightly recurved, antero-mesial, anterior border moderately produced and curving gracefully with the lower border, hinge-line straight, length rather more than half the height of the shell and sloping steeply downwards; costæ about sixteen, solid and unbroken in the earlier stages, cord-like on the lower two thirds of the valve; the first four or five pass with but slight downward curvature over the surface, and form knots at the carina, passing also with slight V-shaped inflexion over the area and somewhat less prominently over the escutcheon also. The other costæ sweep downwards, curve with the lower border, break and are replaced by a few tubercles in the middle third of the valve, and then, becoming solid and very much thickened, pass upwards at a high angle to the carina, across which they (the costæ) pass with bold undulation. The area has a slight median inflexion or line only, and is crossed everywhere by the thick costæ which pass over it without interruption. There are, however, indications of fine costellæ at the posterior part of the area. The ante-carinal depression is so pronounced in one specimen as to form a double row of nodulations, one row upon the carina and another row upon the anterior side of the furrow resembling the nodulations of *T. arduenna*, R. & S.*, as figured by Messrs. Rigaux and Sauvage in their excellent memoir. The escutcheon is shallow and lengthened.

Figure 1 shows the normal and typical form. The other example (fig. 2) is almost distinct enough for a varietal name. In it the

* "Descr. de quelques espèces nouvelles de l'étage Bathonien du Bas Boulonnais" par E. Rigaux et E. Sauvage. Mém. Soc. Académ. Boulogne, 1867, vol. iii. pl. iv. fig. 4.

costæ are not only much thickened, but pass with slight interruption and with strong undulation from the anterior edge of the shell over the carina, where they are much enlarged, and across the area to the postæal border.

The species is related to *Trigonia undulata* of Agassiz*, from which it differs in the peculiar irregularity of its ornamentation.

At Sharpshill quarry near Hook Norton I have found this species in a bed of exceedingly hard siliceous limestone of the Inferior Oolite crowded with *T. signata* and yielding also *Ammonites Parkinsoni*. At Hook Norton fragments occur in the same horizon. The matrix at Sharpshill is so intractable that it is a matter of the greatest difficulty to extract specimens.

I have named the species *Trigonia Lycettii* as a slight tribute to the memory of that veteran palæontologist the late Dr. J. Lycett.

T. LYCETTII, var. *CORRUGATA*. (Pl. I. fig. 3.)

The contour of this variety is similar to that of the previously described form, fig. 1. The shell, however, is larger, the measurement being $2\frac{1}{4} \times 2\frac{1}{4}$ inches. The costæ are finer and much more numerous, about twenty-four, the first five or six only being unbroken; those succeeding them descend steeply from the anterior margin, whilst the lowest set, in confused arrangement, curve irregularly with the lower border. They are cord-like and knotted at the anterior part of the shell, passing into scattered tubercles towards the middle (or vanishing), and then, thickening, ascend steeply towards the carina in straight or slightly undulating tuberculate or plain ridges. An ante-carinal furrow causes the costæ to wave before passing over the carina. Area concave, covered by bold continuations of the costæ, which are knotted slightly on the carina and parted in the middle of the area by a depressed vertical line.

Locality and position.—Inferior Oolite, Sharpshill, as before.

TRIGONIA CONJUGENS, Phill.—Specimens from beds C, of Hook Norton, and from the Clypeus-grit of Over Norton, seem to justify its mention here, though I catalogue the species with considerable doubt. It appears in Beesley's lists† of Hook-Norton fossils together with *T. Phillipsii*, Mor. and Lyc., *T. v-scripta* &c.

TRIGONIA DUPLICATA, Sow., appears only as a badly preserved shell inside a valve of *T. signata*. Its position is probably D, Hook Norton. I have in my cabinet a fine example from the zone of *Am. Parkinsoni* at Avoncliffe. Lycett quotes it from the Upper Trigonia-grit also.

TRIGONIA GEMMATA, Lyc. The figure in the left-hand corner of pl. ii. of supp. no. 2 to the Brit. Trigoniæ should both in text and plate appear as no. 6, not no. 8. Both it and a pretty little varietal form in my collection have been derived from the lower part of

* Mém. sur les Trigones, tab. x. fig. 14-16.

† "On the Geology of the Eastern Portion of the Banbury and Cheltenham Direct Railway," by Thomas Beesley, F.C.S. Proc. Geol. Assoc. vol. v. p. 7.

series C¹ at Hook Norton. Its Cotteswold position is the Upper Trigonias-grit.

TRIGONIA BEESLEYANA, Lyc., appears to be restricted to the sub-zone of *Am. Sowerbyi* at Coombe Hill, near Banbury, whence many specimens have been collected. The beautiful shell so well delineated in Lycett's Brit. Foss. Trigonias, pl. xvii. fig. 4, has been in my collection for nearly fifteen years.

TRIGONIA COSTATA, Sow., begins with a representative of the *T. sculpta* type at the top of series B, and ranges through C at Hook Norton and Otley Hill and through the Clypeus-grit in the various Oxfordshire localities, where it attains a fine development. Wright quotes the species from the zone of *Am. jurensis*, and Etheridge from the Lincolnshire Limestone, whilst Lycett gives its Cotteswold stages from the Ragstones upwards.

TRIGONIA PULLUS, Sow., appears in bed B². In series C also at Hook Norton many small and a few average-sized specimens have been found. Its range through the other beds is demonstrated by fine local examples from the Stonesfield Slate, the upper zone of the Great Oolite, and the Forest Marble; Lycett gives it from the zone of *Am. Murchisonae* upwards.

TRIGONIA DENTICULATA, Ag., ranges from C to E, and exhibits, in Hook-Norton shells especially, the delicate ornamentation of the area in a beautiful state of preservation. In the West of England, according to Witchell *, it begins in the "Cynocephala-beds"; other lists show that it apparently survived through the Great Oolite period.

TRIGONIA SCULPTA, Lyc., makes its appearance in well-developed forms at the top of bed B¹ at Hook Norton, and in series C at Sharphill is more doubtfully recognized, associated with *Gervillia laevis* &c. It ranges through the whole of the British Inferior-Oolite zones.

TRIGONIA WINDOESI, Lyc., has hitherto been recorded only from C of Hook Norton. Young specimens of *T. Painei*, Lyc., from the earthy limestone at the base of the Fuller's Earth near Bourton-on-the-Water, come near to this little shell.

GREAT OOLITE SPECIES.

TRIGONIA IMPRESSA, Sow. Stonesfield Slate, Stonesfield.

TRIGONIA UNDULATA, Fromh. Great Oolite (lower zone), Culworth, Northamptonshire, and at Milton and Tainton Down near Burford, Oxon. The *Trigonias* at Culworth are associated with *Ostrea Sowerbyi* and *Rhynchonella concinna* in some limestone courses which alternate with beds of marl.

TRIGONIA MORETONI, Mor. & Lyc. Stonesfield Slate, Stonesfield, Great Oolite, Kirtlington, Oxon and Buckingham †, and Forest Marble, Islip and Kidlington †.

* * 'Geology of Stroud,' by E. Witchell, F.G.S., p. 35. Stroud, 1882.

† 'Geology of the Country round Banbury' &c., by A. H. Green, Mem. Geol. Survey.

TRIGONIA PULLUS, Sow. Stonesfield Slate, Stonesfield, upper zone, Great Oolite, near Banbury, and Forest Marble, near Rollright.

A beautiful costate species from the upper zone of the Great Oolite at Capps Lodge, near Burford, furnishes an instance of the difficulty of finding names for the whole of the varied forms of the group. Mr. W. H. Hudleston, F.R.S., F.G.S., has kindly allowed me to examine a specimen more perfect than any in my own cabinet; and from it the following description has been written:—height $1\frac{5}{8}$ inch, width $1\frac{7}{8}$ inch, breadth of area 1 inch, breadth of escutcheon $\frac{1}{2}$ inch, depth of united valves $1\frac{1}{8}$ inch. The breadth of the area is thus two thirds that of the costated part of the shell. The umbones are pointed and recurved. The anterior border is first curved and then slightly straightened as it sweeps towards the lower border. The costæ, 27 in number, are prominently elevated with sharp ridges and deep interspaces, undulating slightly as they curve gently downwards and then cross transversely towards the carina. The marginal carina is greatly elevated, in the lower part of the shell as much as $\frac{1}{8}$ inch above the costæ; it is also boldly denticulated. The area is divided by a tuberculated median carina in the left valve, with a corresponding groove in the right valve and a prominent adjacent row of costellæ. It is ornamented by four rows of costellæ, which are decussated by transverse markings. The escutcheon is ovately cordate and is bounded by prominent tuberculate or denticulate carinæ. It has a raised cushion-like centre and numerous longitudinal lines. The area is concave.

It differs from *T. elongata* in the want of convexity near the carina, and also in its wider form; the area, however, has much similarity. The escutcheon is not that of the ordinary type of *T. pullus*, and the area is larger. Though it seems to find a place between the two species, it will suffice for the present to look upon it as a variety of *T. pullus*.

TRIGONIA PAINEI, Lyc., is found in the Great Oolite of Groves Quarry, Milton, near Burford, though it does not there exhibit the massive ornamentation of the Inferior-Oolite and Fuller's-earth forms previously mentioned p. 41.

TRIGONIA, sp.—Height $1\frac{7}{8}$ inch, breadth 2 inches. Shell convex. Umbo slightly recurved, antero-mesial. Surface covered with about twenty bold slightly waved costæ, which cross the shell with but a slight curve toward the lower margin. The lower seven costæ, when about a third of their length distant from the carina, are crossed and nearly obliterated by three bold rows of nodulous costæ bearing downwards almost vertically from the carina. The area takes up about a third of the shell and is convex posteriorly. Anteriorly the strong costæ cross the area, but appear to pass into fewer striæ in the lower half of the shell. It is so much like the shell figured by Morris and Lycett on tab. v. pt. ii. of their 'Monograph of the Mollusca from the Great Oolite,' as *T. Goldfussi* (subsequently altered to *T. Painei*), that for the present it seems best to let the species pass with this reference.

A single valve, and the only one I have hitherto seen, was got by me from the lower zone of the Great Oolite in the railway-cutting at Ashford Bridge, near Stonesfield.

TRIGONIA WALFORDI?, Lyc.—*T. Walfordi* is one of the allies of *T. Painei*, but differs from the latter in its more erect and narrowed contour and in its subtuberculate costæ and their arrangement. The types of the shell were got from Stow-on-the-Wold; the Oxfordshire variety from the Great Oolite of Milton, near Burford. The latter form varies from the type in the less massive character and disposition of its ornamentation. The figure has been wrongly numbered in Supp. no. 2 to Lycett's Brit. Foss. *Trigoniæ*, pl. ii., and should appear as fig. 6, not fig. 8.

TRIGONIA CLATHRATA, Ag.—The contour of the shell, curvature of the rows of tubercles, and the disposition and number of the rows seem to me to agree so well with Agassiz's species, that I prefer to class the Oxfordshire shell with it, notwithstanding the want of a definite horizon in the description by Agassiz*. The number and curvature of the rows of tubercles of Lycett's *T. tuberculosa* are very distinct; as in Rigaux and Sauvage's *T. clavulosa* they are more numerous, and there is in those species an absence of that downward curvature or inflexion which *T. clathrata* seems to present. The markings on the area are worn, but appear to have been fine. I have noted in other *Trigoniæ*, e. g. *T. signata*, that the fineness or coarseness of the area-markings is often due to the state of preservation of the fossil; the bolder area-markings seem to underlie the others. The only example I have seen of Agassiz's species is in the collection of Mr. B. Thompson, F.G.S., who has kindly lent it for my examination. It was got from the Forest Marble or Cornbrash of Kidlington, Oxon. *T. clathrata* is quoted by Terquem and Jourdy† from the zone of *Ammonites Parkinsoni* of their Bathonian of the Moselle region.

TRIGONIA GOLDFUSSI, Ag.—In Whiteave's 'List of the Fossils of the Cornbrash at Islip and Kidlington' this species finds a place. It may, however, be the *T. Painei* of Lycett, who has stated his reasons for rejecting *T. Goldfussi* as a British species‡. Sharp tabulates it from both Great and Inferior Oolite of the Northamptonshire district§.

TRIGONIA FLECTA, Mor. & Lyc.—The Forest Marble of Kirtlington has yielded, so far as I know, the only Oxfordshire specimen. The intensely hard matrix makes the extraction of complete shells well-nigh impossible.

TRIGONIA TUBERCULATA?, Lyc.—The same Forest-Marble stratum at Kirtlington, in which is found *T. flecta*, has also supplied me with a small tuberculate *Trigonia* agreeing in many points with the

* 'Mémoire sur les Trigoniæ,' par L. Agassiz, tab. ix. fig. 9, & p. 22.

† "Monographie de l'étage Bathonien dans le département de la Moselle" par O. Terquem et E. Jourdy, pp. 109 & 161. Mém. Soc. Géol. de France, 1869.

‡ 'Mon. Foss. Trigoniæ,' by Dr. J. Lycett, p. 59.

§ "The Oolites of Northamptonshire" by S. Sharp, F.S.A., F.G.S.; Quart. Journ. Geol. Soc. vol. xxvi. pp. 383 & 388.

form I have referred to *T. clathrata*, Ag., but differing in the curvature and absence of undulation in the rows of costæ. It varies from Lycett's definition principally in the fewer rows of costæ.

EXPLANATION OF PLATE I.

- Fig. 1. *Trigonia Lycetti*. Inferior Oolite, Sharpshill, near Hook Norton.
 2. ——— (example with solid costæ). Same locality.
 3. ——— var. *corrugata*. Same locality.
 4. ——— *Northamptonensis*. Upper Lias, Moulton, near Northampton.
 5, 6. ———. Same locality.
 7. ——— (specimen without transverse costæ). Same locality.

DISCUSSION.

Prof. Judd expressed his sense of the great value of Mr. Walford's work in showing the relations of the several divisions of the Inferior Oolite of Oxfordshire as compared with the beds of the same age in South Northamptonshire and in Gloucestershire.

Dr. Woodward hoped that Mr. Walford's studies would enable us to distinguish which of the forms described by Dr. Lycett should be regarded as species and varieties respectively. He suggested that the difficulties might to some extent be got over by employing a trinomial nomenclature.

Prof. Seeley pointed out the importance of defining the range in time of fossil species with a view to fixing the geographical distribution. The varieties of one district become representative species in other countries.

Mr. H. B. Woodward thought that some of the difficulties in correlating subdivisions of the rocks would be removed if the stratigraphical evidence were attended to as well as the palæontological.

The Author agreed with Dr. Woodward in thinking that many of the species of Dr. Lycett must be grouped as varieties. The lithological evidence, to some extent, bears out the palæontological evidence as to the relationship of the Fowler and Hook-Norton strata.