On the Middle and Upper Lias of the South West of England.

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IN a paper on the "Zones of the Lower Lias and the *Avicula contorta*," in the Journal of the Geological Society for November, 1861, the relative positions of those beds to the Middle and Upper Lias of the neighbourhood of Ilminster were pointed out.

The district around Ilminster presents considerable variety in its geological character. A bird's-eye view, taken from the north west of the town, would shew at no great distance the lofty range of the Quantocks, of Devonian age, whilst at their base, stretching towards Ilminster, might be found the variegated and red marls of the Keuper. On these, five miles distant, at Beer Crowcombe, were found the thin representatives of the Rhœtic beds of the continent noticed in the above-mentioned paper. Resting on the latter, succeed the saurian and other limestones and marls of the Lower Lias, which, though in great part covered by beds of drift, reach to the foot of the hill west of Ilminster and pass under the beds to be hereafter described. Within half-a-mile on the east, the Middle and Upper Lias, on which the observer stands, may be seen passing under the oolitic, or as denominated by others, the upper liassic sands, and the inferior oolite; whilst two or three

miles to the south the latter are covered by the range of green sand and chalk, which, passing from the neighbourhood of Crewkerne, around Chard, is then continued in the Blackdown Hills of Devonshire.

The beds we propose to describe are all superior to the *Ammonites raricostatus* zone, the highest member of the Lower Lias, and below the yellow sands, until lately classed with the inferior oolite. We shall also refer to beds in the Bath district, which occupy a lower position in the series than any at Ilminster, and which, at the latter place, so far as we know are wanting.

At Ilminster the beds may be grouped in the following zones, in ascending order:—

GENERAL DIVISIONS OF MIDDLE AND UPPER LIAS AT ILMINSTER.

1. THE MIDDLE LIAS.

		ft.	in.
1 *a*	Blue and gray micaceous marls with intercalated nodular sandstones	100	0
b	Yellow micaceous brick marls with sandstones	30	0
c	Irony sands with ironstone nodules	20	0
d	Marlstone, the workable stone of the district, average	8	0
	Greenish sand full of *Belemnites paxillosus*		4
	Marlstone, highest member of Middle Lias		4

2. THE UPPER LIAS.

		ft.	in.
A	The Leptœna Clays	1	6
B	The Saurian and Fish Beds ..		8
C	The Ammonite Beds	8	0

3. YELLOW SANDS OF INFERIOR OOLITE.

Sections of the Middle Lias below the marlstone, or those included in the zones 1 *a*, *b*, *c*, are rarely exposed, so that neither their precise divisions, nor their organic contents are to be very satisfactorily made out. My friend Mr. Day, has lately described their general characters in an admirable section near Lyme, to which we shall have occasion to refer.

These zones are crossed in approaching Ilminster from the west. After passing from the Lower Lias, the first group of the Middle Lias, 1 *a*, may be observed in a canal cutting between Ilminster and Dowlish Ford, and in the railway cutting towards Donyatt, where the beds are composed of blue and brown micaceous marls, with occasional concretionary masses containing pentacrinites, &c., and they were opened up in an excavation made for a building on the same horizon, at Haslewell, in which the *Ammonites Bechii* was found.

The above beds graduate insensibly into marls of a grey or yellow colour embraced by zone 1 *b*, which is to be seen in a brickyard at Cross, and in another at the village of Lambrook, near South Petherton. Large nodular masses of sandstone are found in this zone. A list of organic remains will be hereafter given, amongst them are found the *Ammonites margaritatus* and *Rhynchonella furcillata* in abundance. *Ammonites serpentinus* also occurs in this zone, having hitherto only been observed in the Upper Lias.

Zone No. 1 *c*, is composed of rusty-looking irony marls, with frequent nodules of ironstone. We have observed them in the road leading out of South Petherton towards Martock, and also immediately under the next zone of the marlstone, in the neighbourhood of Wotton-under-Edge, Frocester, and Newent in Gloucestershire.

Resting conformably on the latter, succeed the beds of the

marlstone, embraced in zone 1 *d*, for the extraction of which nearly all the quarries in the Middle and Upper Lias are opened up. The workable beds of this group are sometimes eight in number, lying immediately one upon another, but in some instances are reduced to two, and accordingly vary in different localities from 12 ft. to 3½ ft. in thickness. Included in this is an argillaceous band of marl, four to five inches thick, characterized by the enormous number of belemnites it contains. Upon this band rests a thin layer of marlstone, generally without organism, constituting the highest member of the Middle Lias. Its upper surface is covered by a thin spongy-looking limy deposit of a yellow colour.

2. THE UPPER LIAS.

Under this head are included various thin beds of clay and stone, which usually have to be passed through to reach the beds of the marlstone before mentioned, and which are interposed between the latter zone and the inferior oolite. They only average eight feet in depth in the West of England, a thickness quite insignificant when compared with their equivalents, the alum shales of Yorkshire, or even with the zones they represent in some of the sections in Gloucestershire, which are there as many feet in thickness as they are inches in the district under notice. The whole of these beds are crowded with organic remains, some of which are of the highest interest to the palæontologist.

When the saurian and fish bed is present, which is not always the case, they may be divided into the following groups:—

A. THE LEPTÆNA CLAYS.—These lie in immediate contact with the marlstone, and consist of several thin bands of laminated clay about 18 inches in thickness, in which

appear four species of the palæozoic genus leptæna, which was supposed to have become extinct with that era, together with numerous other fossils which will be noticed hereafter.

B. The Saurian and Fish Zone.—When the quarries are worked, the heading, which consists of the beds contained in the next group, is removed down to the saurian bed, which is then exhibited in irregular elongated or rounded patches, frequently extending to some distance. They present flattened pavement-like forms, of a yellow colour externally, but at times bluer in the interior. From the contraction of the bed the separate patches are divided vertically in every direction, like septaria, but without any subsequent infiltration into the cracks by which the fractured sides have been again united. The bed when thus seen in the Ilminster district is rarely more than five inches in thickness, unless it encloses some organic remains, the presence of which would probably be indicated by a thickening of the matrix surrounding it, though usually when they are of any size, they are in detached boulders. These portions of the saurian and fish beds are not concretionary, but are evidently the remains of a continuous bed, which was afterwards subject to denudation. The boulders exhibit regular sedimentary laminæ, and together with the thinner portions of the bed contain insects, small fish of the genus leptolepis, crustacea, ammonites, &c.

C. The Upper Cephalopoda Beds.—This group is intended to include all the other beds of the Upper Lias, above the saurian zone, to the inferior oolite. They are characterized by the enormous number of ammonites they contain. Many of the species are also found in the saurian zone and in the upper portion of the leptæna clays, but in the latter they are usually in flattened impressions only. The *Ammonites Moorei* and *A. insignis*, which have been

found to pass upwards into the cephalopoda beds above the sands of the next stage occur only in the very highest member of the Upper Lias, immediately under the sands, which are to be seen resting on the Upper Lias at Whitelackinton, at Shepton Beauchamp, and between that village and South Petherton; but the cephalopoda bed, as it occurs in Gloucestershire, is only to be seen at Compton, near Yeovil, and a section shewing its relative position to the beds now described will be hereafter given. The lithological distinction between the yellow sands of the inferior oolite and the Upper Lias, and the marked difference in the general facies of their fauna, have prevented my recognizing the propriety of including the former with the Upper Lias.

Sections of Middle and Upper Lias.—These beds are developed in the neighbourhood of Ilminster, in three ranges of hills, of slight elevation, having, usually a dip to the south. Owing to the inclination of the strata in the first or north range, which commences at Puckington, the upper marls of the Lower Lias occur at its northern base, and graduate into the irony and grey micaceous marls and clays, which constitute the lower zones of the Middle Lias. Although from cultivation, and the absence of sections, this part of the series is not easily observed, there is little doubt that they occupy the greater thickness of the northern escarpment of this range; whilst the marlstone for which the quarries, on the top of the hill, are worked, and the Upper Lias that overlies them follow in successive stages, and are to be observed on the southern slope. Between the Puckington range, and the second immediately north of Ilminster, a distance of about two miles, the beds have been denuded, and the valley is occupied by a rich alluvial deposit.

In the Ilminster range the beds are to be observed under similar circumstances. The lower beds cropping out on the northern side, and the marlstone and Upper Lias again occupying the southern slope, but with this difference, —that about the middle of the town there appears to be a considerable fault, which has brought down the inferior oolite from Butts to Townsend, to a depth of probably forty feet.

Between this range and the one commencing at Earn Hill, about a mile to the south, there again occurs another alluvial tract. The arrangement and position of the beds in the latter are the same, but their dip being much greater, they are soon lost beneath a range of greensand and chalk to the south.

As these beds proceed from west to east, from their commencement at Earn Hill, last mentioned, their upper members have been denuded where they are crossed by the road leading from Ilminster to Chard, and at this point the clays, included in zone 1 *b*, are exposed in a brickyard at Cross. A short distance from this, the Upper Lias and the marlstone again come in, overlooking the hamlet of Moolham, where the latter zone has been very extensively worked. They then continue to Kingstone, where, within about a mile and a half of their western limit at Earn Hill, the beds pass under the inferior oolite.

The quiet little town of Ilminster, embosomed in orchards, stands partly on the southern slope of the second range. The beds pass from west to east by Dillington and Whitelackington, when, like the former, at a distance of two miles, they are also covered by the inferior oolite.

The range further to the north, which commences at Puckington, has a more circuitous route, and passes from thence to the village of Barrington, Shepton Beauchamp,

South Petherton, and Stoke-sub-Hamdon, at the latter place the beds pass under Hamdon Hill, the inferior oolite from which furnishes the district with an excellent building stone. On the eastern side of this hill they again appear, taking the direction of Yeovil, where, to the south east they entirely disappear under later formations. At Trent, Sandford, and Rimpton, on the north east of Yeovil, the beds have been extensively worked, and afford interesting sections, particularly as their passages into the inferior oolite are in some of them well shown. From this point, to the neighbourhood of Bath, the beds are with difficulty to be recognized as distinct formations, their presence being indicated only by narrow belts of marl or clay, at the base of the oolitic escarpments.

Brent Knoll, the Tor Hill at Glastonbury, and the Pennard Hills, are however exceptions, and form remarkable outliers of Middle and Upper Lias, indicating by their isolation the extent of denudation to which the districts, wherein they are situated, must have been subjected.

Middle and Upper Lias near Bath.—Mr. Lonsdale, when writing on the Bath district, says, Geo. Tran. vol. 1, p. 100, that "The marlstone, (with which was then included the Upper Lias,) was probably co-extensive with the hills surrounding Bath, yet that it was rarely to be seen, he having observed it only at Box, Batheaston, and the descent from High Barrow Farm to Pennyquick Bottom, whilst Mr. Smith also gave Bathampton and the Coal Canal as two of his localities." We find Mr. Lonsdale's supposition to be correct, and that the beds are to be traced almost continuously along the escarpment of the hills surrounding Bath, though from the few sections made in them they are seldom opened up. In addition to the above localities, we have observed them at Kelston, near

Beech, at Upton Cheyney, under Lansdowne, and above Cranwells, on the side of Beechen Cliff, and in the Lyncombe Vale, at Monckton Combe, and at St. Catharines. The reservoirs of the Bath Water Works at Bathampton, are in the Middle Lias, and the beds were opened along the line of railway from Bath to Weymouth, at Limpley Stoke. On the top of Bitton Hill, the Upper Lias is composed of several ferruginous-looking beds of stone, with what appears to be a single bed of the Middle Lias marlstone immediately beneath, without any intervening beds of clay. An extensive fault at this point places them on the same level as the Lower Lias. From Radstock, Camerton, and Paulton, interesting sections will be hereafter given.

Middle and Upper Lias of Gloucestershire.—After skirting the base of Lansdowne, near Bath, which forms the southern termination of the Cottswold Hills, these beds may be traced along the whole western side of that range in its passage through Gloucestershire, though often they are but thinly represented in its escarpments, and only worked at wide intervals. At Wotton-under-Edge and Dursley they have a larger development, and present much the character of the sections around Ilminster. They continue from the former districts by way of Frocester and Leonard Stanley, surrounding the valley of Stroud, and from thence to the east of Gloucester and Cheltenham, to Chipping Campden, on their way to the iron manufacturing districts of the North of England. In the neighbourhood of Gloucester there are two small outliers, on platforms of the Lower Lias, at Robin Hood's Hill, and Churchdown, and to the north of Cheltenham there are others at Stanley, Oxenton, Bredon, and Dumbleton, to some of which reference will be hereafter made.

Economic Importance of the Upper and Middle Lias.—Since the discovery that the Middle Lias

formation of the North of England, yields, over a large area, an iron ore giving an average of about 32 per cent. of metallic iron, these beds have attained a commercial importance, second only to our coal deposits. The beds under notice are the precise equivalents of the Yorkshire deposits, from which upwards of 600,000 tons of iron are annually being manufactured. When the value of this ironstone became known a few years since, we lost no time in testing the value of the deposits in the West of England for the same mineral, but although in most instances the beds look more ferruginous than their northern representatives, their average yield of iron in the district owing to the rock being much more siliceous is about 16 per cent., a little less than one half, a circumstance much to be regretted, both for the Welsh ironmaster as well as for the district, for had it been otherwise, an inexhaustable supply might have been obtained at the surface over a very extended area in this part of England. It is also to be regretted by the Palæontologist, for had the beds of the marlstone in some parts of this district been more extensively worked, the Upper Lias resting upon it would yield its marvellously perfect organisms in greater abundance, and the saurians and fishes now probably destined to remain undiscovered along the slopes of the hills would be more frequently brought to light. In the neighbourhood of Bitton, the Middle Lias yields an average of 22 per cent. of metallic iron, and there are beds in the Limpley Stoke Valley, and in other places around Bath, giving about 30 per cent., and it probably only arises from the accident that these beds are not quite thick enough to work profitably, that the beautiful district around that city is not converted into one for the manufacture of iron. Some years since the roads in the Ilminster district were repaired with the marlstone, but latterly

the mammal drift gravel, a more durable material, has been employed, in consequence of which many of the quarries have been entirely closed.

In the year 1829, the town of Middlesborough, in Yorkshire, which is now the chief seat of iron manufacture, was occupied by a solitary farm house; but the population now amounts to about 25,000. In the district there are 600 square miles of land, under which the ironstone of the Middle Lias is to be found. It has been stated that one landed proprietor owns land which would realize, in the money value of its *manufactured* iron, money enough to pay off the national debt. I have often pictured to myself the wonderful revolution that might have been effected at Ilminster, under the same favourable circumstances. Some of the land would have yielded 30,000 tons of ironstone to the acre, which at a royalty of 4d. per ton, would have realized £5,000 per acre. The incomes of the landed proprietors would have been largely increased; the pretty little town would have been extending in every direction; railway companies would long since have contended for its traffic; money wages, to the extent of many thousands per week, would have been in circulation; the clang of the forge would have resounded, and its hills lit up by the lurid glare of blast furnaces. Indeed the whole aspect of the district would have been changed into one of general bustle and commercial prosperity.

ANALYSIS OF THE ILMINSTER MARLSTONE.

Carbonate of iron	36	53
Carbonate of lime (with a little of the carbonates of magnesia, manganese, &c.) ..	30	14
Insoluble sand and clay	33	33
	100	00

The total quantity of iron present amounts to 15.91 per cent., this being the mean of two experiments, viz. :—

I.	II.	MEAN.
16.09	15.74	15.91

The clays which rest upon the marlstone in the west of England are the representatives of the alum shales of Whitby, on the north coast, where they have, for many years, been largely worked for the manufacture of that material, those clays, which are here but of a few inches in thickness, having there a large development. It is also from certain members of these Upper Lias shales that the jet is obtained, which is so well known in the manufacture of ornaments. Some bands of the shales are worked expressly for the extraction of this article, in doing which, at uncertain intervals, are found flattened pieces of the ancient trees of the period, which are converted into the beautiful articles to which I refer. The pieces are never of large size. The high price of jet is accounted for by the difficulty of obtaining it. A piece in my museum cost, in its natural rough condition, five guineas, though measuring only 18 in. by 12 in. To the outside of this block there are attached a number of *Inocerami*, shewing that before it was covered up, it had been floating in the ocean in which these shells then abounded.

Having given a general outline of these formations in their passage through Somersetshire into Gloucestershire, we now propose to describe one of the more interesting sections at Ilminster, from the marlstone, upwards, in greater detail, as typical of those in that district. With this we shall then compare other sections, and afterwards proceed to an examination of the organic contents of the different beds.

SECTIONS IN THE ILMINSTER DISTRICT.

On comparing the sections which follow it will be seen that

very considerable variety exists in the Middle and Upper Lias. Although they may be found in the same locality, not only do they differ as regards the number and thickness of the beds, but often also with reference to their organic contents. This is more especially the case with the Upper Lias. The marlstone at its base, for which the quarries are worked, is continually faulted in the direction of its dip to the south, from this cause, and partly perhaps from the contraction of the beds, they are everywhere found disturbed and much fissured, and usually occupying narrow terraces on the slopes of the hills. This has allowed them to give way more readily to denuding action, and may account for much of the variety that is seen. From the above causes the thin beds, which in this district constitute the Upper Lias, are correspondingly modified. Although the chief features in the sections may be readily noticed, it is often difficult, and may require care to make out satisfactorily the more minute divisions which are shewn in the following section at Strawberry Bank. This was worked from my boyhood, and from it were obtained most of the saurian and fish remains that enrich my museum. On my last visit to Ilminster, I observed with much regret that the section had been filled in, probably never again to be worked.

1. THE MIDDLE LIAS.

		ft.	in.
1 *d*	*The Marlstone.*—Various irregular thick bedded ferruginous rocks, penetrated by vertical fissures, and containing *Pecten æquivalvis* and various other organisms ..	10	0
e	A bed of greenish marl characterized by containing immense numbers of *Belemnites paxillosus*		4

		ft.	in.
f	A bed of ferruginous stone, the highest member of the Middle Lias		5

2. THE UPPER LIAS.

A. THE LEPTÆNA BEDS,

which under favourable circumstances, may be divided into

a	A band of yellow clay resting immediately upon the Middle Lias, the zone of the *Leptæna Bouchardii*, and *L. Moorei*		2
b	Variegated yellow and green laminated clay		1
c	Dark brownish clay. Zone of *Thecideum rusticum*		4
d	Greenish clay. Zone of *Alaria unispinosa*		2
e	Greenish clays, divided by a thin irony band, the zone of *Leptæna granulosa*, *Spirifera Ilminsterensis* and *Zellania liassica*		6

B. THE SAURIAN AND FISH ZONE.

a	Bed of clay beneath the fish bed ..		3
b	The saurian and fish bed—a yellow nodular, or septarian limestone, with enclosed organisms ..		4-5½
c	Clay above fish bed		2½

C. THE UPPER CEPHALOPODA BEDS.

a	Yellow and green clay. Zone of *Rhynchonella Bouchardii* ..		2
b	Layer of stone		1½
c	Concretionary blue clay		9
d	Rubbly stone		3
e	Blue mottled clay		3
f	Stone		1½

SECTION AT ILMINSTER.

SCALE 3/4 IN. TO A FOOT.

		ft.	in.
g	Gray clay		4
h	Stone		3½
i	Gray clay		3
k	Rubbly stone		4
l	Gray clay		5
m	Rubbly brown stone		4
n	Light blue clay		3
o	Three layers of drab-looking clay and stone		9
p	Light blue clay, with *Crania Moorei*		4½
q	Eight bands of clay and stone, often from disturbance not separable, with *Ammonites insignis A. variabilis*, and *A. Moorei*, about ..	2	0

D. YELLOW MICACEOUS SANDS OF INFERIOR OOLITE.

In the foregoing section it will be seen that although the beds of the Upper Lias, above the marlstone, are in the aggregate but from eight to nine feet in thickness, they present a remarkable variety in lithological condition, indicating that they must have been deposited slowly, and that there were probably periods of rest during their accumulation. This is satisfactorily proved by the fact, that although some of the cephalopoda have ranged through them, yet in other respects, each thin layer can, by careful and minute examination, be shewn to represent a zone of zoological life during its deposition, each stage indicating the introduction and the subsequent disappearance, as far as this district is concerned, of some of the peculiar genera and species which it encloses. This will be again referred to when speaking of the organic contents of the beds.

In most of the sections in the West of England, excepting those south of Bath, and in Gloucestershire, the quarries

are all worked for the marlstone at their base, which is in each case on the same geological horizon; but when the following sections are compared with that at Strawberry Bank, the Upper Lias beds above will present considerable variations, and many of the beds often found to be entirely absent.

OTHER SECTIONS NEAR ILMINSTER.

Similar sections to that given at Strawberry Bank, have at different times been opened up and again closed. The one now in work which most nearly resembles it is at Earn Hill, on the south side, immediately overlooking the village of Donyatt. This is only worked for the purposes of the farm, and very little fresh ground is opened up, in consequence of which but few organic remains are obtained from it. From this to the east, the marlstone and Upper Lias have been denuded down to the micaceous brick clay of zone 1 *b*, found at Cross, between Ilminster and Chard. On ascending the hill to the east from this point, the former beds are again found on the south side of the hill, between Pretwood and Moolham, giving the following section :—

SECTION OF MIDDLE AND UPPER LIAS AT MOOLHAM.

	ft.	in.
Middle Lias.—Marlstone eight or nine beds	12	0
Grayish clay		6
Stone		3
Gray clay		6
Upper Lias.—Various thin layers of stone and clay, with the characteristic cephalopoda of the Upper Lias as at Ilminster	5	0

The noticeable variations in this section, when compared with that at Ilminster, from which it is only a mile distant,

are, that the saurian and fish zone *B*, and the leptæna beds *A*, are entirely absent. The marlstone is also thicker,—indeed it attains a greater thickness in this quarry than in any other with which we are acquainted. In former years the Moolham stone was largely worked, and the chief supply is still derived from thence. In all other districts the shelly and indurated character of the stone prevents its being readily dressed, which from its softer texture at this place can be done, and it generally yields a very durable building material. The upper bed of the Middle Lias of this section has afforded the finest examples of *Rhynchonella serrata*, *R. tetrahedra* and *Terebratula sub-puncata*, and it also contains sponges and claws of crustacea.

Along the line of road from this section to Kingstone, a distance of half a mile, are several other quarries in which all the beds of the Upper Lias have been denuded, and the marlstone comes at once to the surface. The last section in this range, before the beds pass under the inferior oolite, is at the above village. In this the saurian zone and the leptæna beds are again present, but the former is only represented by a few very flattened nodules, in which no organisms have been found, some of the nodules not being larger than a crown piece. From the absence of this bed at Moolham, and its insignificance at Kingstone, it is shown that it had been denuded before the deposition of the cephalopoda beds of the Upper Lias above.

About half a mile north of the Kingstone section, in the range in which the Strawberry Bank quarry is situated, are two others, one in a large field south of the Whitelackinton road, and another in an adjoining field facing the Long Ponds. In the former all the zones are again present; the marlstone is nine feet thick; the leptæna beds are thinner than at Ilminster, and not so fossiliferous. The saurian bed

is here composed of a stone of a denser character, from which cause insects and organisms of delicate structure are seldom preserved in it. The upper cephalopoda beds, although only a mile from Strawberry Bank, are reduced to three feet, but thicken again at the Long Ponds, where the beds occupy a line of faults, on the opposite side of which, the inferior oolite is present.

In the Puckington range, north of Ilminster, there are several good sections, one above the village of Stocklinch, and another at Atherstone. The upper cephalopoda beds are partly exposed in the roadway leading to the village of Shepton Beauchamp. In the village below, the saurian and the leptæna beds are present, but much darker, the latter assuming a deep blue colour. The upper members are thicker here than at any other place in this district; they have not only suffered less from denudation, but indicate, from the increased thickness of the beds, a deposition in a deeper sea. At Hurcot, and at Seavington, within a short distance, there are other sections, in which the saurian bed is again absent.

Until lately we supposed there was an entire absence of the leptæna and saurian zones in every other locality between Shepton, and their equivalents in Gloucestershire, but we have since observed them in one place only, at Marston, beyond Yeovil.

SECTIONS AT SOUTH PETHERTON AND STOKE SUB-HAMBDON.

In crossing the fields from Shepton to South Petherton, an old working of the higher beds of the upper cephalopoda zone is exposed in a small field near the former village, where they are capped by the sands to the depth of four feet. From the weathered surface of the Upper Lias at this place, were obtained two of the corals so rare in the

lias, viz :—the *Trochocyathus Moorei*, Milne Edwards, and *Trochocyathus primus*, Milne Edwards.* From thence to South Petherton, these beds are everywhere covered by the sands. At this town the irony sands below the marlstone, belonging to zone 1 *c*, are well shewn at the end of North Street, in the hill descending to Martock. In a large field adjoining, the marlstone is extensively quarried for the roads, and from this section were obtained many of the Brachiopoda, figured by Mr. Davidson, from the Middle Lias. The organic remains are here especially abundant, and on the whole in better preservation than in most other localities. The beds are here again much reduced in thickness; the marlstone being but three and a half feet in thickness, and all the beds of the Upper Lias are included in three feet. At the adjoining village of Stoke-sub-Hamdon, they are again quarried for road material, and are seen to pass under the inferior oolite, their connection with which will be shewn hereafter.

On the eastern side of the Stoke-sub-Hamdon Hill, there are several quarries, in which the Middle and Upper Lias beds vary but little from those at Petherton and Stoke, but at Yeovil, and in the sections beyond that town, considerable variations are to be found in the deposits, especially in those of the Upper Lias; thus instead of the numerous thin bands of clay and stone in that zone as at Ilminster and other places, we find the following changes :—

* Since the above was written we have been fortunate enough to discover a very large series of Lower Lias Corals, amounting to about forty species, which will be described by Dr. Duncan, F.G.S., in the Palæontographical Society's Proceedings for 1867.

SECTIONS OF MIDDLE AND UPPER LIAS NEAR YEOVIL.

	ft.	in.
1 *Marlstone*	5	0
2 *Upper Lias.*—"Ingotton," a blue marl	10	0
Yellow brick clay	4	0

The Marlstone of the above section contains all the usual organic remains of that zone, but they are very rare in the marls and clays of the Upper Lias above.

SECTION IN "HOME GROUND QUARRY," COMPTON.

1 *Marlstone.*—Thin bands about ..	6	0
2 *Upper Lias.*—Greenish mottled clay		9
Stone		8
Thin bands of clay and stone ..	1	2
3 *Inferior Oolite.*—Dark clay with oolitic grains		2
Mottled brown clay	2	0

The Upper Lias contains *Ammonites Walcottii* and other shells characteristic of that formation; the upper surface of the highest bed was much eroded before the deposition of the oolitic bed above, a circumstance observable wherever the junction of the Upper Lias with the sands is exposed. In the section under notice, the organic remains are left standing out sharply from the bed, and in it are to be found a most interesting series of shells hitherto found in no other section of Upper Lias in this county. Unfortunately this quarry is not worked. We have visited it occasionally with the hope of enlarging our series of organisims from it, but only to be disappointed. The bed No. 3, almost passes into a clay ironstone, and those above are also ferruginous.

SECTION AT TRENT.

Within half a mile of the last section we have again the following remarkable change in the character of the beds:—

		ft.	in.
1	*Middle Lias*—Firestone,—bottom bed	1	2
2	*Upper Lias.*—Grey clay		6
	Irony stone		3
	Gray micaceous clay		3
	Rotton stone,—several beds very irony-looking	2	0
	Building stone		4
	Gray clay		9
	Gray water-worn stone ..		9
	Gray clay		6
	Building stone		10
	Rotton stone, very irony ..		9
	Indurated irony sands	1	0
3	*Inferior Oolite.*—Micaceous sands, with occasional bands and nodules of ironstone	8	0

The firestone in this section is the only bed of marlstone present, and shews when compared with the Middle Lias at Compton, that within so short a distance the thickness has been reduced from six to little more than one foot, whilst there has been a corresponding thickening of the Upper Lias. The micaceous sands represent the lower beds of the inferior oolite.

In none of the sections given east of that at Shepton Beauchamp, can any of the clays above the marlstone be recognized as the equivalent of the Ilminster leptæna zone, and the saurian and fish bed over an area of 14 miles is entirely wanting. Whilst proceeding from the Trent section just given, to one overlooking the village of Rimpton, near Sherborne, we were therefore surprised to see some piles of stone intended for the repairs of a bye road, which in the distance we at once recognised as our old friend the

saurian zone. Our expectations were raised to the highest pitch by the promising character of the large rounded nodules we were approaching, each of which in imagination we supposed might contain either a *Pachychormus*, a *Lepidotus*, a *Cuttle Fish*, or it might be even an *Ichthyosaurus*, or a *Teleosaurus*, but disappointment awaited us, for notwithstanding the extreme richness of this bed in the Ilminster district, and also in Gloucestershire, we were unable to find any organic remains, though subsequently on another visit to the spot we found scattered scales of *lepidotus*, and *leptolepi*, both in the fish bed and the surrounding clay.

SECTION AT RIMPTON.

	ft.	in.
1 *Middle Lias.*—Marlstone	2	0
2 *Upper Lias.*—*A.* Leptæna clays ..		5
B b Saurian Zone—flat bed ..		3
Ditto in large irregular septarian nodules ..		10
c Clay	2	6
C Upper Cephalopoda Beds.—Thin stone, irregular		4
Clay		5
Stone		1½
Several rubbly beds with *A. Walcottii*. *A. serpentinus*, &c.,	1	6

The last section we shall give in this district is found in the adjoining village, about a mile from the above.

SECTION AT SANDFORD.

1 *Middle Lias.*—Irony sands below the marlstone	15	0
Marlstone,—several beds ..	2	0
Ditto		2½

	ft.	in.
Marlstone		7½
Ditto		4
Ditto irony stone		10
Irony indurated clay		2½
2 *Upper Lias.*—Yellow sand with *Leptæna Moorei* and *L. Bouchardii*		2½
B a Clay of saurian zone, ..		7
Ditto ditto ..		10
b Saurian and fish bed ..		8
c Upper clays of ditto ..	1	8

In no instance have the leptæna and the saurian zones been noticed between the latter sections, and those which occur in Gloucestershire, and the greater thickness of the saurian bed and the larger size of the nodules, reminded us of its character as seen in the quarries of Dumbleton, Stanley, &c., in that county, to which we shall presently refer.

Oolitic Sections.—Before finally closing the physical description of the Middle and Upper Lias of this part of the county, it will be desirable to point out, as far as practicable, the passage of these formations into the inferior oolite. Until lately the yellow micaceous sands above the Upper Lias were classified and mapped as the basement of the oolitic series, but the discovery that several species of ammonites have lived on from the former into the latter period, has induced the removal of the sands from their original position, and their classification with the Lias. We have never been able to recognize the necessity for this change. Not only have we in the two horizons as distinct a fauna in its general facies as can be found with any other formations, but we have, wherever the junction of the sands with the Upper Lias is observed, a most marked

and permanent lithological distinction in argillaceous beds crowded with ammonites, &c., capped by yellow sands, with but few evidences in their lower beds of organic life. Under the former classification, the line of separation could be drawn with the greatest nicety, but must now, in this district at least, be purely arbitrary, since in almost every locality the lower oolitic rock and the sands beneath possess special characters, are of very varying thickness indicating different conditions of the sea bottom of the period, and in the material of which the rocks are composed.

The sands are to be observed above the Upper Lias at Ilminster, Whitelackington, Shepton, Seavington, and in many other places, but their thickness is best seen in the sections at Stoke-sub-Hamdon, and Compton, near Yeovil, and also in the railway cuttings near Yeovil.

SECTION AT STOKE.

		ft.	in.
1	*Marlstone*	3	6
2	*Upper Lias*	3	0
3	*Inferior Oolite.*—Yellow "Brim Sands," with occasional concretionary boulders of sandstone	80	0
	Bottom Bed—a hard nodular bed, not worked	1	4
	Gray Bed	2	0
	Ditto	2	6
	Ditto	2	0
	Ditto	1	8
	The "Yellow Beds," closely bedded varying from 2ft. to 1ft. 6in. thick	50	0
	"Ochre"—consisting of yellow sands, sometimes passing into sandstone	30	0

The workable freestone at this spot is 58ft. thick, and almost entirely composed of comminuted shells, united by an irony cement, and is a remarkable deposit, for though attaining so considerable a thickness it does not appear to be represented in any other locality. It has been largely worked for centuries, and yields a very excellent stone of a light brown colour, due to the presence of carbonate of iron, an analysis of the deposit proving it to contain 14 per cent. of metallic iron.

The gray beds yield the best weathering stone. They are separated from the yellow beds by a band about 1ft. thick, containing many pellets of iron ore.

The lower members of the sands in the next section are not well exposed, but their thickness may be estimated in passing from the Upper Lias of Compton, up the escarpment to the "Half-way House" quarry at that place, their passage into the oolite being there quite distinct, and the difference it presents to the Stoke section, only a few miles off, will serve to show the marked contrast exhibited in the beds of this horizon, in this part of England. The cephalopoda bed of Half-way House, contains many of the organic remains of that zone in Gloucestershire, and amongst the ammonites may be mentioned *A. Parkinsoni*, *A. Sowerbyi*, *A. Moorei*, *A. Martinsii*, and *A. variabilis*.

SECTIONS SHOWING MIDDLE AND UPPER LIAS AND INFERIOR OOLITE AT COMPTON, NEAR SHERBORNE.

	ft.	in.
1 *Middle Lias*, in "Home Ground" Quarry	6	0
2 *Upper Lias*, ditto ..	2	7
3 *Inferior Oolite*.—Brown mottled clay	2	2
Yellow sand and sandstone, leading from the former to the turnpike road, about	100	0

	ft.	in.
In the roadway towards Yeovil:—		
Sandstone		6
Sand		5
Sandstone		5
Yellow Sand	2	0
Irregular Blocks—sandstone ..	1	6
Yellow sand	6	0
Sandstone		11
Sandstone		10
Yellow sand	14	0
Sandstone	1	0
Continued in Quarry at Half-way House, Compton:—		
"Due Stone."—Bottom bed ..	1	4
"Due Stone," used for roads ..	2	0
Stone		8
Blue oolitic bed	2	2
Cephalopoda bed		9
Stone, with numerous univalves ..	2	0
Rotten stone	1	0
Sand		1
Cephalopoda bed	1	2
Sand		1
Stone	1	6
Sand		1½
Stone		8
Sand		4½
Stone	2	0
Stone		4½
Stone		5
Stone		4½
Stone		5
Sand		1
Stone		6

	ft.	in.
Sand		6
Stone		5
Sand		3
Stone		6
Stone		3
Sand		1
Stone		4
Sand		2
Stone		5
Sand		3
Sand		4
Sand		3
Rubbly stone and sand	6	0
Vegetable soil	1	0

According to the present proposed classification of the liassic and oolitic groups, the Upper Lias would terminate with the cephalopoda beds, which in this instance are in the middle of an oolitic quarry, surrounded both above and below with beds of a similar lithological character. In other localities this terminal zone might not be recognized, so that it would be impossible to say where the one formation ended and the other commenced. We are therefore of opinion that much difficulty must arise from this arbitrary arrangement, and that it would be safer to again include all the yellow micaceous sands with the inferior oolite.

No sections of the Middle and Upper Lias are to be found between Sandford and the neighbourhood of Bath, except in the outliers of the Tor Hill, Glastonbury, and the Pennard Hills. As the beds around Bath, with one exception, to be hereafter noticed, are on a different horizon

from the marlstone and Upper Lias hitherto described, we purpose first to pass to their equivalents in Gloucestershire, and then return to some interesting sections near Bath.

SECTIONS IN GLOUCESTERSHIRE.

The Middle and Upper Lias occupy the base of the western escarpment of the Cotteswold Hills, through their whole range from Bath through Gloucestershire, but we are not aware that the marlstone zone is worked until near Wotton-under-Edge, where it has an extensive development. Still further north, near Stinchcombe, the marlstone attains a greater thickness than in any other part of the West of England with which we are acquainted. As we proceed still further north to Stanley, Dumbleton, &c., this zone is seen to be again much reduced in thickness, whilst on the contrary, the fish and saurian bed and the leptæna clays, which are altogether absent at Stinchcombe, are again present and attain a thickness not found in any other sections to the west.

SECTION AT NEWENT QUARRY NEAR STINCHCOMBE.

		ft.	in.
1	*Middle Lias*.—Indurated marls with irony concretions thickness unknown		
	Marlstone	20	0
2	*Upper Lias*.—Clay, yellow at the base, but gray at the top, varying from eight inches to	2	0
	Stone		2
	Gray clay		8
	Stone		2½
	Gray clay		8
	Stone		2
	Gray clay		9
	Stone		2

The Indurated marls in the lower portion of this section are to be seen in the cellar of a small inn, in the village, and occupy a similar position, and are lithologically identical with the irony zone previously mentioned, at the base of the marlstone at South Petherton. Shafts have been sunk in this part of the series for iron ore, but without a profitable result, and the marlstone which is the chief depository of this mineral in the North of England, like that still further west, is too poor to be worked, the average yield of metallic iron being about 17 per cent.

Organic remains are comparatively rare at Newent, both in the Middle and Upper Lias. In the former we noticed *Terebratula punctata*, *Rhynchonella tetrahedra*, *Pecten æquivalvis*, *Avicula*, *Belemnites*, *Cardinia crassissima*, &c.

SECTION AT FROCESTER HILL.

In a hurried visit we lately paid to this section we observed that the succession of the strata passing upwards from the Lower Lias at the base of the hill, was very similar to that found near Ilminster, but as no quarries are here worked, the beds are only seen in the hill side sections. Above Frocester we noticed the brick clays and the irony micaceous marls of the preceding section. The marlstone above, which is here more ferruginous, is reduced from 20 feet at Newent, to but 2 feet in thickness. Higher in the road we found a piece of the saurian and fish bed, and an *Ammonites serpentinus*, indicating the presence of the Upper Lias, while still higher were some good exposures of the yellow sands forming the cynocephala stage of Dr. Lycett.

SECTION AT STANLEY HILL.

Before the meeting of the British Association at Cheltenham, in 1856, we visited this section with the Rev. P. B. Brodie, who had often successfully worked there at the

insect bed. Up to this time none of the larger fishes or saurians had been obtained from it. My experience of this zone in the West of England enabled me to give the quarrymen special instructions respecting the kind of nodules in which those remains might be found, which resulted in their bringing to the museum at Cheltenham, during the meeting, a very fine example of *Lepidotus*, which is now in the cabinet of Dr. Wright, and which is as yet the only example of that genus found in this formation in Gloucestershire.

SECTION AT STANLEY.

		ft.	in.
1 *Middle Lias.*—Marlstone		3	6
2 *Upper Lias.*			
Leptæna Beds	Gray laminated clay ..	14	0
	Compact blue clay ..	2	6
	Blue clay	2	6
Saurian and fish bed		1	0
Clay and vegetable soil ..		4	0

There are several small outliers of the Middle and Upper Lias in Gloucestershire which we have been unable to visit, two of these are Robin's Wood Hill and Churchdown, near Gloucester, and Oxenton and Bredon Hills, north of Cheltenham. An account of the Churchdown beds has been given by the Rev. F. Smithe, F.G.S., in the proceedings of the Cotteswold Club, in which for the first time in Gloucestershire, he recognizes the presence of the leptæna zone with some of the characteristic shells previously found at Ilminster.

The last section to be noticed in this district is that of Dumbleton. On a visit we had the pleasure of making to E. Holland, Esq., M.P., of Dumbleton Hall, some years ago, we noticed that although the beds there would probably

not equal those of Ilminster in the variety and interest of their contents, still that the fish bed more especially would, if carefully watched, yield many fine specimens. Miss Holland was at this time commencing a collection. Subsequently at a meeting of the Cotteswold Club, at Dumbleton, we had the gratification of seeing that meanwhile that lady had been indefatigable in her researches, and had added largely to her collection from the Upper Lias. Indeed, next to my own, there is no other collection in this county more complete, or possessing specimens of greater interest from the latter formation.

SECTION AT DUMBLETON.

		ft.	in.
1	*Middle Lias*.—Marlstone	6	0
2	*Upper Lias*.—Leptæna Clays ..	15	0
	Saurian and fish bed	1	0
	Clay and vegetable soil ..	2	0

In all the sections we have hitherto given both in Somersetshire and Gloucestershire, the marlstone of zone 1, for which they are all worked, is undoubtedly on the same horizon. It is lithologically similar, and is to be at once recognized by its peculiar organic remains, many of which are special to this deposit. It will however have been observed that the beds vary very much in thickness without any apparent law to account for such diversity; in Somersetshire changing from 12 feet in thickness at Moolham, to 3½ feet at South Petherton, a few miles off, and in Gloucestershire from 20 feet at Newent, to 6 feet at Dumbleton, and 3½ feet at Stanley, and 2 feet at Frocester. But when the Upper Lias is considered, a still more remarkable diversity appears when the sections we have given are compared. In Somersetshire the leptæna clays of zone *A*, are often wanting, at times when these

are present the saurian and fish zone *B* are missing, which latter, is the case over the greater part of the area under notice. It is not improbable that the same variety might be found in the beds *below* the marlstone were there opportunities for comparison. In the Gloucestershire sections of Churchdown, Stanley, Dumbleton, &c., the saurian and fish bed is found at the top of each section, and was probably the means of preventing the total denudation of these hills down to the marlstone. All the ammonite beds above as found in the Somersetshire sections are generally wanting in Gloucestershire, but on the other hand, the leptæna clays of zone *A*, which in Somersetshire are only 18 inches, are in Gloucestershire from 15 to 18 feet thick.

BATH DISTRICT.

The sections hitherto noticed have been on the horizon of the marlstone, but around Bath, with one or two exceptions, these beds appear to be wanting, and lower members come in, which are not to be recognized in any of the former sections. The exceptional case is first given, which from the remarkable unconformability the beds is of much interest.

SECTION OF MIDDLE LIAS AND COAL AT MELLS.

A shaft has lately been sunk for coal at this place, on the property of the Rev. J. S. H. Horner. The "old men's" coal workings are visible on the surface of the ground in the immediate neighbourhood of the pit where the coal crops out, and on the south of the workings are beds of Dolomitic Conglomerate and Carboniferous Limestone. Instead of at once reaching the coal as was expected, the miners passed through a bed of clay into a rock which was quite unknown to them, specimens of which were forwarded to me for my opinion, with some of its

fossils, with the intimation that it was a dense unstratified rock. I was no less surprised than gratified to recognize in such a peculiar position my old friend the marlstone of Ilminster, and like its representative very fossiliferous .It contained many specimens of *Belemnites paxillosus*, *Pholodomya ambigua*, and *Ammonites spinatus*, and a *Montlivaltia*, the only coral I have ever found in these beds. In the blue marl at the side of the pit I also obtained a specimen of Star Fish, *Ophioderma Egertoni*, many fine examples of which are obtained in the blue marls on the coast near Charmouth.

The marlstone when passed through proved to be 9 feet in thickness, and the coal was won immediately below. Had the former been sufficiently ferruginous for working it would have been a most fortunate combination for the proprietors, who are members of the Westbury Iron Company, but this was not the case. We have at this spot the marlstone resting unconformably upon the coal, and were all the intervening stratified rocks present, they would, between these two formations, have an aggregate thickness of several thousand feet.

SECTION AT UPTON CHEYNEY.

The number of nodules of ironstone around Upton induced me to suggest to J. Parker, Esq., who has always been interested in the advancement of scientific knowledge, the desirability of making some excavations for their discovery. Accordingly on that gentleman's land, a trench was dug in a pasture field on the west of the village, when about two feet under the surface what appeared to be a remarkable deposit of iron ore was reached, bed after bed apparently following one another without interruption through a length of seventy feet, and dipping at an angle

of 36 degrees into the hill. There appeared therefore a very thick deposit of iron ore at this spot, giving an average of 24 per cent. of metallic iron, with a probable continuation of it under thousands of acres in the adjoining district. The next thing was to test its exact thickness by a vertical shaft, and then we had the disappointment of finding that what appeared to be the edges of a succession of stratified beds, was in reality only a series of *steps* produced by a single bed, which had been displaced, and at some period carried down the escarpment and left in this position.

At Oak's Lane, in ascending order, the following section is present :—

	ft.	in.
Middle Lias.—Blue micaceous stone ..	1	4
Gray marls	8	0
Shelly marlstone		4
Stone with blue interior		7
Mottled gray and red marls with numerous small irony nodules ..	40	0
Band of ironstone		3
Mottled gray and red marls ..	54	0
Pecten bed		1½
Red marl		1
Pecten bed		1
Red and gray marls	7	0
Blue pecten bed		4½
Irony nodules		6
Red and gray marls	7	0
Shaley pecten bed		4
Ironstone yielding 24 per cent. ..	1	8
Gray marls	33	0
Marlstone ?	1	0

	ft.	in.
Upper Lias.—About twelve beds with numerous *Ammonites serpentinus*,	12	0
Inferior Oolite.—Sands and rock ..	unknown	
Fuller's Earth.—	ditto	

Through the whole of the series under the Upper Lias organic remains are very rare; only *Gryphæa gigantea*, *Ammonites maculatus*, *Belemnite*, *Pecten*, and two or three casts of bivalves were observed.

Sections at Charlcombe and in the Limpley Stoke Valley, show beds which are again on a different horizon to those previously mentioned.

Opposite Dundas the following order was exhibited :—

Blue micaceous marl with thin nodules of ironstone	20	0
Brownish marlstone with *A. maculatus*, *Unicardium cardioides*, *Lingula Beanii*, abundant, Crustacea and saurian teeth	1	0
Blue clay	3	0
Upper Lias.—A single bed with *A. Walcottii*, *A. Serpentinus*, &c. ..	1	0
Gray clay	2	0
Inferior Oolite.—sands of	20	0

In a paper we have prepared for the Geological Society of London, on the "Abnormal Conditions of Secondary Deposits when connected with the Somersetshire and South Wales Coal Basins," we have shown that south of Bath there is a very remarkable thinning out of the secondary beds as compared with their equivalents beyond the Mendips, and that whilst in the latter case they would attain an aggregate thickness of 3320 feet, in the neighbourhood of Radstock, Paulton, and Camerton, they are reduced to 169 feet, which we believe arises from the Mendip Hills having been a land area during a great part

of this lengthened period, thereby serving to prevent the incursion of the secondary seas within its borders. Thus at Munger near Paulton, the 800 feet of Somersetshire Lower Lias is represented by only three beds of 18 inches, interposed between the Rhætic series and the Middle Lias, all of which are present in the same quarry. The following section at Camerton is one of much interest from its affording thin representatives of all the beds, from the Rhætic series upwards to the inferior oolite and fuller's earth, and as shewing also the relative positions of the Middle and Upper Lias in this district.

SECTION AT CAMERTON.

	ft.	in.
Rhætic White Lias.—A series of 21 cream coloured closely bedded limestones	8	0
Lower Lias.—Thirteen beds of the *Lima* series	4	10½
Spirifera Bank, with many *Spirifera Walcottii*		6
Foraminifera zone.—Blue clay ..	8	0
Blue limestone with fish scales, &c.		6
Brownish clay	2	0
Nodular bed with *A. raricostatus*		3
Middle Lias.—Irregular beds of marlstone	2	0
Upper Lias.—Unopened beds in escarpment towards Tunley, about ..	50	0
Inferior Oolite in roadway about ..	3	0

The same order of succession is seen in the Radstock quarries, but the marlstone of the Middle Lias attains a thickness of fifteen feet. In this district it has an iron shot or oolitic structure, and is usually very fossiliferous, the prevailing shells being *Gryphæa Maccullochii*, *Pholadomya ambigua*, and many *Brachiopoda*. There appears to

be little doubt the marlstone of this district occupies a different horizon from that at Ilminster, which is unquestionably the uppermost in the Middle Lias series, whilst probably the former is at the very base of the series and represent the passage beds of the Lower into the Middle Lias.

The Middle and Upper Lias as at Ilminster and in Gloucestershire occur under precisely similar circumstances at Curcy, May, and Fontaine-etoupe-four, in Normandy, and have been ably described with many of their organic contents by Dr. Eugene Deslongchamps. The same unconformability occurs in the sections he has noticed, in some of them the Middle and Upper Lias rest immediately upon the upturned edges of silurian strata. In his "Memoir sur la Couche a Leptæna du Lias," a series of remains are described which had not been observed in this country, and clearly form an horizon of Middle Lias that had not yet been recognized. Whilst on a visit to the Rev. J. S. H. Horner, of Mells, we were examining the very varied and interesting geology of that district, and on passing one of the carboniferous limestone combes, near Whatley, almost vertical limestones were exposed for about eleven yards, on the edges of which was a thin deposit of gray marl with drifted oolitic material above, giving the following section :—

SECTION AT WHATLEY.

		ft.	in.
1	*Inferior Oolite.*—Irony clay with sulphate of barytes and blocks of inferior oolite	4	0
2	*Middle Lias.*—Gray laminated marl ..	1	2
	Gray marl, very fossiliferous ..		10
3	*Carboniferous Limestone,* upturned edges of	3	0

The Middle Lias of the Radstock district and the deposit at Whatley represent the lowest Middle Lias beds. On removing to my residence a quantity of the marl from the latter place, species after species were found which were new to this country, and in this thin and abnormal deposit I had the pleasure of recognizing an horizon of Middle Lias, which hitherto had only been found on the ragged edges of the Normandy silurian strata. This reveals the interesting fact that when this zone was being deposited, the carboniferous limestone formed the floor of the liassic sea, and that at this time the silurian rocks of Normandy had been uplifted and were on the same level, and that both were receiving on their surfaces and in their cracks and fissures organic remains of the same age.

The fossiliferous marl at Whatley is in great part composed of dismembered *Pentacrinites*, but the same thin deposit has yielded sixty-four species of organic remains; of these the most varied are the *Brachiopoda*, of which there are present the genera, *Argyope*, *Crania*, *Leptæna*, *Rhynchonella*, *Spirifernia*, *Suesseia*, *Terebratula*, *Terebratulina*, and *Thecideum*. The *Leptæna rostrata* Desl. which occurs here is found also at Munger.

The following species occur at Whatley :—

Ichthyosaurus, teeth of
Hybodus, ditto
Sphenonchus
Raiæ
Nautilus
Belemnites acutus
,, clavatus
Chiton
Turbo
Trochus
Astarte
Avicula inæquivalvis, Sow.
Avicula sp.
Gryphæa depressa, Phil.
,, incurva, Sow.
Lima Deslongchampsii, Stol.
,, punctata
,, Haueri, Stol.
,, sp.
Ostrea ocreta, Desl.
,, monoptera, Desl.
Pecten textorius
,, sp.
,, sp.

Plicatula spinosa, Sow.
,, sp.
Argyope Suessii, Desl.
,, liasiana, Desl.
,, Perieri, Desl.
Crania
Leptæna rostrata, Desl.
,, Bouchardii, Dav.
,, Davidsoni, Desl.
Rhynchonella furcillata
,, egretta, Desl.
,, fallax, Desl.
Spiriferina Walcottii, Sow.
,, oxygona, Desl.
,, Deslongchampsii, Dav.
Suessia imbricata, Desl.
Terebratula punctata, Sow.
Terebratulina Deslongchampsii, Dav.
Thecideum Bouchardii, Dav.
Thecideum granulosum, Moore
,, Moorei, Dav.
,, rusticum, Moore
Neuropora Haimii, Desl.
,, sp.
Berenicea Archiaci, Haime
Serpula sp.
,, sp.
Apiocrinus amalthei, Quenst.
Cotylederma fistulosa, Desl.
,, vasculum, Desl.
Plicatocrinus Mayalis, Desl.
Cidaris, Edwardsii
,, sp. spines of
,, sp. ditto
Pentacrinus tuberculatus, Mill
,, robustus, Wright
,, Bronnii, Quenst.
,, moniliformis, Quenst.
Ophioderma, joints of

Within two miles of Whatley, the Middle Lias is again present under very peculiar conditions at the hamlet of Holwell. On the carboniferous limestone at this place, and extending as far as Cranmore, are deposits of conglomerate of Middle Lias age, almost undistinguishable lithologically from the older rocks, but containing organic remains, many of which have only been found in the Hierlatz mountains and at Fountaine-etoupe-four. Not only does the Middle Lias conglomerate fringe the ancient coast line at this point, but it has been carried down for great depths into the veins and fissures of the limestone, the infillings in one of the quarries occupying nearly a third the length of the section, one of the liassic veins being fifteen feet in breadth. From the side of this, about fifty feet from the surface, was extracted a block but a few inches square, containing fourteen species of gasteropoda of Middle Lias age, and all of them new to this country.

LIASSIC REMAINS AT HOLWELL.

Trochus turritus, Moore
,, labellatum, Stol.
,, gradatus, Moore
Phasianella turbinata, Stol.
Amberleya Alpinus, Stol.
Delphinula reflexilabrum, Horne.
,, nuda, Moore
Neritopsis lævis, Stol.
Nerinæa Horneri, Moore
Pleurotomaria Buchi, Desl.
Solarium lunatum, Moore
Turbo nodulo-carina, Moore
,, Mariæ, Moore
,, angulata, Moore
Avicula nuda, Moore
Opis triangularis, Moore
Lima Deslongchampsii, Stol.
,, scrobiculata, Stol.
,, sp.
Pecten Rollei, Stol.
,, verticullus, Stol.
,, palosus, Stol.
Gryphæa incurva, Sow.
Spirifera Walcottii, Sow.
,, Munsteri, Dav.
Terebratula punctata, Sow.
,, Waterhousei, Dav.
Rhynchonella furcillata, Theod.
,, concinna, Dav.
,, variabilis, Schlot.
Crustacea, claws of
Pentacrinites tuberculatus, Mill.

Holwell is celebrated for the very beautiful series of *Rhætic vertebrata* we obtained from another of its fissures.

From the foregoing description it will be seen that a remarkable variety is presented, not only in the South West of England, but wherever the Middle and Upper Lias are found. This is obvious when the beds are in the same district, and often when they are on the same horizon. When the Ilminster and the Bath districts are compared it may be accounted for from equivalent beds not being exposed.

The most complete vertical section that has been given is that by Mr. Day, in his description of the coast section in Dorsetshire. He there gives the thickness of the Middle Lias at Golden Cap at 350 feet, and the Upper Lias (including the sands) at 210 ; but it appears from his account that although the general features of his section may be recognized that they even there present variety. Although only seventeen miles from Ilminster, it is somewhat difficult to correlate the two series.

The following sections are from Mr. Day's paper :—

MIDDLE LIAS &c., AT WESTHAY CLIFF, DORSET.

		feet.
Lower Lias and sandstone with *Ammonites raricostatus*		
Middle Lias.		
1	Blue marl	30 to 40
2	Gray lias stone	12 „ 18
3	Gray marl	16 „ 22
4	Gray shale and marl	
5	The belemnite stone ..	
6	Gray marl	15
7	The green ammonite beds ..	18
8	Gray marl with ferruginous seams	73
9	"The Three Tiers." — Sandstone and marl	20

At Golden Cap the following continue above the Three Tiers :—

10	Marlstone concretions with shells	4
11	Gray micaceous marls with sandstones	160
12	Shell bed	
13	Star fish bed	
14	Gray and brown sands with nodules	70

and at Down Cliff

15	The *Ammonites margaritatus* bed	1
16	Blue marl	6½
17	Light brown sands	60
18	Blocks of indurated sand ..	8
19	Clay	18
Upper Lias.		
20	Band of stone	
21	Upper Lias clays	70
22	Yellow sands	140

A comparison of the above section with that given from Ilminster, will show how little agreement there appears between them. The leptæna clays and the saurian zone are wanting near Lyme, and the only satisfactory conclusion we can arrive at is, that the marlstone of the Ilminster section probably represent the *Ammonites spinatus* and *A. margaritatus*, 15 and 16 of Mr. Day's sections, and the brick clays at Ilminster, the brown sands below, in which as at Lyme the *A. margaritatus* also occurs.

The ocean in which the Middle Lias was deposited does not appear to have extended much beyond Ilminster to the west. Its boundary in an opposite direction, it is impossible to define, from the beds being covered up by later deposits, but that its area must have been great is arrived at by the fact, that its western boundary is continuous almost uninterruptedly from the Yorkshire coast through the midland counties to Bath and Ilminster, and thence by way of Lyme crosses over into France and Germany.

DISTRIBUTION OF ORGANIC REMAINS.

When the two groups of the Middle and Upper Lias in the districts we have noticed are compared, a change is found to occur in the lithological character of the deposits; the former being arenaceous and irony, the latter chiefly argillaceous. To this may to some extent be attributed the presence of a different fauna in the two series of deposits. In the Ilminster district the Middle Lias is crowded with fossils, but very few of the species have passed from it into the Upper Lias. One of these is the *Spirifera rostratus*, with which the lower beds are crowded, and yet we only know of one solitary specimen which lived on into the higher beds. Several species of foraminfera have also done so, but these little shells are generally known to have a very extended range.

MIDDLE LIAS OF THE CAMERTON AND RADSTOCK DISTRICTS.

The beds at the base of the series, and where they rest immediately upon the Lower Lias have yielded the following species :—

Cristellaria rotula, Lam.
,, cultrata, Mont.
Dentalina obliqua, Linn.
Nodosaria radicula, Linn.
Cidaris, sp.
Pentacrinus tuberculatus, Mill.
Serpula socialis, Goldf.
,, strangulata, Terq.
,, capitata, Phil.
Entomostraca, sp.
Crania, sp.
Leptæna Bouchardii, Dav.
,, rostrata, Desl.
Rhynchonella furcillata, Thodor.
,, rimosa, Buch.
,, variabilis, Scloth.
Spirifera rostratus, Schlot.
,, verrucosus, Buch.
Trebratula numismalis, Lam.
,, punctata, Sow.
,, Waterhouseii, Dav.
Avicula inœquivalvis, Sow.
,, sp.
Crenatula ventricosa, Sow.
Gryphæa cymbium, Lam.
,, depressa, Phil.
,, incurva, Sow.
,, Maccullochii, Sow.
Inoceramus dubius ? Sow.
Lima punctata, Sow.
,, antiquata, Sow.
Pecten textorius, Schloth.
,, dentatus, Sow.
,, cingulatus, Goldf.
,, sp.
Pinna
Plicatula spinosa, Sow.
,, sarcinula, Goldf.
Arca elongata, Quenst.
,, sp.
Astarte Oppeli, Moore
,, Camertonensis, Moore
Modiola, sp.
Myacites, sp.
Nucula, sp.
Pholadomya ambigua, Sow.
Opis clathrata, Stol.
Cerithium granuliferum, Stol.
,, Camertonensis, Moore
Dentalium gracile, Moore.
,. liassicum, Moore
,, trigonalis, Moore
Pitonillus linctus, Moore
,, turbinatus, Moore
Pleurotomaria anglica, Sow.
,, expansa, Sow.
Solarium sp.
Scalaria (Turritella) liassica
Trochus lævisculus, Stol.
,, Schubleri, Quenst.
,, morpheus, Stol.
,, torosus, Stol.
,, latilabrus, Stol.
,, concinnus, Moore
,, mammilaris, Moore
Turbo bifurcatus, Moore
,, bullatus, Moore
,, polita, Moore
Turritella anomala, Moore
Ammonites hybrida
,, Maugenesti, D'Orb.

Ammonites lineatus, Quenst.
,, maculatus, Y. & B.
,, Boblayei, D'Orb.
,, cornucopiæ
,, obtusus, Sow.
,, armatus, Sow.
Belemnites acutus, Mill.
,, compressus, Voltz.
Nautilus semistriatus, D'Orb.
Ichthyosaurus, tooth of
Hybodus, teeth of

From the scarcity of sections below the marlstone, we have only had the opportunity of collecting organic remains in the brick marls at Cross, near Ilminster. They are only found in ferruginous casts or impressions, and owing to the friable nature of the matrix are difficult to preserve, and for the same reason the specific forms are at times difficult to determine. The *Ammonites margaritatus* is specially abundant, and with it are several examples of *A. serpentinus*, which pass into the ammonite beds of the Upper Lias. There are some crushed impressions which appear to be the detached beaks of ammonites. Amongst the brachiopoda the *Rhynchonella furcillata* is common, and there are the casts of the *Argyope Suessia* of Deslongchamps, the interest of which, though in our hands for many years, we did not recognize, and also the casts of Thecidium.

Hemepedina Jardinii, Wright
Pentacrinites
Argyope Suessia, Desl.
Crania sp.
Rhynchonella concinna, Sow.
,, furcillata, Theodor.
,, tetrahedra, Sow.
Spirifera
Terebratula punctata, Sow.
Thecidium—casts
Avicula inœquivalvis, Sow.
,, species
Inoceramus
Lima acuticosta, Goldf.
Pecten, 5 species
Plicatula spinosa, Sow.
Leda elongata, Sow.
Venus pumila, Goldf.
Astarte
Cardium multicostatum, Goldf.
Modiola
Nucula complanata, Phillips
,, inflexa, Roem.
,, truncata, Quenst.
,, variabilis, Quenst.
Ammonites margaritatus, Montf.
,, serpentinus, Rein.
,, sp.
,, sp.
,, beaks of
Belemnites, 2 sp. casts
Nautilus

1 *d.* THE MARLSTONE.—In passing upwards to this horizon we come to the stone for which all the quarries are worked, both in the Ilminster district and in Gloucestershire. In the former especially, the shells stand out of the rotten sides or fissured edges of the rock in the greatest profusion. Very few vertebrate remains are present, these being rarely represented by fish teeth and an occasional vertebra of *Ichthyosaurus*, of an undescribed species. The ammonites of this zone are about eleven species in number, the *A. margaritatus* and *A. spinatus* being the most abundant, and often in fine preservation, whilst *A. Bechei*, *A. Engelhardtii*, *A. fimbriatus* and others are rare. The two former ammonites have been supposed to represent distinct horizons in the Middle Lias, but in this district they occur together, and in about the same numbers. The *A. Bechei* passes upwards from the lower beds into the marlstone, and *A. fimbriatus*, *A. variabilis*, and *A. radians*, are common to the Middle and Upper Lias, so that we cannot rely upon the precise range of these cephalopoda in our determination of geological horizons, which can be proved to apply equally to others from the lower beds. Myriads of the *Belemnites paxillosus*, with *B. compressus* and *B. breviformis*, often showing their chambered phragmacones, are present, a hand specimen of the marlstone often containing as many as twenty examples. The most characteristic shells in the Ilminster district are the *Pecten æquivalvis*, and the *Gryphæa gigantea*, which abound, and are usually very fine.

The *Brachiopoda* of the district are unequalled, and yield a greater number of genera and specific forms than any other ; many of those in my collection being the typical species figured by my friend T. Davidson, Esq., F.R.S., most of whose life has been devoted to the working out the

history of this interesting group of shells. The *Terebratula cornuta* is the most abundant and presents much variety in form. Next to it would be the *Spirifera rostratus*. The soft character of the matrix occasionally allows the spire of this shell, and also the loop of *Terebratula*, to be exposed. The *Terebratula sub-punctata* and the *Rhynchonella serrata* are only found at Moolham. The Thecididæ, another group of brachiopoda are very rare in the marlstone, but attached to the plaited exterior of a specimen of the last-named shell, there are seventeen specimens of the only species found in it, viz :— *T. Bouchardii*, *T. triangularis*, and *T. Moorei*, *Dav.* The brachiopoda, including new species found at Whatley, number about thirty species from the Middle Lias series.

The *Gasteropoda* of the marlstone are also an important and interesting class, and have yielded many new species which will hereafter be figured and described. Some of the *Pleurotomariæ* attain considerable size, one specimen in my collection being 2ft. in circumference by 7½in. in height. The *Crustacea* excepting *Entomostraca* are rare, being represented by the *Eryma Greppini* and the claws of *E. elegans* from Moolham. *Echinodermata* are also rare, as hitherto only four genera have been recognized belonging to the *Hemipedina Jardinii*, Wright, *Rabdocideris Morlandina*, Cotteau, and dismembered joints of *Pentacrinites* and *Ophioderma*.

From the marlstone at Moolham there has been obtained two species of *Amorphozoa* belonging to the genus *Cupulospongia*, De Frome, and although I have lately discovered a large series of Corals in the Lower Lias this class is to the present time represented by a single specimen of *Montlivaltia*, from the Middle Lias of Mells.

Foraminifera.—Although this very beautiful class of

microscopic shells, has been detected by Mr. J. G. Borneman in the Middle Lias of Gottingen, their presence in the English Middle Lias is now first recognized. On an examination of the exposed or friable surfaces of the marlstone it may be seen that to some extent it is composed of comminuted shells, and other organic bodies, amongst which the Foraminifera may be found not unfrequently. Nothing can well exceed the great beauty and variety of form presented by these delicate little shells, and through the kindness of my friend H. B. Brady, Esq., F.G.S., who is working at this class for publication in the Palæontographical Society, I have been furnished with drawings and descriptions of all the species in my collection from the Somersetshire Middle and Upper Lias. In the whole the marlstone yields nine genera and twenty-seven species of which not less than twenty-two species have passed into it from the Foraminifera zone of the Lower Lias of the Camerton section. The genera most abundant are *Cristellaria*, *Nodosaria*, *Dentalina*, and *Planularia*, many of the others being exceedingly rare. The genus *Polymorphina* has been found only in the marlstone of this district. All the species are given below.

Many other remains might be noticed from the horizons of the Middle Lias. Its Palæontological importance may be recognized from the fact that my collection contains a series of 183 species from the Ilminster marlstone alone, besides uncertain forms and casts of others which would still add to the list.

1 *d*.—Species from the Marlstone of Ilminster.

Plantæ, remains of
Algœ
Onychites contractus, Quenst.
,, numismalis, Quenst.
Cupulospongia, sp. De Frome
,, sp.
Cristellaria acutauricularis, F. & M.

Cristellaria cultrata, Montf.
,, rotula, Lam.
,, rhomboidea, Cyjzek.
Dentalina communis, D'Orb.
,, obliqua, Linn.
,, pauperata, D'Orb,
,, plebeia, Reuss.
Frondicularia striatula, Reuss.
Lingulina carinata, D'Orb
,, tenera, Borne.
Marginulina eusis, Reuss.
,, glabra, D'Orb
,, raphanus, Linn.
Nodosaria hispida, D'Orb
,, paucicostata, Roem.
,, humilis, Roem.
,, raphanus, Linn.
,, radicula, Linn.
Polymorphina compressa, D'Orb.
,, lactea, W. & J.
Planularia Bronni, Roem.
,, longa, Cornuel
,, pauperata, P. & J.
,, reticulata, Cornuel
Vaginulina legumen, Linn.
,, lœvigata, Roem.
Hemipedina Jardinii, Wright
Rabdocideras Morlandini, Cotteaux
Ophioderma, sp.
Pentacrinus basaltiformis, Mill
,, Bronni, Quenst
Serpula capitata, Phil.
,, socialis, Goldf.
,, sp.
Entomostraca, sp.
Eryma Greppini ? Oppel.
,, elegans, Oppel.
Bryozoa, sp.
Crania, sp.
Lingula, sp.

Rhynchonella acuta, Sow.
,, furcillata, Theod.
,, serrata, Sow.
,, tetrahedra, Sow.
,, sub-tetrahedra, Dav.
,. sub-concinna, Dav.
,, variabilis, Schl.
Spirifera rostratus, Schl.
,, Munsterii, Dav.
Terebratula corunta, Sow.
,, quadrifida, Lam.
,, Edwardsii, Dav.
,, resupinata, Sow.
,, Moorei, Dav.
,, numismalis, Lam.
,, punctata, Sow.
,, sub-punctata, Dav.
Thecidium Moorei, Dav.
,, Bouchardii, Dav.
,, triangularis, D'Orb.
Avicula cygnipes, Phil.
,, inœquivalvis, Sow.
,, novem costæ, Brown
Anomia oxynoti, Quenst.
Gryphæa gigantea, Sow.
,, depressa, Phil.
Hinnites velatus, Goldf.
,, sp.
Lima Deslongchampsii, Stol.
,, punctata, Sow.
,, acuticosta, Quenst.
,, antiquata, Sow.
,, sp.
Ostrea ocreata, Desl.
,, monoptera, Desl.
Pecten œquivalvis, Sow.
,, dendatus, Sow.
,, textorius, Schlot.
,, Rollei, Stol.
,, cingulatus, Goldf.

Pecten several sp.
Perna antiquata, Moore
Pinna Hartmanni, Ziet.
Plicatula spinosa, Sow.
,, sarcinula
Astarte sp.
Arca elongata, Quenst.
Cardinia crassissima, Stuch.
,, concinna, Stuch.
,, Partschi, Stol.
Cardita liasiana, Moore.
,, multicostata, Phil,
Cardium truncatum, Sow.
Cucullæa bilineata, Moore,
,, transversa, Moore
,, Munsterii, Goldf.
Cypricardia cucullæata, Goldf.
,, intermedia, Moore
Hippopodium ovalis, Moore
Isocardia liassica, Moore
Modiola cuneata
,, numismalis, Oppel.
,, ornata, Moore
Myacites unioides, Goldf.
,, longissimus, Quenst.
,, donaciforme?
,, sp., several
Opis, sp.
Myoconcha crassa ? Sow.
Pholadomya ambigua, Sow.
,, several sp.
Solen liasinus, Oppel.
Sanguinolaria striata, Stutch
Unicardium cardioides, Phil.
,, globosum, Moore
Tellina, sp.
Actæonina Ilminsterensis, Moore
Cerithium coronatum, Moore
,, gradatum, Moore
,, liassicum, Moore
,, pyramidalis, Moore
Cerithium costulatum, Desl.
,, asperulum, Moore
Chemnitzia Hierlatzensis, Stol.
Cylindrites Whitfieldii, Moore
Dentalium giganteum, Phil.
Nerinœa liassica, Moore
Phasianella turbinata, Moore
Pleurotomaria anglica, Sow.
,, tuberculato-costata, Munster
,, heliciformis
,, costulatum, Moore
,, expansa, Sow.
,, rotellœformis
,, gigas
Purpurina ornatissima, Moore
Solaruim crenatulum, Moore
,, costulatum, Moore
Trochus imbricatus, Sow.
,, granuliferus, Stol.
,, lineatus, Moore
,, Pethertonensis, Moore
,, flexicostatus, Moore
,, nodulatus, Moore
,, carinatus, Moore
,, Rutteri, Moore
,, auvernus, Stol.
Turritella (Scalaria) liassica
Turbo Bertholeti, D'Orb
,, lineatus, Moore
,, elegantissima, Moore
,, coronatus, Moore
,, linctus, Moore
,, rugifera, Moore
,, Ilminsterensis, Moore
,, Escheri, Goldf.
,, heliciformis, Ziet.
Ammonites margaritatus, Montf.
,, fimbriatus, Sow.
,, spinatus, Brug.
,, Engelhardtii, D'Orb.

Ammonites maculatus, Y. & B.
,, radians, Rein.
,, heterophyllus, Sow.
,, valdani, D'Orb.
,, serpentinus, Rein.
,, Bechei, Sow.
,, variabilis, D'Orb.
Nautilus semi-striatus D'Orb.
Nautilus obesus, Sow.
Belemnites compressus
,, breviformis, Voltz
,, paxillosus, Schlot.
Ichthyosaurus vertebræ, n. s.
Hybodus, teeth of
Lepidotus, scales

THE UPPER LIAS.

With the exception of "rotten stone," which is silicified vegetable matter, almost every organism yet detected in the Middle Lias is of marine origin, but the evidence of these drifted fragments of trees shews that dry land was probably not far removed. Except from the rare but occasional admixture of terrestrial with marine remains we should have little, if any, evidence that dry land had anywhere appeared. This is not so much to be wondered at when it is considered that our vegetable soil of but a few inches thick, represents a period to be measured only by thousands of years, and how readily, should a submergence of the present land area take place, all traces of its ever having been in existence might be obliterated; but that land existed, and more especially on the margins of the seas which succeeded the Middle Lias there is abundant evidence.

Numerous and varied as was the fauna of the age we have been considering, we now arrive at the fact that with but few exceptions it ceased to exist, and a new order of things and of organic life succeeded. Life and death, through all time has been the wise provision of the Almighty for

"Where He vital breathes there must be joy"

and from every change He is

"From seeming *evil* still educing *good*,
And better thence again, and better still,
In infinite progression."

It is not only a privilege, but a work of the greatest interest to the geologist to endeavour to realize to himself the physical and other conditions under which the earth has passed, and to endeavour to interpret each succeeding page of the great book of nature, in doing which he cannot but be struck with the wonderful variety and beauty of the organic beings, which at its several epochs have had their places upon the globe, again in their turn to make room for others and disappear for ever.

Perhaps at no other place can the great stone book be thus more readily read than in the thin bands of clay and stone, which compose the few feet forming the Upper Lias of the neighbourhood of Ilminster.

On referring to the section at p. 132, the succession of the beds and their thickness are given. Insignificant as they appear, they yield to none in Palæontological interest. It was a remark of Dr. Buckland, that "almost every particle of the earth we tread on was once living." It is certainly true that the hills around Ilminster are, in great part, composed of organic remains, many of which are unequalled for the beautiful condition in which they are found. Although it may be the case, that some species pass through all the Upper Lias beds, or may be common to several of them, still, each thin layer of which they are composed has a special zoological character, and differs slightly lithologically, indicating that they were slowly deposited, and that genera and species being peculiar to such thin layers, their deposition may represent in time, in this district at least, the life of such genera or species.

We propose dividing the Upper Lias into the following stages, in ascending order, and noticing some of the beds and their organic contents more minutely, viz. :—

A. The Leptæna Beds.

B. The Saurian and Fish Zone.

C. The Upper Cephalopoda Beds.

The Leptæna Beds.—No. A, *a* to *e*, of the general section are composed of thin bands of different coloured clays, 18 inches thick in the Ilminster section, and represent the thicker clays under the saurian and fish bed in Gloucestershire. They lie immediately upon the marlstone, and are therefore the basement beds of the Upper Lias. Under favourable circumstances, when this zone is not disturbed by compression into the fissures of the marlstone, it may be divided into—

A a.	Zone of	*Leptæna Bouchardii, L. Moorei, &c.*
b	„	ditto ditto
c	„	*Thecidium rusticum, &c.*
d	„	*Alaria unispinosa*, and other univalves.
e	„	*Spirifera? Ilminsterensis, Zellania liassica, Leptæna granulosa.*

With the termination of the marlstone and the extinction of many of its species, there appears to have been a period of rest before the new order of deposits succeeded. Immediately upon the marlstone, the first band of the leptæna clays rests. They are so denominated from the fact, that some years since we discovered in them six species of the genus *Leptæna*, which was supposed to have disappeared with the Palæozoic epoch. These consist of the *Leptæna Bouchardii*, Dav., *L. Moorei*, Dav., *L. liasina*, Bouch., *L. Davidsonii*, Desl., *L.? Pearcei*, Dav., and *L. granulosa*, Dav. A great hiatus still remains between the Upper Lias and the more ancient beds in which they may yet be detected. One step in this direction is advanced by finding the *L. rostrata*, Desl., in the Middle Lias at Whatley and in the Lower Lias of Munger, near Paulton.

A a. The first zone of the leptæna beds consists of a clay of a yellowish or golden tint from one to two inches thick, which adapts itself to the hollows and inequalities of the marlstone on which it rests. Its slow deposition is to be inferred from the fact, that it is in great part composed of myriads of spines and plates of microscopic echini and other remains. Amongst these the brachiopoda, including the first three species of leptæna above mentioned, are of most interest, and there also for the first time appear with them in abundance, the *Terebratula globulina*, Dav., and the *Rhynchonella pygmæa*, Dav. The *Thecidium rusticum*, Moore, also first appears, but is exceedingly rare. Six genera of *Foraminifera* are present in this bed, but they are also very rare, most of them being represented by but two or three individuals. Under the new order of deposits, fish and other vertebrata appear scarcely to have taken possession of the water, though just above there is evidence of their presence in increasing numbers. Thirty species are present in this thin bed, most of which, excepting the *Foraminifera*, which have passed into it from the Middle Lias seas, make their first appearance.

A b. This bed consists of a variegated clay about an inch thick. The *Leptæna Moorei* is present though more rarely than immediately below, whilst the *L. Bouchardii* and the *Thecidium rusticum* are more abundant; echini are also less frequent. In this band only two species of foraminifera—the *Planularia cornucopiæ*, Brady, and *Cristellaria rotula*, Lam., have been found, together with *Terebratula globulina*, *Rhynchonella pygmæa*, *Nucula*, *Entomostraca*, casts of several small univalves, and traces of fish scales, a much smaller list than that from the last bed.

A c. A brownish clay four inches thick, designated the *Thecidium rusticum* zone, from that shell having here its

greatest development. With the increase of this little brachiopod, those which first appeared in the lower zones as we pass upwards through these few inches of clay become more rare, and we now find that the *Rhynchonella pygmæa*, and the *Leptæna Moorei* have all but disappeared and we have never found them in the zone above. For the first time we notice the *Leptæna granulosa*, Dav., a species of great rarity, and only found in this and the three bands above. Detached *Aptychi*, with *Ostrea*, *Pentacrinites*, two species of foraminifera, and a few fish scales complete the list of remains from this bed.

A d. A bed of greenish clay two inches thick, in which are found a great number of the flattened casts of univalves, owing to which they cannot very satisfactorily be determined. The *Alaria unispinosa*, Moore, whence we designate this zone, is a very pretty and an abundant shell. Several valves of *Chiton unilobatum* (the *Peltarion* of M. Deslongchamps) have been obtained from it, and are also found in the ammonite beds above the fish and saurian zone.

A e. f. These beds having the same general character may be considered together. They are six inches thick, composed of a greenish clay. A circumstance to be noticed respecting them is, that they are separated about the middle by a thin irony band, and it is not a little remarkable as showing the persistent character of deposits of the same age over widely separated areas, that the same thin irony film is present in the Gloucestershire beds and has been noticed by the Rev. F. Smithe, M. A., in the Churchdown beds, in the Journal of the Cotteswold Club. In these bands we have the appearance of two new brachiopoda. One of them a new genus, the *Zellania liassica*, Moore, but which we have lately found in the Lower Lias, and the

Spirifera ? Ilminsterensis, Dav., which has never been found elsewhere. The *Thecidium rusticum* which has been traced upwards now becomes scarce, and has never been found above the leptæna clays, and such is also the case with the *Planularia cornucopiæ.* Flattened impressions of ammonites are abundant, and nearly so their *Aptychi.* In the Gloucestershire sections fish remains are frequent in these clays, but in those of Somersetshire vertebrate life is rare, forming a most marked contrast to the conditions under which the beds next to be considered were deposited.

ORGANIC REMAINS OF THE LEPTÆNA BEDS.

Algœ
Seeds and plant remains
Cristellaria acutaricularis, F. & M.
,, cultrata, Montf.
,, rotula, Lam.
Dentalina filiformis, D'Orb.
,, obliqua, Linn.
Flabellina rugosa, D'Orb.
Frondicularia striatula, Reuss.
Lituola cenomana, D'Orb.
Lingulina carinata, D'Orb.
Marginulina eusis, Reuss.
Nodosaria raphanus, Linn.
,, paucicostata, Roem.
,, hispida, D'Orb.
Planularia cornucopiœ, Brady.
,, Bronni, Roem.
Vaginulina striata, Reuss.
Pseudodiadema Moorei, Wright
Echini, sp.
Ophioderma, sp.
Pentacrinus, sp.
Serpula, sp.
Crustacea, claws of
Entomostraca, sp.
Coleoptera, wing of
Discina orbicularis, Moore
Leptæna Bouchardii, Dav.
,, liasiana, Bouch.
,, Moorei, Dav.
,, granulosa, Dav.
,, Davidsoni, Desl.
,, Pearcei, ? Dav.
Lingula, sp.
Rhynchonella pygmæa, Dav.
Spirifera? Ilminsterensis, Dav.
Terebratula globulina, Dav.
Thecidium Bouchardii, Dav.
,, Moorei, Dav.
,, triangularis, D'Orb.
,, rusticum, Moore,
Zellania liassica, Moore
Avicula pygmæa, Moore
Inoceramus dubius, Sow.
Lima, sp.
Ostrea, 2 sp.
Perna dubia, Moore
Plicatula sarcinula? Goldf.
Arca, sp.
Astarte
Cardita, sp.
Nucula, sp.
Alaria unispinosa, Moore

Cerithium, cast
Chiton unilobatum, Desl.
Melania, cast
Nerinæa, cast
Turbo, casts
Turritella, casts
Ammonites annulatus, Sow.
„ bifrons, Brug.
Ammonites Raquinianus, D'Orb.
„ communis, Sow.
„ serpentinus, Rein.
„ fimbriatus
Leptolepis
Hybodus, tooth
Fish scales
Ichthyosaurus, tooth of

B. THE SAURIAN AND FISH ZONE.

Whatever may have been the case with the leptæna clays, that the saurian and fish bed was deposited in an estuary there can be little doubt, since thousands of insects of this remote age were driven from the adjoining land, and settling upon the muddy surface, left by the ebbing tide of the surrounding ocean, were entombed, and their remains preserved through succeeding ages to this time, and with them are occasional fruits and vegetables which point to the same conclusion. Included in this zone are the beds of clay which surround the fish bed. The lowest has a thickness of three inches, the upper about the same. The yellow limestone or the fish bed proper, is at Ilminster, from three to six inches thick, except when it encloses any particular organism, when it usually takes a nodular form and is increased in size. At Rimpton and in the Gloucestershire sections the bed is often much thicker.

In passing upwards from the lower clays into that under the fish bed most of the mollusca have disappeared, and we find, though rarely, dismembered pentacrinites, echini, and star fish, foraminifera of three genera, with small pecten, ostrea, bryozoa, and entomostraca. *Vertebrata* now take possession of the water, and the bed below the limestone is in a large proportion composed of coprolitic matter and the scattered bones and scales of fish.

There is probably no other six inches of the earth's

crust in which are centered such a remarkable fauna, as in the saurian and fish bed, and in which the remains are in such a wonderful state of preservation. The bed in which they lie has been most conservative, and as Hugh Miller remarked of the old red fishes they have "caught no harm under its care," and seem almost to be things of life. When the upper ammonite beds are quarried and removed down to this zone, the saurian bed is seen to occur in irregular elongated or rounded patches, sometimes extending to some distance, and presenting a flattened pavement-like appearance, yellow externally, but sometimes bluer within. From contraction the bed is divided vertically in every direction into small blocks, not unlike septaria, but without any subsequent infiltration into the cracks, by which they were again united.

The larger and more important saurians and fishes are found in separate nodular masses. The marlstone below is much fissured, and there is a corresponding modification of the beds above. Although generally horizontal they are slightly compressed into the lines of fissure, giving on a small scale an appearance not unlike the pipe veins in the chalk. Whenever the beds cross one of these frequent lines of fissure, "gullies" are produced, and in them the separate nodules containing organic remains are most usually found. Such nodules are generally considered concretionary, but it is not the case in this instance as they have regular horizontal laminæ, and within them the little leptolepis, insects, and other remains are found, which, if they had been simply concretionary, could not have happened. It is not improbable some of the saurians and fishes may have met their death by being caught or overwhelmed in these fissures, for in two instances we have Teleosauri with their slender heads and jaws

almost erect as though they had been suffocated in an effort to disengage themselves. The great destruction of life at this period seems to have been caused by the sudden irruption of mud into the estuary or sea.

It is evident that the fish bed then deposited was not afterwards subject to any very violent denuding action; the mechanical force of the waves, seems to have been only equal to the effect of wearing down the nodules, so as to present in many cases a stony outline of the organisims they enclose and of shifting then into the little "gullies" to which we have alluded. It often happens that a delicate portion of a jaw or fin has been left protruding from the nodule without having been abraded. The rippling action of the waves seems also to have been exerted chiefly on the upper surface of the fish bed, its under side usually retaining a more flattened form. The nodules might in many cases be compared to various forms of tea cakes, or to slightly contorted loaves of bread. It would be as though a young crocodile or a recent fish was taken and wrapped in a slight covering of dough or cement the outline of the specimen being to some extent preserved. This is most singularly exhibited when an Ichthyosaurus or a Teleosaurus happens to be imbedded. In this case the nodule containing the head of the specimen tapers to the point of the snout; the base of the head being the thickest, is the broadest, and most raised. Below it, at the sides would most likely be found two lateral projections, indicating the position of the anterior paddles. The nodule then takes the rounded form of the enclosed body, until the tail is reached, and then as this diminishes in size there is a corresponding decrease in the stony matrix, until it again comes to a point. When a specimen is enclosed of greater size or length than usual, it is invariably sep-

tarian. A nodule containing an Ichthyosaurus for instance, might be divided into twenty or more pieces, some of the sections being separated almost as smoothly as though they had been cut through by a mason's saw. Prior to working it out it only requires washing and sticking together with cement to restore the original form. The outer shape indicates to the practised eye the generic and almost the specific character of the specimen enclosed, though no portion of it is visible. When a nodule contains a *Pachychormus*, the large size of the head of that fish shews the position in which it lies, whilst one containing the remains of a cuttle fish is comparatively flatter, more oval and uniform in shape. It must not be supposed that every Upper Lias nodule contains a specimen, or that they are plentiful, on the contrary, though for so many ages hundreds of saurians and fish have been lying undisturbed within a few feet of the surface of the Ilminster hills, yet it is very rarely that one comes to light, owing to the best localities being closed, and to the very little fresh ground opened up. Thirty years since, when all the roads were repaired with marlstone, would have been the geologist's harvest, for where one load is now extracted there were then many hundreds.

THE ICHTHYOSAURUS ACUTIROSTRIS?—All the specimens of this genus from the district we have described belong to one species, and are not improbably to be referred to the above, which has been found in the Upper Lias of Whitby, and at Boll in Germany, though the same species is quoted by Mr. Hawkins, from the Lower Lias of Street. We are not acquainted with any figures of the Upper Lias species, so that the conclusion must not be supposed definitive. Our species possesses a short head,

with a large cranium, and with a short jaw rapidly tapering to a point. The teeth are comparatively small, close-set and slightly curved. The eye is large, rounded or slightly oval, with its sclerotic plates usually uncompressed. The eyes of the first Ichthyosaurus we discovered had tumbled out of their sockets, and were lying separated from it in the clay, and were at first mistaken for ammonites. Until lately no specimen had been found in the Upper Lias of the South West of England but at Ilminster, but on lately attending a meeting of the Cotteswold Naturalist's Club at Dumbleton, we had the gratification of determining that saurian remains are also present in the Upper Lias of Gloucestershire. On entering the Dumbleton quarry our attention was attracted by a large nodular section of the saurian bed in the debris, which contained a portion of the body of an Ichthyosaurus. Some other portions were subsequently found, which were left to enrich the collection from the Upper Lias already formed by Miss Holland. In the railway cutting between Stroud and Nailsworth, the saurian bed is also present and from it we obtained a small jaw of Ichthyosaurus.

In the Dumbleton case, as at Ilminster, the saurian was in a number of detached sections, and unless these are all secured the specimen must be incomplete. We have seen an instance in which an Ichthyosaurus has found its long resting place over one of the "gullies," when a portion of it was lying in the undisturbed horizontal bed, and that part of it would be the first found, still without careful search and constant watching the completion of the specimen would be doubtful, but as the quarry was worked down the other portions of the specimen were extracted bit by bit in the fissure of the marlstone into which the beds had been compressed.

THE SKIN AND FOOD OF THE ICHTHYOSAURUS.—In a paper published in the Geological Journal for May, 1853, by Mr. Cole, that gentlemen stated that in cleaning an Ichthyosaurus he occasionally observed layers of carbonaceous looking matter, which on microscopic examination showed numerous black points having a resemblance to teeth, that he had arrived at the conclusion that these dark patches formed part of the integument of the Ichthyosaurus, and that the teeth-like bodies were minute spines with which the body of the creature was covered, and my late friend Professor Quekett, gave a plate with enlarged figures of the spines confirming this view. My attention being directed to the point, I examined the Ichthyosauri in my museum, and found that in not less than seventeen of them this carbonaceous looking matter, or scattered hooks like those mentioned could be traced. On examining these black patches with the lens, it was found that they were almost wholly made up of these minute bodies. Supposing them to have been portions of the skin, they would be expected to be found on any part of the Ichthyosaurus, instead of which, in every instance, they were in the stomachs of these ancient saurians. The conclusion was therefore forced upon me that they could have no connexion with the skin of the Ichthyosaurus, but rather that they formed part of the food of the animal. Contemporaneously with these creatures, there were living a number of naked cephalopoda allied to the cuttle fish of the present day, and it was to them I looked for a solution of the question. Although in some formations—the Oxford Clay for instance—the fleshy arms of the *Belemnoteuthis*, and the *Geoteuthis* are preserved, these hooks had not at this time been found in connexion with the cephalopoda of the lias, but on an examination of the clays of the lias, several

kinds were detected. There is no doubt therefore that the cuttle fishes and allied genera were devoured by the Ichthyosauri in great numbers, if we may judge by the immense numbers of their horny hooks still retained within their stomachs, and there can be no doubt the dark inky matter with which they are associated was the once fluid ink of these ancient fishes. In one example in my museum the ink may be taken from under the ribs of the saurian, and though such an enormous time has elapsed since it formed part of the food of the Ichthyosaurus, it is found still to retain its colouring properties and may be used instead of sepia, and I have also lately extracted from a coprolite a perfectly preserved beak of cuttle fish.

Were the foregoing not conclusive on this point, the wonderful preservation in which the Upper Lias saurians are found would afford sufficient evidence. It is not often the softer parts of extinct animals are preserved, but from the Upper Lias there have been instances in which I have had to cut through the outer integument of the Ichthyosauri in order to clear their skeletons, which may now be seen lying upon their under skins which can be traced almost uninterruptedly throughout their entire length. The animals are usually uncompressed and the line of skin fringes the vertebral column and the paddles in proportion to the thickness of the flesh which has perished. Cuttle fish ink and hooks are in almost every instance within their stomachs, but none of the latter were ever attached to the skin. This retains its purplish gray tint, and possesses a wrinkled texture very similar to that of the porpoise of the present day.

It is a curious fact, and one we believe that has not previously been noticed, that whilst the Ichthyosauri appear in liassic times to a great extent to have fed on the naked

cephalopoda, others of this family in their turn retaliated. In several instances, which were probably those of *dead* saurians, their bodies were covered by colonies of ammonites, which were evidently preying upon them before they were finally entombed, and in order to clear their skeletons from the matrix, we have had to cut through them before they could be reached.

The Teleosaurus temporalis, *Blainville.*—This is the only other saurian yielded by the Upper Lias of this district, though in the alum shales of Whitby, the *Teleosaurus Chapmanii* of much larger size, with the *Plesiosaurus brachycephalus* are found. The remains of Teleosauri appear to be more frequent in the saurian and fish bed than those of Ichthyosauri, for during the time we have been working at the Upper Lias, ten examples have been noticed, some of which are very perfect. There is a portion of this saurian from the Tesson collection, in the British museum, which was found in the same bed in Normandy. The largest specimen from Ilminster indicates a saurian of about six feet in length. Another with a small part of the caudal vertebræ wanting, measures only thirteen inches in length, and when perfect could scarcely have exceeded eighteen inches, and is probably the smallest Teleosaurus known. As its discovery was quite accidental, and as it is a very beautiful specimen its history is given. On carelessly striking a piece of the yellow limestone of the saurian bed, which was lying on a heap of the marlstone, with the hammer, a small portion flew off exposing a fragment of bone, which on examination proved to be part of the jaw of a little saurian, the continuation of which, after a lengthened search, was found in another block. Several months was occupied with its development, and when finally cleared the cervical vertebræ

leading to the edge of the stone indicated that its body might have been found in another block, and the quarry was again repaired to with the hope of finding it, but without success. Some months again elapsed when, as a last hope, it was considered possible the body might still be lying in its original bed in the section.

With the block containing the head the quarry was again sought and it was fitted to the exposed edges of the saurian and fish bed until a piece was found which joined on somewhat roughly, but which, notwithstanding, was supposed to contain the body of the little specimen. On working down below the point where the skeleton should have shown itself no part was visible, and it was thought after all the labour had been lost. Turning the block on edge and endeavouring to split it, a bit of bone not larger than a pin, belonging to one of the lower limbs was exposed, and working away from this indication we were led on to the body, which, with its vertebral column, is still covered up by its undisturbed bony scutes, with which, like the gavial of the present day, to which it is closely allied, this little crocodile is furnished, and by these fortunate incidents we were enabled to complete one of the most beautiful little specimens ever discovered. The head and neck had been dislocated and slightly removed from the body before it was covered up, which prevented its continuation from being traced in the block. Whilst engaged in slowly clearing its body a part was reached where the scutes gave way under the chisel, owing to the matrix being less consolidated, and as this was supposed to be the position of the stomach of the little creature we felt much curiosity to look therein for evidences of its food, which, as in the case of its contemporary the Ichthyosaurus, we were at last enabled to determine. In the waters with the

Teleosaurus, a little fish of the genus *Leptolepis* abounded, and when it was sufficiently cleared we found one of these fishes lying undigested in the stomach of the little Teleosaurus, the last meal it had eaten countless ages ago.

Fishes of the Upper Lias.—Equally perfect with the reptilia just mentioned, when removed from their stony sarcophagi, are the fish of the yellow limestone. In some instances they are still as round and uncompressed as if they had just been taken from their native element. Of the larger predacious ganoid fishes, the *Pachycormi*, are the most common, and are probably represented by six species. The *P. macropterus*, Ag., attains the largest size, and reaches $2\frac{1}{2}$ feet in length, whilst the *Lepidotus gigas*, Ag., reached the same size, and was not uncommon. Of the genus *Eugnathus*, three examples only, with little more than their heads preserved have been found, whilst still more rare are the genera *Dapedium* and *Pholidophorus*, which are represented in my museum by a single head of each genus. On the contrary, the little *Leptolepis* must have existed in the Upper Lias seas in shoals, and no doubt formed the staple food, not only of the Teleosaurus, but of the predacious fishes just mentioned.

Pachycomus macropterus, Ag.
„ curtus, Ag.
„ gracilis, Ag.
„ latirostris, Ag.
„ latipennis? Ag.
„ sp.
Eugnathus chirotes? Ag,
Lepidotus gigas, Ag.
Pholidophorus, sp.
Leptolepis constrictus, Egerton
„ concentricus, Eg.
„ Bronni, Ag.
„ sp.
„ sp.
Dapedium, sp.
Hybodus, teeth of

Cephalopoda of the Saurian and Fish Bed.—The most noteworthy of this class are the naked cuttle fishes of the genera *Geoteuthis*, Munst., and *Teudopsis*, Desl. Almost every second nodule, containing organic remains

from this bed, would probably yield one or other of the above, so that they must have been very numerous, and it has been previously shown that they formed the chief food of the Ichthyosauri of this period. The softer parts of these cuttle fishes have perished, leaving only the internal cuttle bone, in the centre of which the ink bag is usually found, still charged with its black pigment. It is rarely any traces of their fleshy arms, with their suckers and horny hooks are found attached, though the latter are often found scattered on the surfaces of the limestone. The *Belemnitidæ* in this bed are very rare. Several minute forms from it, associated with ink bags, are at present in the hands of Professor Phillips, F.R.S., who is completing a monograph on this class for the Palæontographical Society. The *Ammonites* include the *A. fimbriatus*, *A. serpentinus*, *A. radians*, *A. complanatus*, *A. communis*, and *A. Raquinianus*, and in many instances, even though they may be microscopic, they still retain within their outer chambers their *Aptychi* which served as an operculum. Seven varieties of this body are present in this bed, a special form belonging to each separate species of ammonite. We gave a notice of the Aptychus in the "Proceedings" for the year 1851.

Insecta of the Saurian and Fish Bed.—The interest attaching to the discovery of insect life in periods so remote is at all times considerable, and with those from the Upper Lias it will not be less so, from the fact that my collection consists of more than 1000 specimens, and will include many genera and species. Their description needs a special study, and would be a work involving much labour, and it is a matter of regret that hitherto I have been unable to place them in the hands of any gentleman who has sufficient courage for the task. The Rev. P. B.

Brodie, F.G.S., has given figures of several species from the Upper Lias of Dumbleton. The families represented at Ilminster include the *Libellula*, *Neuroptera*, *Orthoptera*, *Homoptera*, *Diptera*, and *Coleoptera*.

For the discovery of insects as well as for any small organisms, it is necessary to break up the bed and carefully examine the surface of its laminæ. Some hundreds of tons have been broken up in this way to furnish the fauna under notice.

Crustacea of the Saurian and Fish Bed.—With the varied fauna previously enumerated, the thin band of stone under consideration has also yielded not less than six genera and nine species of crustacea. They have been for some time in the hands of my friend Henry Woodward, Esq., F.G.S., of the British Museum, for description, who has kindly furnished the following notes respecting them. A point of considerable interest concerning them is, his determination that the specific forms which occur at Ilminster, in the Upper Lias, recur in the lithographic slate of Solenhofen, one of the upper members of the oolite.

"The first systematic account of the Jurassic Crustacea was published by our late lamented friend Dr. Albert Oppel, Professor in the University of Münich, and Conservator of the Palæontological Collections in that city, (entitled "Ueber Jurassische Crustaceen (Decapoda macrura)," being Part I. of his "Palæontologische Mittheilungen," Stuttgart, 1862.)

In this work he gives a list of all the Macrouran Decapods (*i. e.* the lobsters and shrimps) from the Lower Lias up to the Lithographic Stone, the summary of which

I append, as serving to illustrate the distribution of this class in the oolitic and liassic series.

Published in 1862. Number of	LOWER LIAS.	MIDDLE LIAS.	UPPER LIAS.	INFERIOR OOLITE.	BATH OOLITE.	KELLOWAY ROCK.	OXFORDIAN.	KIMMERIDGE GROUT.	LITHOGRAPHIC LIMESTONE.
GENERA ...	5	3	4*	2	1	5	5	3	21
SPECIES ...	10	8	4*	7	3	12	14	8	70

Decapoda. Macrouro.

Actual Number of Genera 24

Actual Number of Species 136.

To this summary many additions must now be made. Of the 136 species given, *none are recurrent*, but of the 24 genera, 8 are widely ranging forms.

Thus the genus *Eryma*, Meyer, occurs in the Middle Lias, the Lower and Upper Oolite, the Kelloway Rock, the Oxford and Kimmeridge Clays, and the Lithographic Stone.

Species of the genus *Glyphea*, Meyer, were known to occur in every section of the lias and oolites, *except the Upper Lias*.

The genus *Eryon* is found in the Lower and Upper Lias, the Oxfordian and Lithographic series.

I now propose to enumerate all the forms known to occur in the Upper Lias limestone of Ilminster, determined from specimens sent me for examination by Charles Moore, Esq., F.G.S.

ERYON.—*Desm.*

The largest consists of an almost entire, but much mutilated, specimen of *Eryon*, the carapace of which would have been 3 inches in length and more than 2 inches in breadth ; the abdomen $3\frac{1}{4}$ inches in length and 2 inches in

* By additions from Ilminster given below, these are increased to 9 Genera and 14 Species. June, 1867. H. W.

breadth. It differs in its proportions from *E. Barrovensis* only in the greater length of the fore arm, in which character it resembles *E. antiquus*. Should more remains be found, it may be specifically separated, meantime I prefer to refer it to *E. antiquus?* with a note of interrogation, (see Quart. Jour. Geol. Soc., vol. XXII. p. 500.)

The other specimens of *Eryon* consist of detached limbs, portions of body segments or carapaces, too fragmentary to be of more than generic value. The most interesting of this genus is the *Eryon Moorei, (mihi)*, described in Quart. Jour. Geol. Soc., vol. XXII. p. 499, pl. XXV. fig. 3. It is one of the best preserved specimens from this formation.

PALINURINA.—*Münst.*

Three species of this curious genus are known to occur in the lithographic stone of Solenhofen. It is at once distinguished (like its recent homologue *Palinurus*) by the great development of its antennæ, (which are usually more than double the length of the entire body of the animal), by the large size of the three first joints of the same organs, and by the absence of chelæ in the thoracic limbs which are all monodactylous in the fossil species. These generic peculiarities are well seen in one of the specimens of *Palinurina longipes*, Münst.

I have examined two imperfectly preserved examples of this genus, from Ilminster, and from their measurements I have referred them to the *Palinurina pygmæa*, of Münster. Length of abdomen 4 lines; length of cephalothorax $3\frac{1}{2}$ lines. Breadth of cephalothorax and abdomen, both 2 lines. The abdominal segments are porcellanous and ornamented with exceedingly minute tubercles upon their dorsal surface.

PALINURINA LONGIPES.—*Münst.*

The impressions and counterparts of four examples of this genus, much larger than those which I have attributed to *P. pygmæa*, have decided my adoption of a second species, and I have accordingly determined them to belong to the *P. longipes?* of Münster, but as they are only imperfectly preserved, it would perhaps be more correct to add a note of interrogation after the specific name. Length of cephalothorax and abdomen, 11 lines, breadth of same, 3 lines. Length of antenna preserved, 13 lines, length of one of the thoracic limbs, 6 lines.

PENAEUS.—*Fabricius.*

The remains of two individuals apparently belonging to this genus have been found by Mr. Charles Moore, at Ilminster.

They agree very closely in size with the *Penaeus latipes*, of Oppel, and until more perfect remains occur to warrant a change, I propose to refer them to that species. Length of cephalothorax, 1 inch 7 lines, depth 11 lines. Length of abdomen $2\frac{1}{2}$ inches. Depth of segments $\frac{1}{2}$ inch. The surface of both the cephalothorax and abdomen has been covered with a light brown-coloured glistening enamelled shell as thin as that of the modern *Palæmonidæ*.

ERYMA, *Meyer.*—(Glyphæa, Münster.)

The genus *Eryma* is most widely distributed, being found in the Middle Lias, and thence ranging up to the lithographic limestone. It was only absent from the *Upper Lias*. This *hiatus* has been supplied by Mr. Charles Moore's collection.

I have identified a carapace, and a chela with Oppel's *Eryma elegans*, some detached chelæ with Oppel *Eryma Greppini?* and certain others may be the chelæ of *E. fuciformis*, or one of the other smaller species of the genus *Eryma*.

ERYMA ELEGANS.—*Oppel.*

The surface of the carapace is evenly turberculated, the gastric, cardiac, hepatic, and branchial regions, are surrounded by well defined sulci, the two principal of which, passing over the dorsal surface of the carapace, unite with the hepatic furrows on either side near the margin. Length of carapace 2 inches, breadth at widest part, from the median line to the lateral margin, 1 inch.

A well-preserved hand (No. 28) probably belonging to the same species (*Eryma elegans*, Oppel) measures from its articulation with the wrist to the extremity of the fixed ramus of the pincer, 17 lines; its greatest breadth is 7½ lines; the length of the ultimate joint or moveable finger is 10 lines. The tuberculation of the surface of the chelæ is less strong than that of the carapace, but the specimen appears to have been somewhat rubbed, or scraped, in developing it from the matrix.

HEFRIGA.—*Münster.*

Remains of five examples of a minute shrimp-like crustacean (measuring about 10 lines in length) have also been met with in the Upper Lias of Ilminster by Mr. Charles Moore.

From a careful examination of these specimens I am enabled to refer them to Münster's genus *Hefriga*, but I prefer deferring its positive specific determination in the hope that more perfect remains may be found. It agrees most nearly with the *Hefriga Frischmanni* of Oppel, from Solenhofen.

GLYPHEA.—*Meyer*, sp.

Remains also occur of a small species of *Glyphea*, the carapace of which measures 8 lines in length, and agrees in the finely granulated character of its surface with the

Glyphea Heeri, of Oppel from the Lower Lias. It was found by Mr. Moore at Ilminster, and is of the age of the Upper Lias.

Conclusion.—The species of Crustacea already known and described as occurring in the Upper Lias are as follows :—

I.	1.	Eryon Hartmanni, Meyer	U. Lias,	Wurtemburg.
	2.	,, Edwardsi, Morière	,,	Calvados, France.
	3.*	,, antiquus ? Brodp., sp.	,,	Ilminster (H. Wodw.
	4.*	,, Moorei, H. Woodw.	,,	Ditto ditto
II.	5.	Magila Bonjouri, Etall	,,	Les Nans, Jura.
III.	6.	Uncina Posidoniæ, Quenstedt.	,,	Franconia, Germany.
IV.	7.	Pseudoglyphea stricta, Etall	,,	Corlée, France.

The genera and species now added are :—

V.	8.	Palinurina pygmæa, Münst.	U. Lias,	Ilminster.
	9.	,, longipes ? Münst.	,,	,,
VI.	10.	Penaeus latipes, Oppel	,,	,,
VII.	11.	Eryma elegans, Oppel	,,	,,
	12.	,, fuciformis, Schl.	,,	,,
VIII.	13.	Hefriga Frischmanni ? Oppel	,,	,,
IX.	14.	Glyphea Heeri ? Oppel	,,	,,

making an addition of five genera and probably seven species to our list of British Crustacea.

It is not a little interesting that we find so many forms, common to our Lias, which agree in identity with species found only in the lithographic stone of Solenhofen in Bavaria. The persistence of such forms as *Eryon*, *Eryma*, and *Glyphea* seems clearly to demonstrate that having escaped total extinction in the Lower Lias sea, they must have migrated from time to time to more favourable areas, and thus have been enabled to live on, during the deposition of the long series of sedimentary deposits up to the period of the deposition of the lithographic stone in which so many examples are found fossil."

H. W.

* Already noticed in Quart. Jour. Geol. Soc. Vol. XXII., p. 499, (1866.)

To the above list of crustacea are only to be added a colony of *Cirrhipedia* of many hundreds in number, attached to a piece of wood throughout its entire length, or rather to another colony of *Mytilidæ*, which had previously taken possession of its surface.

Notwithstanding the variety of the *Brachiopoda* in the marlstone and the peculiar forms in the leptæna beds, only one member of this family passes into the saurian and fish bed—the *Discina orbicularis*, Moore.

Having so fully noticed the contents of this remarkable bed, it will only be necessary to give a list of the remaining fauna occuring in it, most of which are very dwarfed, possibly arising from the estuarine condition of the deposit before suggested.

Avicula, sp.
Gervillia oblonga, Moore
Gryphæa depressa, Phil.
Inoceramus dubius, Sow.
Lima, sp.
Ostrea, sp.
Pecten, sp.
Placunopsis, sp.
Plicatula sarcinula ?
Astarte parallela, Moore
Corbula Somersetensis, Moore
Cypricardia ? sp.
Modiola dorso-plicata, Moore
Mytilus, n.s.
Posidonomya Bronni, Goldf.
Alaria, sp.
Pleurotomaria ? sp.
Turbo, sp.
Plantæ
Fruits
Ferns, remains of
Algœ Bollensis
Chondrites, Quenst.

The Upper Cephalopoda Beds *C. a to q.*

The absence of vertebrate life in the beds below the saurian zone has been alluded to, and when those above that horizon are examined, the absence of this important class is again most marked. The beds in this group are a succession of alternate bands of stone or indurated marl and clays, varying with almost every thin layer, and each having, as has before been remarked, its special zoological

horizon, though not of so decided a character as those below. Our space will allow only a somewhat general reference to them.

A visit to any of the sections in which these beds are present will at once show the great abundance of the cephalopoda through them. Chief amongst these are the *Ammonites bifrons*, *A. serpentinus*, *A. annulatus*, *A. radians*, *A. communis*, and others more rarely, a list of which will be given hereafter. *Belemnitidæ* of four or five species are also abundant, including, though rarely, fine examples of the *B. Ilminsterensis*, Phill., with their lengthened phragmacones still attached.

Although the great abundance of organic life at the time of their deposition is at once manifest, still a mere superficial view will give but a very imperfect idea of their profusion, which can only be obtained by a more minute investigation of the material of which the beds are severally composed. It will then be seen that they are crowded with interesting organisms, the *Foraminifera*, of which figures will be found in plates 1, 2, 3, being most abundant.

Zone *a*, which comes immediately above the saurian and fish clays, is not only an illustration of this fact, but also of the zoological changes apparent in beds immediately contiguous. The vertebrate remains below seem almost entirely to have disappeared, and multitudes of lower forms take their place. The *Rhynchonella Bouchardii*, Dav., is abundant on this horizon, and has not been observed elsewhere, and within this thin bed of two inches, nearly forty species of organic remains may be found. It is generally only the bands of clay that admit of this critical examination. *Foraminifera* in this bed are very abundant.

b. Stone with numerous *Cephalopoda.*

c. An indurated concretionary clay with but few organisms.

d. Cephalopoda.

e. Mottled clay 3 inches, with *Foraminifera* and other remains very abundant.

It will be sufficient to state that similar changes take place as the beds pass upwards, some shells, as the *Planularia harpula*, D'Orb., and the *Crania Moorei*, Dav., being apparently confined to special horizons.

SPECIES FROM THE UPPER CEPHALOPODA BEDS.

Choanites, sp.
,, sp.
Cristellaria acutauricularis, F. & M.
,, costata, D'Orb.
,, cupidula, F. & M.
,, cultrata, Montf.
,, rotula, Lam.
Dentalina communis, D'Orb.
,, filiformis, D'Orb.
,, pauperata, D'Orb.
,, plebeia, Reuss
Flabellina rugosa, D'Orb.
Frondicularia complanata, Defr.
,, striatula, Reuss
Lituola cenomana, D'Orb.
Lingulina carinata, D'Orb.
Marginulina raphans, Linn.
,, eusis, Reuss
Nodosaria hispida, D'Orb.
,, humilis, Roem.
,, paucicostata, Roem.
,, raphanus, Linn.
,, raphanistrum, Linn.
,, radicula, Linn.
Planularia Bronni, Roem.
,, harpula, D'Orb.
Planularia longa, Cornuel
,, pauperata, P. & J.
Vaginulina legumen, Linn.
,, levigata, Roem.
,, striata, Reuss.
Webbina irregularis, D'Orb.
Trochocyathus Moorei, M. Edw.
,, primus, M. Edw.
Thecosmila, sp.
Corals, several sp.
Serpula gordiatus, Quenst.
,, trisulcatus, Quenst.
,, several sp.
Crustacea, claws of
Entomostraca, 2 sp.
Pseudodiadema Moorei, Wright
Cidaris Ilminsterensis, Wright
Apirocrinus amalthei, Quenst.
Ophioderma, joints
Pentacrinites
Bryozoa, sp.
Crania Moorei, Dav.
Lingula, sp.
Rhynchonella Bouchardii, Dav.
,, coronata, Moore
,, Moorei, Dav.
,, variabilis, Schlot.

Spirifera rostratus, Schlot.
,, sp.
Terebratula Lycettii, Dav.
,, sp.
Terebratella
Thecidium triangularis, D'Orb.
,, Bouchardii, Dav.
Avicula, sp.
Crenatula, sp.
Hinnites velatus, Goldf.
,, sp.
Gryphæa depressa, Phil.
Inoceramus dubius, Sow.
,, plicatus, Moore
Lima punctata, Sow.
,, several sp.
Ostrea cymbium, Oppel
,, sp.
Pecten contrarius, Quenst.
,, textorius, Schlot.
,, several sp.
Plicatula, sp.
Arca interrupta, Moore
Astarte, sp.
Leda complanata, Phil.
,, ovum, Sow.
Lithodomus, sp.
Myacites, sp.
Opis, sp.
Pholadomya, sp.
Amberleya capitaneus, Goldf.
,, Lycettii, Moore
Actæonina, sp.
Alaria coronata, Moore
,, angulata, Moore
Cerithium coronatum, Moore
,, Ilminsterensis, Moore
,, sub-lineatum, Moore
,, minor, Moore
,, planum, Moore
,, varicosum, Desl.

Chiton unilobatum, Desl.
Discohelix Dunkeri, Moore
Dentalium, sp.
Natica Pelops, D'Orb.
Neritopsis Spekei, Moore
,, transversa, Moore
Onustus spinosus, Moore
Pleurotomaria Comptonensis, Moore
,, princeps, Kock. & Dunk.
,, dicipiens, Desl.
Rimula punctata, Moore
Solarium, sp.
Trochus similis, Moore
Turbo Bertholeti ? D'Orb.
,, constrictus, Moore
,, Jonesei, Moore
,, varians, Moore
,, Rutteri, Moore
,, sp.
Turritella varicosum, Desl.
Ammonites annulatus, Sow.
,, armatus, Sow.
,, bifrons, Brug.
,, communis, Sow.
,, comensis, Buck.
,, complanatus, Brug.
,, crassus, Phil.
,, fibulatus, Sow.
,, fimbriatus, Sow.
,, heterophyllus
,, insignis, Schrub.
,, jugosus, Sow.
,, Ilminsterensis, Lycett
,, Moorei, Lycett
,, raquinianus, D'Orb.
,, radians, Rein.
,, serpentinus, Sow.
,, sub-armatus, Sow.
,, sub-carinatus, Phil.

Ammonites striatulus, Sow.	Belemnites tripartitus?
,, variabilis, D'Orb.	Nautilus semi-striatus, D'Orb.
Belemnites Ilminsterensis, Phil.	Hybodus tooth
,, quadricanaliculatus, Quenst.	Lepidotus scales
,, striolatus, Phil.	Many species in casts undeterminable.

On the uppermost horizon of the Upper Lias, and particularly where the beds attain the greatest thickness, several are present in which the *Ammonites variabilis, A. insignis,* and *A. Moorei,* are chiefly found, and which have migrated from the Upper Lias seas into the Cephalopoda bed of the sands above, such being also the case with the *Amberleya capitaneus.* It has not only been proposed to classify these oolitic sands with the lias, but my friend Dr. Deslongchamps, has also suggested including all the beds of the Upper Lias down to the marlstone with the inferior oolite. With so varied a fauna in the Upper Lias, and so few species that are common to the two formations, to say nothing of the very persistent lithological distinctions between them, I am unable to agree with the propriety of either of these proposals.*

Before the deposition of the oolitic sands, there appears throughout the South West of England to have been an interregnum in which the gasteropoda more particularly abounded. The upper beds have been much abraded, and to their ragged surfaces they are attached in considerable numbers. This is very well shown in the upper beds of Compton, and it is generally the case that the few corals in the Upper Lias are found also in the higher beds. In a paper on the "Abnormal Conditions of the Lower Lias when connected with the Somersetshire and South Wales

*According to Dr. Lycett, who has given much attention to this point, only 14 species are common to the two horizons. See "The Cotteswold Hills," 1857.

Coal Fields," I have pointed out similar conditions, and that there also gasteropoda and a coralline fauna prevailed.

It is rarely within the space of a few feet so interesting and varied a fauna as has now been noticed is present.

In the Ilminster Middle Lias, including Cross, are 197 species; in the leptæna beds 70; in the saurian and fish zone 110?; and in the cephalopoda beds 150; whilst the rocks of the lower horizons of Camerton, Whatley, &c., yield 179. Allowing for those which are recurrent, and including some few forms in casts which are specifically not recognizable, the Somersetshire fauna yields in the whole from the Middle and Upper Lias, about 580 species.

DESCRIPTION OF SPECIES.

AMBERLEYA CAPITANEUS. Plate 6, fig. 1—5.

Turbo capitaneus.—Goldf.

Shell thick, turbinated, conical, turreted; whorls 5-6, with encircling nodulated carinæ, between which are interstital canaliculated spaces which are crossed longitudinally by very fine striæ, the carinæ increasing in number on the body whorl, and passing round the base of the shell; aperture very large, sub-quadrate, or lengthened, widening at the lower margin; outer lip thin and fringed by the carinæ; columella folded and produced.

There appears little doubt that our specimens are identical with others described from the Nailsworth sands. Several of our examples however have an additional whorl, and are as large again as any previously figured, the last or body whorl being as long as all those above. The aperture has been modified thereby, and from being sub-quadrate has become more lengthened. *Eucyclus* has been proposed by Dr. Deslongchamps for this group of gasteropoda, but the term *Amberleya*, Lycett, appearing to have priority has been retained.

Dr. Lycett having figured a specimen from the Forest Marble, the species is shewn to have a very long range in time. Figures 4 and 5 are added for comparison from the inferior

oolite. Our examples are from the highest bed of the Upper Lias at Compton. Length of largest specimen $1\frac{3}{4}$ in., breadth 1 in.

AMBERLEYA LYCETTII.—*Moore.*—Plate 6, fig. 6.

Shell rather elongate, conical; volutions 6–7; angulated or convex towards their base. The upper portion of each whorl is ornamented by two concentric lines of faint rather irregular turbercles; on the lower margin are two regular closely granulated carinæ, between which is a flattened area; these are crossed longitudinally by faint oblique striæ; the base of the body whorl is extended and possesses many striations; aperture large, longitudinally ovate; columella and inner lip folded.

We possess but a single example of this species from the Upper Lias at Compton. It is not in very good condition.

ALARIA UNISPINOSA.—*Moore.*—Plate 4, fig. 1, 2.

Shell fusiform, elongate, turreted; apex acute; volutions 8, angulated and carinated; surface with numerous transverse striæ, and with longitudinal costæ on the upper whorls. From the carina on the body whorl there springs a very fine and narrow spine, which curves upwards and extends more than the diameter of the shell beyond the margin; outer lip slightly recurved; aperture rather large, lengthened, and continued into a very long slender canal; columella very extended and slightly folded.

This elegant shell is rather plentiful in the leptæna clays of zone *A d* of the Upper Lias, at Ilminster and other localities, and hitherto we have failed to recognize it elsewhere. It is only found in the laminæ of the clay in which it is compressed and has in all cases lost its test.

ALARIA ANGULATA.—*Moore.*—Plate 4, fig. 4.

Shell fusiform, tapering, spire extended; apex acute; whorls, 6–7, carinated rather below the middle of each whorl, on each side of which is an angulated area, ornamented by encircling striations; aperture longitudinally ovate, with a narrow produced, straight canal.

Of this species we possess but one example from the highest Upper Lias bed of Compton. It is not quite perfect and like most of the gasteropoda from this place has suffered slightly from abrasion.

ALARIA CORONATA.—*Moore.*—Plate 4, fig. 3.

Shell turreted; spire moderately elevated; volutions 7, angulated. The upper margin of each whorl possesses a single line of small regular granulations, whilst rather below the middle of each whorl is a rounded faintly nodulated carina, which divides the angulated portions of the whorl and there is a smaller carina towards the base. The three upper whorls have longitudinal costæ which are very faint or disappear on those below.

This is a very pretty species, of which we possess only a single specimen from the Upper Lias at Ilminster. The mouth and lip are concealed so that its entire form cannot be determined.

ACTÆONINA ILMINSTERENSIS.—*Moore.*

Plate 5, fig. 25, 26.

Shell sub-cylindrical, of five whorls, conical, smooth, but marked by numerous depressed transverse striæ, and also by depressed longitudinal lines of growth; spire extended, acute, the upper part of each whorl having an angle bounded by a raised transverse line; aperture the length of the last whorl, ovate; the inner lip slightly folded and thickened.

This genus has not been recognized in this country below the great oolite, though we have obtained the allied forms of *Cylindrites* of several species from the Rhætic beds. We have only two examples of the species which are both from the marlstone of Ilminster. Length of shell $6\frac{1}{2}$ lines, breadth $3\frac{1}{2}$.

CYLINDRITES WHITFIELDII.—*Moore.*—Plate 5, fig. 27.

Shell cylindrical, smooth and without ornamentation; spire extended; volutions 6, rather convex, separated by a slightly angular transverse sinus; last whorl extended, with long aperture, widest in the middle; outer lip somewhat convex; columella lengthened and slightly folding outwardly.

Only one example of this shell which is from the marlstone at Ilminster, is known, and is named after my friend the Rev. E. Whitfield, of that town. Length of shell 5 lines, breadth 2 lines.

CERITHIUM ASPERULUM.—*Moore.*—Plate 4, fig. 5.

Shell turreted, conical; spire tapering; apex acute; volutions 7–8, divided by a slight sutural area, into which the

upper row of nodulations slightly project; shell ornamented by distinct transverse striæ, which are crossed by numerous straight longitudinal costæ, which possess sharp raised nodulations.

We have only a single example from the Upper Lias of Whitelackington, and also one from the Middle Lias, of Ilminster.

CERITHIUM VARICOSUM.—*Desl.*—Plate 4, fig. 15.

Shell cylindrical; spire extended, of 13–14 volutions, the suture dividing them small and angulated; on the surface are three or four raised transverse striæ, the first and third being most prominent, these cross nine very raised longitudinal costæ which possess an edge of nodulations of rather unequal elevation. Between the costæ are eight deep oblique rounded sutures which continue through the length of the shell.

We possess four examples of this species which are from water worn raggy beds on the highest horizon of the Ilminster Upper Lias.

CERITHIUM MINOR.—*Moore.*—Plate 4, fig. 6.

Shell small, tapering; volutions 7, convex and slowly increasing; suture distinct; the whorls with numerous longitudinal curved costæ, and with very faint transverse striæ, which are only distinguishable with the lens.

We have only a single specimen from the Ilminster Upper Lias.

CERITHIUM PLANUM.—*Moore.*—Plate 4, fig. 7.

Shell elongate, pyramidal, apex acute; spire regularly tapering, composed of 12 flattened smooth volutions, which are separated by a very fine encircling suture.

Of this shell we possess but two examples, both of which are from the Upper Lias at Compton.

CERITHIUM CORONATUM.—*Moore.*—Plate 4, fig. 14.

Shell small, cylindrical, turreted; volutions 6–7, increasing very slowly, convex; apex obtuse; whorls with longitudinal costæ which are most prominent and terminate in nodules on their upper margins. The costæ are crossed by six or seven regular transverse striæ.

This little species is from the Upper Lias of Ilminster, from whence we have but two examples.

CERITHIUM GRADATUM.—*Moore*.—Plate 4, fig. 10.

Shell fusiform; spire tapering; apex acute; whorls 10–11, separated by a narrow angular suture; the surface ornamented by encircling striæ, which are crossed by oblique rather curved costæ, on the edges of which are rounded turbercles, which are largest on the upper margin of the whorls, and gradually decrease below.

Only two specimens are known, both of which are from the Upper Lias, one from Ilminster, the other from Moolham.

CERITHIUM ILMINSTERENSIS.—*Moore*.

Plate 4, fig. 12-12 *a*.

Shell small, thick, turreted, pyramidal, with 9 convex volutions, encircled by three rows of nodulated striæ on the upper whorls, and by eight or nine on the lower, which are decussated by numerous longitudinal costæ which cross an angulated sinus at the base of each whorl; aperture sub-ovate; inner lip reflected. No umbilicus.

This pretty species is from the Upper Lias of Ilminster from which we have four examples.

CERITHIUM SUB-LINEATUM.—*Moore*.—Plate 4, fig. 11.

Shell elongate, thin, pyramidal, smooth; whorls 10–11, rather flattened; shell structure smooth, but ornamented by very numerous depressed curved longitudinal striæ.

We possess but one example of this species which is not quite perfect either at the apex or base. It is however quite distinct from the other liassic forms with which it is associated. It is from the Upper Lias at Compton.

CERITHIUM CAMERTONENSIS.—*Moore*.—Plate 4, fig. 9.

Shell narrow, turreted; whorls 8–9, convex, separated by seven transverse granulated striæ, the one in the middle of the whorl having rather larger nodules and being most raised; base with small encircling striæ; columella folded and slightly extended; mouth oval. It approaches closely the *Trochus granuliferus* of Stolitzcha, but the whorls are more angular than that species. Length of shell 5 lines, width of body 2 lines.

Of this species we have but one example. It is from the Middle Lias at Camerton.

CERITHIUM LIASSICUM.—*Moore.*—Plate 4, fig. 16, 17.

Shell small, tapering gradually to an acute apex; whorls 10, flattened, divided by a slight sinus, with, on all but the last whorl, fine encircling transverse striæ, crossed by slightly curved close-set longitudinal nodulated costæ; base with encircling striæ; columella folded with a short canal; aperture small, sub-quadrate.

We have but one specimen of this shell, which we originally considered to be the *Chemnitzia asperula*, but on examination it was found to possess more whorls than that shell, which are flatter and have a more delicate ornamentation. Its aperture however shows it to be quite distinct. It is from the marlstone of Ilminster.

CERITHIUM PYRAMIDALIS.—*Moore.*—Plate 4, fig. 8.

Shell pyramidal, elongated; whorls numerous, narrow, slightly convex, divided by a small oblique rather waved sinus; each whorl possesses numerous bent longitudinal costæ, which are crossed by very fine transverse striæ, about ten on each whorl, the upper and lower bounding the sinus being largest and slightly nodulated; aperture moderately large and rather ovately elongated.

It is from the marlstone of Ilminster. The only perfect example we possess is 14 lines in length, but we have a portion of larger dimensions.

DISCOHELIX DUNKERI.—*Moore.*

Plate 5, fig. 28, 29, 29*a*.

Shell orbicular, depressed, truncated; spire depressed, volutions 7–8, narrow and encircling. The upper surface is flat, with the whorls on the same plane or very slightly concave, the under side presenting a large umbilical opening, within which all the whorls are seen, and the sides of which are step-like and angulated; the edges of each whorl are tuberculated, and both their upper and lower surfaces covered with very fine wavy concentric striæ; towards the aperture the shell is occasionally irregularly costated; aperture broader than deep; back flattened, crossed by curved costæ and fine encircling striæ.

We possess six examples from the Upper Lias of Compton, which, if of the same species, show considerable variety. The genus has been found in the Hierlatz, at May, and Fontaine-etoupe-four, but we are unable to connect our species with either of those from the latter localities. It is named after Von Dunker, by whom the genus was first recognized.

DENTALIUM GRACILE.—*Moore.*—Plate 5, fig. 23.

Shell thick, elongated, turbular, nearly cylindrical, outer surface smooth.

The only species hitherto figured from the marlstone is the *Dentalium gigantæum* of Phillips's Geology of Yorkshire, which also occurs with the above, but from which this little species is clearly distinct. It is from the Middle Lias of Camerton. It is only 8 lines in length by 1 line broad.

DENTALIUM LIASSICUM.—*Moore.*—Plate 5, fig. 24.

Shell slightly incurved and tapering, thick, outer surface ornamented with about twenty-four longitudinal ridges at rather irregular distances, within which are numerous slightly oblique annular lines of growth; aperture circular.

We possess but one specimen which has lost its apical portion. It is from the Middle lias of Camerton.

DENTALIUM? TRIGONALIS.—*Moore.*—Plate 5, fig. 22.

Shell triangular, thick, sheath-like, elongate, smooth, slightly curved, sides flattened, or rather convex, covered by numerous very fine annular oblique concentric striæ, every fourth or fifth of which is slightly raised and increased in thickness; section of the shell somewhat triangular, the base being thick, broadest, and with a slight sinus, whilst the opposite or dorsal margin is obtusely angular or carinated; aperture elliptical.

With some doubt we place this curious little shell with Dentalium. We possess three examples from the Middle Lias of Camerton, but neither is quite perfect. Like the Dentalium they are tubular and appear to have been open at both ends.

NERITOPSIS SPEKEI.—*Moore.*—Plate 5, fig. 11.

Shell globose, spire depressed; apex obtuse; body whorl inflated, convex, and covered by very close transverse rugose striæ, which are decussated by more raised regular longitudinal costæ, which are nodulated at their junction. The ornamentation of this shell gives its surface a turberculated appearance.

We possess only two specimens which are on the same block, from the Upper Lias of Kingstone, and being found in a quarry belonging to Wm. Speke, Esq., we have named it in remembrance of his lamented son Capt. Speke.

NERITOPSIS TRANSVERSA.—*Moore.*—Plate 5, fig. 9, 10.

Shell large; spire small, depressed; apex obtuse; volutions 4; the body whorl much enlarged, inflated and produced transversely, its upper area being rather flattened. The surface is ornamented with very numerous fine transverse striations; aperture large, rounded.

We have two examples of this shell, one of which is a cast, whilst the other is wanting its spire, but otherwise has its test preserved, our figures being restorations from them. They are from the Upper Lias near Ilminster.

NERINÆA LIASSICA.—*Moore.*—Plate 6, fig. 30.

Shell small, cylindrical, turreted, excavated; whorls 9, narrow, surrounded by a very projecting transverse carina, flattened both above and below. On the surface of the volutions are also two or three coarse encircling striæ; aperture higher than wide; columella slightly folded.

This little example which is only 2½ lines in length is the only instance we know of the genus in the lias. It was abundant in the great oolite, and two species have been obtained from the inferior oolite. Only one example is known which is from the marlstone at Ilminster.

ONUSTUS SPINOSUS.—*Moore.*—Plate 4, fig. 21.

Shell thin, smooth, conical, elevated; spire with 5 oblique volutions; the angulated surface of the whorls are crossed by somewhat irregular waved longitudinal costæ, which become obtusely spinose at the base of each whorl.

Three examples of this shell are in our museum, one from the Upper Lias of Compton, the others from Ilminster, but neither shewing the aperture. The base of each volution is slightly extended over the succeeding one, and in the lowest fimbriated. In two of our specimens the base of some of the costæ are seen to have projected beyond the margin of the whorls and that they were turbular and spinose, which does not appear to have been noticed by Dr. Deslongchamps, or Dr. Lycett in the species they have described. In the original condition of the shell these must have given it a peculiar appearance.

PLEUROTOMARIA COMPTONENSIS.—*Moore.*
Plate 5, fig. 15.

Shell trochiform, thick, conical; apex acute; whorls angular, with equi-distant transverse striæ; the sinus is small with a

slightly raised band, below which is an encircling rounded rib terminating each volution; the base is rather concave, with distant regular encircling striæ. Where the test is best preserved fine longitudinal striæ may also be detected.

We possess but one specimen which is from the highest Upper Lias of Compton.

PITONILLUS TURBINATUS.—*Moore.*

Plate 5, fig. 16, 17, 17*a*.

Shell smooth, pellucid, turbinated, of 6 or 7 convex whorls which are separated by a slight sinus, increasing rather rapidly, the larger being somewhat inflated. The body whorl is separated from the base by a very slight transverse line. The outer portion of the base is flatly convex, with very faint concentric lines. This is bounded by a ridge, within which is an angular circular depression containing the columella and the umbilicus. The columella is very thick, twisted and depressed, terminating in a thickened triagonal or rounded knob, from which springs an inner reflected lip which partly covers the umbilical orifice, and joins at its upper part the outer edge of the lip; umbilicus small and partly covered; mouth gaping. Height of shell 6 lines, breadth $5\frac{1}{2}$ lines.

All the specimens we have obtained of this genus are from the Middle Lias of Camerton. In an interesting paper by Von Ferdinand Stoliczka, the *P. conicus*, of D'Orb., is figured and stated to be frequent in the Hierlatz. The genus has also been found by M. Deslongchamps at May, and Fontaine-etoupe-four, in Normandy. From the identification of this genus with other associated gasteropoda in the Middle Lias at Camerton, we are obtaining evidence of the contemporiety of the deposits in these several localities.

PITONILLUS LINCTUS.—*Moore.*—Plate 5, fig. 18, 19.

Shell trochiform, rather small, smooth, shining, conical; volutions 6–7, flattened or slightly convex, narrow, and divided by a small suture with very faint angular lines of growth. The bottom of the larger whorl possesses a slight ridge separating it from a rather flattened base, columella thick, and twisted, bounded by an angular circular depression and folding over a small deltidium.

The above species is well distinguished from the *P. turbinatus* by its more conical form, and by the whorls being much less convex. Its texture is very smooth and crystalline. We

have four specimens, all of which are from the Middle Lias of Camerton. Height 4½ lines, breadth 2½ lines.

PLEUROTOMARIA HELICIFORMIS.—*Desl.*

Plate 5, fig. 14.

Shell smooth, discoidal, turbinated, depressed; spire obtuse, whorls 5, convex, but slightly flattened on upper surface towards a well-marked rounded sinus. The surface is covered with very close semicircular longitudinal striæ, visible by aid of the lens; fissural band on lower margin of the shell enclosed by two almost absolete transverse lines. Base of the shell flattened or slightly convex; umbilicus very small or wanting; aperture oblong.

From the marlstone of most localities, and is one of the commonest univalves of this zone. Width 10 lines, length 6 lines.

PLEUROTOMARIA COSTULATUM.—*Moore.*

Plate 5, fig. 12, 13.

Shell small, discoidal; spire rather small; apex acute; whorls 5, the upper whorls have a carnia of nodules rather larger than on the lower; upper part of last whorl flattened or nearly horizontal, with encircling nodulated striæ, with which the convex sides of the whorl are also covered; base flattened or slightly convex with three or four lines of striæ on its outer edge; umbilicus rather small with a channeld edge.

Of this pretty species we possess but one example, which is from the marlstone of Ilminster.

PURPURINA ORNATISSIMA.—*Moore.*

Plate 5, fig. 20, 21.

Shell rather small, turreted, apex acute; spire with 5 volutions; surface ornamented with numerous prominent transverse striæ, which are crossed by thick raised longitudinal costæ, which disappear on the lower part of the body whorl; lip thin; aperture longitudinally ovate.

This shell is from the marlstone of Ilminster, and is the oldest representative of the genus yet known, none having been hitherto found below the great oolite. It is very rare. After many years examination of the lias, we have only found two specimens; it is 8 lines in length by 6 in breadth.

RIMULA PUNCTATA.—*Moore.*—Plate 5, fig. 30, 31.

Shell rather small; apex curved posteriorly; sides flattened, with 9–10 prominent rounded ribs, in the interspaces between which are transverse lines of rounded punctuations arranged in pairs.

Of this pretty little shell we have but one specimen which is from the Upper Lias of Compton.

SOLARIUM CRENULATUM.—*Moore.*
Plate 4, fig. 19, 20.

Shell depressed; spire obtuse; whorls 4 in number. The upper part of the last whorl is separated from a rounded sinus by a line of nodules, below which are three fine transverse lines, followed by two divided angulated carinæ; base of the shell angular with numerous encircling striæ; umbilicus deep, crenulated on the lower margin with eight other finer lines passing round each inner whorl.

This is the earliest example with which we are acquainted of the genus, none having been found below the inferior oolite. It is from the marlstone at Ilminster.

TROCHUS SIMILIS.—*Moore.*—Plate 4, fig. 22, 23.

Shell small, thick, conical; spire short, acute; of 5 whorls; sides rather angular, having at upper margin next the suture a tuberculated rim, and at the base a rounded carina, between which are depressed longitudinal costæ, which after crossing the carina bifurcate on the base of the shell, uniting again in a nodulated edge surrounding a small round umbilicus. The shell also possesses very fine transverse striæ.

We possess but one specimen which is from the Upper Lias of Ilminster.

TROCHUS FLEXICOSTATUS—*Moore.*—Plate 5, fig. 1, 2.

Shell conical, regularly tapering; at the base of each whorl which are 8 in number, there is a slightly projecting rounded rib; on the angular sides of the whorls there are a number of close-set, faint, curved costæ, which on the lower one cross a carina and cover the flattened base; mouth small, depressed; columella small.

We have but two examples of this shell, neither of which is in very good condition. In its general form it resembles the *T. lineatus*, but is to be distinguished from it by its longitudinal curved costæ. From the marlstone of Ilminster.

TROCHUS LINEATUS.—*Moore.*—Plate 5, fig. 3, 4, 4*a*.

Shell conical, small, tapering to an acute apex, smooth; whorls 9, separated by a very faint transverse line at the base of each whorl. Each whorl is divided rather below the middle by a small transverse sulcation, on each side of which there are also four or five striations, only observable by the lens; base flat, with very fine striæ; mouth depressed; columella slightly extended.

From the marlstone Ilminster, Radstock, and other localities, and is the most abundant of this genus.

TROCHUS PETHERTONENSIS.—*Moore.*—Plate 5, fig. 5, 6.

Shell small, turbinated, depressed; spire short; apex obtuse; whorls 4, the upper part of which is angular or slightly concave, followed on the large whorl by a narrow flattened side. The whole shell is ornamented by bent longitudinal costæ, which on the upper side of the body whorl are slightly nodulated, and cross two slight ridges on the side to an angular base, terminating on the edge of a small umbilicus; columella slightly produced; mouth sub-quadrate.

This shell, which is a well distinguished species, has only been found in the marlstone of South Petherton, and is represented by only two examples.

TROCHUS CARINATUS.—*Moore.*—Plate 4, fig. 24, 25.

Shell small, smooth; spire moderately elevated; whorls 4, the last possessing three transverse encircling carniæ, with a sulcus between the uppermost and a flattened or slightly concave space beneath; upper part of the whorls flattened; base convex, striated; columella slightly extended; umbilicus very small or absent; mouth sub-quadrate.

Of this little species we have but two examples, which are both from the marlstone of Ilminster.

TROCHUS CONCINNUS.—*Moore.*—Plate 4, fig. 28, 29.

Shell small; spire tapering; apex acute; whorls 6, angular, and divided by an angular sinus. The whorls possess transverse lines of crenulated striæ, differing in size, and are terminated at their base by an extended nodular carina. Between the transverse lines are close angular or bifurcating longitudinal striæ; base of the shell covered by concentric striæ, which are decussated by fine longitudinal lines; umbilicus closed; columella slightly elongated.

Of this pretty little species we have but two examples which are from the Middle Lias of Camerton. Length 4½ lines, breadth 3 lines.

TROCHUS NODULATUS.—*Moore.*—*Plate* 4, fig. 26, 27.

Shell conical; apex rather acute; spire of 8 flattened whorls; sutures indicated by a very slight depression; upper margin of whorls possess a line of transverse nodules which steadily increase in size and width with the growth of the shell; the bottom of the upper whorl is bounded by a smaller line of nodules, which are much increased in size on the last whorl; between the lines of nodules on the flattened surface of the shell are five transverse striæ, slightly cancellated; base of the whorl concave, having on the exterior a row of large nodules, and within numerous concentric striæ; umbilicus small; columella short, recurved; mouth elongated, depressed.

Of this pretty shell we have two examples from the marlstone of Ilminster. Its diameter and height of spire are about 12 lines.

TROCHUS MAMMILARIS.—*Moore.*—Plate 5, fig. 7, 8.

Shell small, turbinated, conical, with 5 rather angular convex volutions; the whorls possess transverse lines of tubercles, which on the body whorl are five in number, the third being most raised. The tubercles on the next whorl are joined by angular longitudinal costæ, giving it a slightly reticulated appearance; base flattened or slightly convex, with five or six tuberculated concentric striæ; small opening, rounded, with lip slightly produced.

Of this little shell, which is from the Middle Lias of Camerton, we have but one example. In its ornamention it is not unlike the *T. Kochii*, Munst., Goldf. Pet. p. 193, f. 15, but it is more depressed than that shell. Length 2½ lines, breadth 2½ lines.

TURBO NUDUS.—*Moore.*—Plate 6, fig. 25, 26.

Shell nearly smooth, turbinated, spire moderately elevated, with 5 convex whorls, which are separated by a rounded or concave slightly oblique sinus, the last whorl showing longitudinal lines of growth.

This shell is from the marlstone of South Petherton, and Moolham, near Ilminster, where it is rare. By the entire absence of ornamentation it is at once distinguished from the other species with which it is associated.

TURBO CORONATUS.—*Moore.*—Plate 6, fig. 21, 22, 22 ×.

Shell turreted, with moderately elevated spire; apex acute; whorls 5-6, rather concave on the top and having on their sides transverse striæ. The upper portion of each whorl possesses a single more raised tubercular transverse line, beyond which it is angular; base rather flattened, and with encircling striæ; umbilicus rounded; aperture large and rounded.

From the marlstone of Ilminster and South Petherton, where it is rare.

TURBO BIFURCATUS.—*Moore.*—Plate 6. fig. 27, 28.

Shell small, turbinated; spire of 4 volutions, conical, depressed; apex obtuse; upper margin of whorls ornamented by numerous tubercles, from which on the body whorl bifurcating costæ pass towards the umbilicus, and are crossed both on the sides and base by strong transverse encircling striæ; umbilicus small, rounded; aperture large, rather ovate.

Of this pretty shell we have at present but two examples. It is from the Middle Lias of Camerton. Height 2 lines, breadth 2 lines.

TURBO RUGIFERA.—*Moore.*—Plate 6, fig. 23, 24.

Shell turbinated, depressed; apex obtuse; whorls 5, convex; the upper borders are rather flattened or angular; the surface of each whorl is covered with dense granulations, arranged in close encircling transverse lines which are rather widest on the centre, where they are separated by narrow furrows, within which are angular longitudinal lines uniting the granulations. Base of shell rather convex, with encircling striæ, crossed by the longitudinal striæ; umbilicus small; aperture nearly round.

Only one example is known, which is from the marlstone of Ilminster.

TURBO VARIANS.—*Moore.*—Plate 6, fig. 9, 10.

Shell small, turbinated, rather depressed; whorls 5, the uppermost convex, the lower rather angulated; at the bottom it possesses a slight encircling rib, dividing it from an angulated base. The younger whorls have fine transverse striæ, which are not present, or appear obsolete on the body whorl. Aperture sub-quadrate, columella rather thin; no umbilicus.

From the Upper Lias of Ilminster, from whence we have but two examples.

TURBO BERTHOLETI?—*D'Orb.*—Plate 6, fig. 7, 8.

Shell turreted; volutions 9–10, spirally coiled and turning to the left, divided by a deep angulated suture. About their centre the whorls are furnished with raised tuberculated costæ, which cross longitudinally to an encircling ridge above the suture. The surface is also ornamented by very fine transverse striæ, giving the shell a finely reticulated aspect; umbilicus large, deep; aperture large, round, and reversed.

This interesting species appears to be plenty in the Upper Lias at Compton, five specimens occurring in the same block. It is from the highest bed at that place, and in association with *Ammonites Walcottii.*

TURBO JONESEI.—*Moore.*—Plate 6, fig. 11.

Shell turreted, tapering; apex acute; volutions 8, having on their centre two raised nodulated transverse carinæ, the lower rather the largest, and between which is a canaliculated area. Above the carina the shell is angulated, and at the base of the whorl is a small encircling nodulated rib. The surface also possesses very fine and close longitudinal striæ.

From the Upper Lias at Compton. We have but two examples, both of which are partly concealed by the matrix and not quite perfect. It is named after our friend the Rev. W. A. Jones, F.G.S., of Taunton, one of the Honorary Secretaries of the Somersetshire Archæological and Natural History Society.

TURBO CONSTRICTUS.—*Moore.*—Plate 6, fig. 12.

Shell turreted; apex acute; volutions 6–7, step-like. The middle of each whorl possesses a very extended, slightly granulated carina, with an angulated or slightly concave area both above and below; surface of the whorls with fine encircling striæ. The base and aperture are not exposed, and it is therefore referred with a little doubt to *Turbo.*

We have but one specimen which is from the Upper Lias of Ilminster.

TURBO RUTTERI.—*Moore.*—Plate 6, fig. 29.

Shell thick, turbinated; apex obtuse; volutions 4-5, convex, increasing rapidly, and divided by a rounded suture; sides of the whorls ornamented by numerous transverse striæ, which are very finely nodulated, and crossed by fainter longitudinal striæ, which give the shell a finely reticulated aspect. The ornamentation is the same on the upper as on the body whorl,

though on the latter the nodulated striæ have increased to about fifty in number; base rounded; aperture not exposed.

It is from the Upper Lias of Ilminster, and we have only one specimen.

TURBO POLITA.—*Moore.*—Plate 6, fig. 17, 18.

Shell tapering, with 4 angular whorls, which are separated by a deep transverse angular sinus, within which passes a transverse line of small granulations, the other portions are ornamented by fine transverse lines, which are decussated by still finer close longitudinal lines. Towards the base of each whorl is an elevated carina of minute granulations, from which the longitudinal striæ of the whorls bifurcate. Base of the shell extended, with coarser transverse striæ; mouth of shell rounded or slightly ovate longitudinally; no umbilicus.

Of this pretty shell we possess but one specimen which is from the Middle Lias of Camerton.

TURBO BULLATUS.—*Moore.*—Plate 6, fig. 15, 16.

Shell small, smooth, turbinated, obtuse; whorls 4, convex or inflated; apex of spire obtuse; sutures distinct; base convex, without umbilicus; mouth rounded.

From the Middle Lias of Camerton, where the species appears to be abundant.

TURBO ELEGANTISSIMA.—*Moore.*—Plate 6, fig. 19, 20.

Shell turbinated; apex rather acute; it possesses 6 rounded or convex whorls, the upper parts of which are a little flattened, and are covered by encircling transverse striæ, which are crossed by somewhat oblique equi-distant costæ, which give the shell an ornate appearance; base of the whorls equally concave; umbilicus large; aperture large, rounded.

This pretty little species is somewhat rare. It is from the marlstone of Ilminster. Length of shell 6 lines, width $5\frac{1}{2}$ lines.

TURBO LINEATUS.—*Moore.*—Plate 6, fig. 13, 14.

Shell turbinated, depressed; apex obtuse; volutions 4, whorls very convex, the body whorl being much increased in size, upper part of whorls rather flattened. The whole of the surface of this shell, including its base which is also convex, is covered with fine, close-set, regular transverse lines.

From the marlstone of Ilminster, from whence one specimen has been obtained, and one also from the Upper Lias. Height 6 lines, breadth 7 lines.

TURRITELLA ANOMALA.—*Moore.*—Plate 4, fig. 18.

Shell turreted, tapering, elongate, with 14-15 spiral slowly increasing volutions, which are separated by a well defined concave sinus. The volutions are moderately convex, and covered by distinct concentric striæ, which on the lower whorls are 10-12 in number. In its younger state the striæ are crossed by raised longitudinal costæ, which gradually disappear and become obsolete on the lower whorls. Aperture not exposed.

It is from the Middle Lias of Camerton, and we possess but one specimen.

TURRITELLA SIMILIS.—*Moore.*—Plate 4, fig. 13.

Shell very elongate, tapering to a very acute apex; volutions 21-22, rather convex, but slightly angulated at the base above a distinct encircling suture. The whorls are ornamented by about 10 transverse striæ which can only be detected by the lens. Like the *T. anomala*, Moore, the upper whorls are longitudinally costated, and disappear with age. In this species they become obsolete with the fifteenth whorl, those below being smooth.

We possess but one example of this species which is from the Middle Lias of Ilminster. It is quite distinct from the *T. anomala*, in having more flattened whorls with a narrower suture, and the ornamentation is much finer than in that species.

ASTARTE DUPLICATA.—*Moore.*—Plate 7, fig. 18.

Shell sub-trigonal, rather small, convex, marked with concentric lines, usually arranged in pairs, with smaller but more irregular lines in the intermediate grooves; umbones convex, acute; hinge line short; inferior part of sides and front obtusely rounded. The internal border of the shell possesses about thirty crenulations.

This pretty little species is from the marlstone of Ilminster and though not abundant, is more numerous than other species of this genus.

ASTARTE CAMERTONENSIS.—*Moore.*—Plate 7, fig. 21.

Shell sub-quadrate, thick, convex; hinge line extended; umbo depressed, anterior, from which a ridge passes to the posterior frontal margin, dividing the shell into nearly equal parts; anterior end oblique; posterior end angular and sub-truncate, frontal margin nearly straight; surface covered by transverse lines of growth, which are again divided into numerous fine striæ, which curve upwards after crossing the angle on the posterior side.

This shell is well distinguished by its outline from other species with which we are acquainted. It is nearly as broad as long; most convex on the ridge line crossing the shell, beyond which the surface is flattened or angular. It is from the Middle Lias of Camerton.

ASTARTE PARALLELA.—*Moore.*—Plate 7, fig. 19.

Shell rather small, smooth, depressed; umbones rather anterior, close-fitting; lunule small; ventral margin thin, rounded, close-fitting; posterior and anterior margins angulated and oblique. About twenty depressed concentric striæ ornament the surface.

Two examples only are known from the saurian and fish bed of the Upper Lias at Ilminster.

ASTARTE OPPELI.—*Moore.*—Plate 7, fig. 20.

Shell sub-quadrate, thick, convex; umbones nearly central; margins rounded; surface covered with very fine concentric striæ, and possess eight very raised distinct concentric ribs.

But one example of this shell has been found in the Middle Lias of Camerton. It is named after my late friend Dr. Oppel, of Munich.

ARCA INTERRUPTA.—*Moore.*—Plate 7, fig. 13.

Shell rather ovate, convex; umbones anterior, contiguous; hinge line extended; posterior end lengthened, anterior roundly truncated. About half the surface of the shell on the posterior side is furnished with regular distinct oblique longitudinal lines which become fainter on the anterior surface; the posterior angle which is broad and acute possesses several ribs which are also present on the anterior end. There are numerous fine concentric lines, with distinct interrupted lines of growth. A more perfect example than the figure given shews that the posterior end is rather more extended.

Only two specimens are known from the Ilminster Upper Lias.

AVICULA IMBRICATA.—*Moore.*—Plate 7, fig. 23, 24.

Shell very small, longitudinally ovate, moderately convex; umbones prominent, anterior; hinge line extended; ears very unequal, the posterior one with a broad flattened area.

The surface possesses numerous regular oblique longitudinal costæ, which are crossed by concentric lines of growth, giving the shell a scabrous or imbricated appearance. Unlike the Aviculidæ, the species appears equivalve.

The shell is from zone *e* of the leptæna beds of Ilminster, where only it has yet been found. In our list from these beds it has been given under the name of *A. pygmæa*, but as that name has already been appropriated it has been altered.

CORBULA SOMERSETIENSIS.—*Moore.*—Plate 7, fig. 17.

Shell rather inflated, smooth; umbones prominent, anterior; anterior side and ventral margin rounded, posterior side angulated with a slight concave area separating it from an oblique margin. The dorsal surface possesses about fifty regular transverse ribs, the sides of which are angular, and in the interspaces are other very fine striæ.

This rare shell of which we possess but two examples is from the saurian and fish bed of the Ilminster Upper Lias.

CARDITA LIASIANA.—*Moore.*—Plate 7, fig. 9.

Shell sub-orbicular, convex, a little broader than long; umbones prominent, rather anterior. The surface of the shell is covered by close longitudinal finely tuberculated striæ, amounting to upwards of sixty in number on each valve. Sides and front of the shell regularly rounding; on the interior these are finely crenulated.

This genus which is common in tertiary strata, has not before been recognized below the lower green sand. We believe the *Cardium multicostatum*, Phillips, may belong also to this genus, in which case there are two species present in the Middle Lias.

The species is exceedingly rare. We have never found but a single right valve. From the marlstone of Ilminster.

CUCULLÆA BILINEATA.—*Moore.*—Plate 7, fig. 4.

Shell ovately rhomboidal, ventricose; umbones prominent, rather anterior and somewhat separated; hinge line straight, rather more than half the breadth of the shell; ligamental

area narrow, with transverse striæ; anterior side roundly extended; dorsal margin rather rounded; posterior side angular, separated by an angular sloping carina; dorsal surface covered by very fine longitudinal, slightly waving lines, but more so, and dividing on the anterior side, these are crossed by irregular and distant lines of growth, and also by very fine transverse striæ. The longitudinal striæ on this and other liassic species appear to be arranged in close-set pairs with a slight median groove.

The only described species from the lias is the *C. Munsterii*, Goldf., which occurs with this species, but from which it is well distinguished by its more equilateral and ventricose form, and from its attaining a larger size. It is from the marlstone of Ilminster and other localities.

CUCULLÆA TRANSVERSA.—*Moore.*—N. S.

Shell transversely ovate, inequilateral, ventricose; umbones raised, rather anterior, and widely separated by a deep angular ligamental area; anterior side rounded; dorsal margin curved; posterior side with an oblique carina, beyond which the shell is angular and truncated. The dorsal margin of this species is possessed of strong concentric transverse lines, which being decussated by longitudinal ones, give the shell a somewhat reticulated aspect. From the above characters, by its being more gibbous, and from the concavity and size of the ligamental area it is readily distinguished from the *C. bilineata* and the *C. Munsterii*.

It is from the marlstone of Ilminster and is not uncommon. The figure of this species has unfortunately been omitted from the plate.

CYPRICARDIA PELLUCIDA.—*Moore.*—Plate 7, fig. 6.

Shell very thin, pellucid, transversely ovate, inequilateral; umbones raised and incurved towards anterior margin; lunule round; hinge line distinct; anterior and ventral margins rounded; posterior angulated and separated from the dorsal surface by an oblique carina, beyond which the shell is angular and truncated. The surface is smooth and possesses very close fine transverse striæ.

Owing to the fragile character of the test we possess but one specimen in which it is preserved, though casts are not unfrequent. It is from the Ilminster marlstone.

CYPRICARDIA INTERMEDIA.—*Moore.*—Plate 7, fig. 5.

Shell very thin, broader than long; very tumid; hinge line obliquely extended posteriorly; umbones very prominent, rather anterior; anterior side concave, but produced and rounded to the ventral margin, which is also somewhat rounded; inferior part of the posterior edge angulated and very acute, divided from the dorsal surface of the shell by a very strong oblique keel.

This species is usually found only in casts. We have but one example with the shell preserved, which is seen to be very thin and fragile. It is from the marlstone of Ilminster.

GERVILLIA INCURVA.—*Moore.*—Plate 7, fig. 12.

Shell rather small, elongated, incurved; umbones terminal, acute; hinge line short and slightly curved; posterior auricle moderately extended. The surface exhibits curved lines of growth which cross the winged area.

From the leptæna beds of the Upper Lias at Ilminster.

GERVILLIA OBLONGA—*Moore.*—Plate 7, fig. 11.

Shell rather small, ovate, convex; hinge line straight; umbones anterior, rather depressed; anterior ear small, posterior extended, wing-like and attenuated; ventral margin and sides roundly ovate; shell surface with numerous irregular lines of growth which cross the posterior auricle.

Very rare. A single example only has been obtained from the saurian and fish bed of the Upper Lias at Ilminster.

HIPPOPODIUM OVALIS.—*Moore.*
Plate 7, fig. 1, 2.

Shell ovately elongated, thick, ventricose, inequilateral; umbones incurved, anterior; posterior side very elevated and roundly gibbose; posterior end rounded; anterior end rounded and rather attenuated; ventral margin with a deep wide sinus; surface covered by coarse irregular transverse striæ, which are interrupted and wavy where they cross the sinus.

Excepting in the upper beds of the Lower Lias, this genus is exceedingly rare, and at most is only represented by two or three species. Our species is from the Ilminster marlstone, and only one specimen has been found.

INOCERAMUS PLICATUS.—*Moore.*—Plate 7, fig. 14.

Shell rather small, ovate, rather convex; umbones terminal, prominent; margins rounded; plications on surface distinct, rather distant.

This species is associated with the *Inoceramus dubius*, Sow., but its very plicated surface separates it from the latter, which is generally smooth, and also attains a much larger size. It is from the Upper Lias of Ilminster, and is rare.

ISOCARDIA LIASSICA.—*Moore.*—Plate 7, fig. 3.

Shell thin, smooth, sub-trigonal, inflated, nearly as thick as long, inequilateral; umbones rather anterior, prominent, incurved; anterior side flattened, cordiform; posterior side rather compressed and angular towards the ventral margin. Surface of the shell covered by very fine regular transverse striæ.

This shell is not uncommon in the marlstone of Ilminster and other localities, but rarely possesses its test. It is somewhat variable in its form, some being less inflated than others and more elongated, and occasionally the valves of the same shell differ in their length.

MODIOLA ORNATA.—*Moore.*—Plate 7, fig. 7.

Shell transversely ovate, gibbous; beaks small, incurved, nearly anterior; pedal region short, rounded; dorsal and posterior margins rounded; middle and ventral margins slightly sinuate; back of the shell diagonally gibbous, and covered by striæ, which pass from the umbo to the dorsal margins and posterior end. A slight sulcus divides the gibbous back from the anterior end, on which the striæ are obsolete. The striæ are crossed by numerous narrow regular lines of growth which give the shell a reticulated aspect.

Of this pretty shell we have six examples from the marlstone of Ilminster. It is associated with the *M. cuneata*, Sow.

MODIOLA DORSO-PLICATA.—*Moore*—Plate 7, fig. 8.

Shell rather small, thin, elongate, rather cylindrical; umbones sub-terminal, distinct; dorsal margins straight, ventral margin slightly sinuous; the dorsal surface is obtusely keeled and crossed by numerous raised concentric plicæ which bifurcate and pass into very fine striæ on the angle towards the ventral margin.

Three examples have been obtained from the saurian and fish bed at Ilminster.

OPIS CURVIROSTRIS.—*Moore.*—Plate 7, fig. 22.

Shell thick, sub-trigonal; umbones raised, terminal and curved; lunule rather small, deep, and rounded; the posterior side possesses a raised arched carina; anterior side and surface with distinct transverse or concentric lines, which become finer on the posterior angle after crossing the carina.

This species is from the Middle Lias of Ilminster, and is very rare, only one example having been recognized.

PERNA ANTIQUA.—*Moore.*—N. S.

Shell large, thin, twice as long as wide; umbones depressed, extending beyond the anterior margin; hinge line broad; surface of the shell smooth, flattened, with irregular lines of growth.

This species is from the marlstone of South Petherton, and measures six inches in length by three in breadth. Only one example is known. The inferior oolite is the lowest formation in which the genus has hitherto been found, this is therefore, the oldest known species. It is remarkable that although this genus has continued to live on from the Middle Lias to the present time, only ten species are recorded in a fossil state.

PINNA HARTMANII.—*Ziet.*

This shell is abundant in the marlstone, but is rarely to be found except in casts. These are occasionally upwards of a foot in length. The *Pinna folium*, Phillips's Geology of Yorkshire, t. 14, f. 17, is probably identical with this species, and is obtained from the same formation.

POSIDONOMYA BRONNII.—*Goldf.*—Plate 7, fig. 16.

The abundance of this shell in the Upper Lias clays both in continental and other localities, has suggested for the beds the term *Posodonomya Schiefer*. It is therefore singular that though the leptæna beds at Ilminster represent the same horizon, we have never recognized this shell in them. The example figured is from the saurian and fish bed, and the only one yet seen in the West of England.

PERNA DUBIA.—*Moore.*—Plate 7, fig. 10.

Shell rather small, sub-quadrate, slightly convex; hinge line straight, slightly extended posteriorly; margins rounded; surface with fine concentric lines of growth.

Three specimens have been found in the leptæna beds of Ilminster.

UNICARDIUM GLOBOSUM.—*Moore*—Plate 7, fig. 15.

Shell globose, equivalve, equilateral; umbones raised, mesial, closely meeting over a short hinge line; margins of the valves more depressed, closely fitting, and regularly rounding. The surface of the valves is covered by close depressed, fine concentric lines.

Only one other species of Unicardium has been obtained from the lias. The *(Corbula) Unicardium cardioides*, Phillips. This species we have also from the marlstone of Ilminster, and from Limpley Stoke, near Bath. The *U. globosum* is very well distinguished from it in having the umbones much more central and by its less angular and more rounded form, nor does it attain so large a size as the former species.

It is not uncommon in the marlstone of Ilminster, South Petherton, and other localities.

CORRIGENDA ET ADDENDA.

Page 123 *first line, for* four, *read* five or six.

„ 167 *add to list* Turbo Rutteri.

„ „ „ Cypricardia pellucida.

„ 173 „ Gervillia incurva.

„ 167 *cancel in list,* Turbo Ilminsterensis.

„ 208 *change* Turbo nudus, *a name already appropriated, to* T. linctus.

„ 167 & 210 *change* Turbo Bertholeti? *to* T. Hornesi? *Stol.*

FORAMINIFERA.

[It is perhaps not worth while to anticipate the publication (by the Palæontographical Society) of a Monograph on British Liassic Foraminifera, by any remarks on the geological or geographical distribution of the species and varieties of which short descriptions are now given. The present synopsis has been drawn up exclusively from the specimens in Mr. Charles Moore's collection, and pertains only to the Upper and Middle Lias marls of a limited area. How wide is the field embraced by the Liassic Protozoa may be judged by the various notes which have from time to time appeared in scientific periodicals since Mr. Moore first directed his attention to the subject. Notwithstanding the occasional contributions of Prof. Rupert Jones, the late Mr. Strickland, and others in this country, and the more extended memoirs of Dr. Bornemann and M. Terquem, on the continent, much is still required to render our knowledge of the group even tolerably complete.

Synonyms have been entirely omitted, but those of the prominent varieties will, in most cases, be found in the "Monograph of the Foraminifera of the Crag" (Palæontographical Society, 1865,) to which work the student is also referred for more detailed information concerning the relationships existing in the important groups of Foraminifera represented in the Liassic strata. H. B. B.]

FORAMINIFERA.

Class.—RHIZOPODA.

Order.—RETICULARIA.—*(Foraminifera.)*

Sub-order.—IMPERFORATA.

Family.—*LITUOLIDA, Carpenter.*

Genus.—LITUOLA, *Lamarck.*

Shell free or adherent; one- or many-chambered; straight, scorpioid, or spiral; texture coarsely arenaceous; septal aperture single or composite.

1. LITUOLA CENOMANA, *D'Orbigny*, sp.

Plate 1, fig. 1.

Placopsilina cenomana, D'Orbigny, Prodr. Paléont. Vol. ii, p. 185, No. 758.

Shell adherent, irregular, moniliform; the earlier chambers having a tendency to take a spiral arrangement.

Genus.—TROCHAMMINA, *Parker and Jones.*

Shell free or attached, variable in form, consisting of one or many chambers; texture arenaceous, the constituent particles embedded in a calcareous cement; surface smooth; septa (in polythalamous varieties) formed by the infolding of the primary shell-wall.

Sub-genus.—WEBBINA, *D'Orbigny.*

Shell adherent, one- or many-chambered.

1. WEBBINA IRREGULARIS, *D'Orbigny.*

Plate 1, fig. 2, 3.

Webbina irregularis, D'Orbigny, Foram. Canaries, p. 126, pl. 1, fig. 16—18; and For. Foss. Vien. p. 74, pl. 21, fig. 11, 12.

Shell adherent, moniliform; chambers oval, connected by stoloniferous tubes of variable length.

Sub-order.—PERFORATA.

Family.—*LAGENIDA, Carpenter.*

Genus.—NODOSARINA, *Parker and Jones.*

Shell straight, arcuate, or disco-spiral; composed of several chambers arranged in one series. Septal orifice single, terminal, either central or excentric; surface smooth, or ornamented with straight, parallel, longitudinal costæ or some modification thereof.

Sub-genus.—NODOSARIA, *Lamarck.*

Shell cylindrical, straight; smooth or ornamented with ribs, granules or spines; more or less constricted at the septal lines. Pseudopodial aperture simple, central, often pouting.

1. NODOSARIA RADICULA, *Linné*, sp. Plate 1, fig. 4.

Nautilus radicula, Linné, Syst. Nat. 12 Ed., p. 1164, No. 285.

Surface smooth; chambers few (4 to 8), ventricose.

2. NODOSARIA HUMILIS, *Roemer.* Plate 1, fig. 5.

Nodosaria humilis, Roemer, Verstein. Norddeutsch. Kreid., p. 95, pl. 15. fig. 6.

Shell short, but little constricted at the septal planes. Composed of three or four short wide chambers; surface smooth.

3. NODOSARIA RAPHANUS, *Linné*, sp. Plate 1, fig. 6.

Nautilus raphanus, Linné, Syst. Nat. 12th Ed., p. 1164, No. 283.

Shell composed of a few large chambers, ribbed from end to end by stout parallel ridges. The constrictions marking the septal lines often concealed by the overgrowing longitudinal costæ.

4. NODOSARIA RAPHANISTRUM, *Linné*, sp. Plate 1, fig. 7.

Nautilus raphanistrum, Linné, Syst. Nat., 12th Ed., p. 1163, No. 282.

Shell long, slender, many-chambered; with numerous, well-defined, parallel, longitudinal costæ.

5. Nodosaria paucicostata, *Roemer*. Plate 1, fig. 8.

Nodosaria paucicostata, Roemer, Verstein. Norddeutsch. Kreid., p. 95, pl. 15, fig. 7.

Shell short, tapering, few-chambered; with five or six stout longitudinal ribs. Constrictions at the septal lines scarcely perceptible.

6. Nodosaria hispida, *D'Orbigny*. Plate 1. fig. 9.

Nodosaria hispida, D'Orbigny, For. Foss. Vien. p. 35, pl. 1, fig. 24, 25.

Shell many-chambered; chambers oval or sub-spherical connected by stoloniferous tubes of variable length. Surface rough, beset with aciculi, the points of which are often worn off, and in this condition appear like minute turbercles.

Sub-genus.—Lingulina, *D'Orbigny*.

Shell straight, compressed. Septal orifice central, oblong.

1. Lingulina carinata, *D'Orbigny*. Plate 1, fig. 10.

Lingulina carinata, D'Orbigny, Ann. Sc. Nat., vol. vii, p. 257; Modèle No. 26.

Shell consisting of several slightly convex segments; septal aperture a narrow slit; margins thin, entire.

2. Lingulina tenera, *Bornemann*. Plate 1. fig. 11.

Lingulina tenera, Bornemann, Lias-Formation, p. 38, pl. 3, fig. 24 a—c.

Shell delicate, attenuated, consisting of about six segments; with four to six strong longitudinal ribs at unequal distances from each other; margins but little constricted at the septa.

Sub-genus.—Dentalina, *D'Orbigny*.

Shell sub-cylindrical, curved; aperture terminal, central, or but slightly excentric.

1. Dentalina communis, *D'Orbigny*.

Plate 1, fig. 12, 13.

Nodosaria (Dentalina) communis, D'Orbigny, Ann. Sc. Nat., vol. vii, p. 254, No. 35.

Shell elongated, tapering, arcuate; segments numerous, more or less ventricose; septal lines generally oblique; surface smooth.

2. DENTALINA PAUPERATA, *D'Orbigny*.

Plate 1, fig. 14.

Dentalina pauperata, D'Orbigny, For. Foss. Vien. p. 45, pl. 1, fig. 52—56.

Shell elongated; chambers numerous, the earlier ones cylindrical, and often showing no constrictions at the septa, the later chambers usually somewhat ventricose; surface smooth.

3. DENTALINA PLEBEIA, *Reuss*. Plate 1, fig. 15.

Dentalina plebeia, Reuss, Zeitsch. Deutsch. Geol. Ges. vol. vii, p. 267, pl. 8, fig. 9.

Shell sub-cylindrical; chambers numerous, short; septation obscure; the margin of the shell showing no constriction at the septal planes, surface smooth.

4. DENTALINA FILIFORMIS, *D'Orbigny*, sp.

Plate 1, fig. 16.

Nodosaria filiformis, D'Orbigny, Ann. Sc. Nat., vol. vii, p. 253 ; Soldani, Test. ac Zooph., vol. iv, pl. 10, fig. *e*.

Shell attenuated, arcuate, smooth; chambers numerous, cylindrical, much elongated; septa constricted.

5. DENTALINA OBLIQUA, *Linné*, sp. Plate 1, fig 17.

Nautilus obliquus, Linné, Syst. Nat., 12th Ed., p. 1163, No. 281.

Shell elongated, tapering, somewhat arcuate; chambers numerous, sub-cylindrical, ventricose; surface traversed by numerous, parallel, longitudinal ribs.

Sub-genus.—VAGINULINA, *D'Orbigny*.

Shell elongate, tapering, straight or arcuate, compressed, composed of several oblique segments, arranged in a linear series; septa scarcely at all constricted; aperture marginal.

1. VAGINULINA LEGUMEN, *Linné*, sp. Plate 1, fig. 18.

Nautilus legumen, Linné, Syst. Nat., 10th Ed., p. 711, No. 248.

Shell straight or curved, compressed; chambers compact; septal lines more or less limbate; the surface otherwise smooth.

2. VAGINULINA LÆVIGATA, *Roemer*. Plate 1, fig. 19.

Vaginulina lævigata, Roemer, Neues Jahrb. 1838, p. 383, pl. 3, fig. 11.

Shell straight or curved, compressed, without any ornamentation.

3. VAGINULINA STRIATA, *D'Orbigny*, Plate 1, fig 20.

Vaginulina striata, D'Orbigny, Ann. Sc. Nat., vol. vii, p. 257, No. 3.

Shell elongated, straight or curved, compressed, traversed by numerous longitudinal, parallel costæ; septation often obscured by the thickened shell-wall.

Sub-genus.—MARGINULINA, *D'Orbigny*.

Shell elongated, sub-cylindrical or flattened, curved and tending towards a spiral arrangement in the earlier chambers; aperture terminal, marginal.

1. MARGINULINA RAPHANUS, *Linné*, sp. Plate 2, fig. 21.

Nautilus raphanus, Linné, Syst. Nat., 10th Ed., p. 711, No. 243.

Shell elongated, sub-cylindrical or flattened, usually more or less curved; composed of few stout chambers, usually ventricose; surface having an ornamentation of prominent, parallel ridges. (This is regarded as the type or central form to which all the *Nodosarinæ* are referable specifically.)

2. MARGINULINA GLABRA. *D'Orbigny*. Plate 2, fig. 22.

Marginulina glabra, D'Orbigny, Ann. des Sc. Nat., vol. vii, p. 259, No. 6; Modéles No. 55.

Shell elongated, sub-cylindrical, much curved; surface smooth.

3. MARGINULINA ENSIS, *Reuss*. Plate 2, fig. 23.

Marginulina ensis, Reuss, Verst. Böhm. Kreid., pt. 1, pp. 29 & 106, pl. 13, fig. 26.

Shell elongated, somewhat compressed, straight or crozier-shaped; early chambers helicoid, later ones in a linear series; septa oblique; surface smooth.

Sub-genus.—PLANULARIA, *D'Orbigny.*

Shell out-spread, thin, composed of numerous short, wide, chambers, arranged in one linear series; chambers oblique; earlier growth of the shell sometimes straight, but usually having a tendency to a spiral form; surface smooth, striate, or costate; aperture marginal.

1. PLANULARIA PAUPERATA, *Parker & Jones.*
Plate 2, fig. 24, 25, (& 26 ?)

Planularia pauperata, Parker & Jones, Quart. Jour. Geol. Soc., vol. xvi, p. 454, pl. 20, fig. 39.

Shell broad, somewhat bi-convex; margin entire; chambers oblique, much curved; surface smooth.

Note.—Figure 25 most resembles the specimens described by Messrs. Parker and Jones, in their paper referred to, on the Chellaston Foraminifera. The larger form (fig. 24) is similar to the varieties found in the Subapennine Tertiary Clays, but scarcely needs a distinct varietal name. In the same way fig. 26 does not exactly correspond with any published figure of a *Planularia*, but is a pretty modification of the helicoid form, having the outer margins of the chambers somewhat raised.

2. PLANULARIA LONGA, *Cornuel.* Plate 2, fig. 27.

Planularia longa, Cornuel, Mém. Soc. Géol. France, 2 Ser., vol. iii, p. 253, pl. 3, fig. 38, 39.

Shell elongated, complanate, very thin; chambers oblique, especially the earlier ones, but slightly ventricose at the margins; surface smooth.

3. PLANULARIA CORNUCOPIÆ, sp. nov.
Plate 2, fig. 28, 29.

Shell elongate, complanate, very thin, the portion formed by the earlier chambers much curved, but with its inner margins free, (not helicoid); outer margin of the shell entire, inner margin often irregular owing to the uneven length of the chambers. Chambers very numerous, curved, more or less wedge-shaped.

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4. PLANULARIA BRONNI, *Roemer.* Plate 2, fig. 30.

Planularia Bronni, Roemer, Verstein. Norddeutsch. Kreid., p. 97. pl. 15, fig. 12.

Shell elongate, complanate; earlier chambers somewhat convex and sub-nautiloid; later ones out-spread and thin; chambers oblique, somewhat curved, and often slightly ventricose at their inner margins; surface of the shell covered by delicate, parallel, longitudinal riblets or striæ.

5. PLANULARIA RETICULATA, *Cornuel.*

Plate 2, fig. 31—33.

Planularia reticulata, Cornuel, Mém. Soc. Géol. France, 2 ser., vol. iii, p. 253, pl. 4, fig. 1—4.

Shell elongate, thin, tapering, straight or but slightly curved; chambers numerous, oblique, each chamber having numerous, stout, parallel costæ in the direction of the long diameter of the shell; costæ seldom continuous.

6. PLANULARIA HARPULA, *D'Orbigny*, sp.

Plate 3, fig. 34, 35.

Marginulina harpula, D'Orbigny, Cours Élém. Paléont., vol. ii, p. 195, fig. 318.

Shell elongate, complanate; chambers numerous, oblique, the earlier ones shorter than those forming the bulk of the shell, and somewhat curved. About one half of the shell (the outer half) traversed by stout parallel longitudinal ribs, the inner half smooth and showing the septation.

Note.—D'Orbigny places this variety under *Marginulina*, but the fine, large, well developed specimens from the Lias are quite *Planularian* in character. After all the sub-generic distinction is artifical.

Sub-genus.—CRISTELLARIA, *Lamarck.*

Shell round, disco-spiral, oval, oblong or crozier-like, composed of a single series of chambers, arranged in a spiral of one or more whorls; when in more than a single whorl, each succeeding circle embraces those within; the latter chambers often depart from the spire. Aperture near the outer or convex margin, usually close to it; variable in form.

1. CRISTELLARIA ROTULATA, *Lamarck*, sp.

Plate 3, fig. 36.

Lenticulites rotulata, Lamarck, Annales du Muséum, vol. v, p. 188, No. 3.

Shell lenticular, nautiloid, bi-convex, usually having a small circular depression at the umbilicus; edge rounded or sharp, but not keeled; aperture variable.

2. CRISTELLARIA CULTRATA, *Montfort*, sp.

Plate 3, fig. 37.

Robulus cultratus, Montfort, Conchyl. Systém., vol. i, p. 214, 54e genre.

Shell lenticular, nautiloid, bi-convex, often depressed at the

umbilicus, having a thin, well-defined keel, widest at the earliest portion of the outer turn of the spiral, gradually narrowing towards the terminal chamber. Aperture very variable; in typical specimens, triangular, and situated near the margin of the terminal chamber.

3. CRISTELLARIA ACUTAURICULARIS, *Fichtel & Moll*, sp.

Plate 3, fig. 38.

Nautilus acutauricularis, Fichtel & Moll, Testac. Microscop. p. 102, pl. 18, fig. *g*, *h*, *i*.

Shell oblong or oval, bi-convex, sub-nautiloid; the later chambers projecting beyond the helicoid portion; aperture often pouting; surface smooth.

4. CRISTELLARIA CREPIDULA, *Fichtel & Moll*, sp.

Plate 3, fig. 39.

Nautilus crepidula, Fichtel & Moll, Testac. Microscop. p. 107, pl. 19, fig. *g*. *h*. *i*.

Shell elongated, narrow; earlier chambers minute, helicoid; later chambers much elongated, and reaching nearly or quite to the spiral portion; shell compressed, transparent.

5. CRISTELLARIA RHOMBOIDEA, *Czjzek*.

Plate 3, fig. 40—42.

Cristellaria rhomboidea, Czjzek, Haidinger's Nat. Abhandl. vol. ii, p. 140, pl. 12, fig. 21, 23.

Shell much elongated, crozier-like, compressed; earlier chambers helicoid, later ones in a straight or curved line; later chambers commonly ventricose, and subject to great irregularity in form and setting on.

Note.—This species may be conveniently taken to comprise a large number of anomalous forms having irregularly connected chambers.

6. CRISTELLARIA COSTATA, *D'Orbigny*.

Plate 3, fig. 43.

Cristellaria costata, D'Orbigny, Ann. Sci. Nat. vol. vii, p. 292, No 10; Modéle No. 84.

Shell oval, compressed, few-chambered, often having a slight keel at the margin of the earlier chambers; septation obscure; surface ornamented by partial, delicate, ridges, parallel to the axis of the shell.

Sub-genus.—FLABELLINA, *D'Orbigny.*

Shell compressed, elongated; earlier chambers spiral in arrangement as in *Cristellaria*, the remainder Λ shaped, each closely applied by its inner margins to the previouse hamber, as in *Frondicularia*; aperture at first marginal, ultimately central.

Note.—*Flabellina* gives the connecting links between *Cristellaria* and *Frondicularia*, and like other intermediate forms is very variable. See the figures.

1. FLABELLINA RUGOSA, *D'Orbigny.*

Plate 3, fig. 44—46.

Flabellina rugosa, D'Orbigny, Mém. Soc. Géol. France, vol. IV, p. 23, pl. 2, fig. 4—7.

Shell compressed, oblong, oval, or rhomboidal; earlier growth not distinguishable from *Cristellaria*, later chambers Λ shaped, thin, and out-spread.

Sub-genus.—FRONDICULARIA, *Defrance.*

Shell regular, equilateral, oblong or rhomboidal, much compressed; chambers representing two sides of a triangle, or strongly arcuate.

1. FRONDICULARIA COMPLANATA, *Defrance.*

Plate 3, fig. 47.

Frondicularia complanata, Defrance, in Blainville's Dict. Sci. Nat., vol. xxxii, p. 178; Atlas Conch. pl. 14, fig. 4.

Shell complanate or slightly bi-convex; chambers numerous, the earlier ones swollen; surface smooth.

Note.—Many fine specimens amongst those from the Lias have the margin of each chamber thickened (limbate), forming a sort of border, as in the figure. It seems scarcely necessary to separate these from the sub-type; they resemble most strongly *Fr. canaliculata* of Reuss.

2. FRONDICULARIA STRIATULA, *Reuss.*

Plate 3, fig. 48.

Frondicularia striatula, Reuss, Verstein. Böhm. Kreid., pt. 1, p. 30, pl. 8, fig. 23, and pt. II, p. 107, pl. 43, fig. 11.

General form as in *Fr. complanata*; surface traversed longitudinally by delicate parallel striæ. Sometimes the margin of the chambers are thickened into a raised border, and in these

specimens the ribblets are only found on the depressed portion of the chambers, as in Professor Reuss's figure. When the striation is continuous the septation is obscured thereby.

Genus.—POLYMORPHINA, *D'Orbigny.*

Shell free, spherical or oblong; segments varying in number, obscurely bi-serial, or sometimes in a confused spire, and more or less embracing, sometimes enclosing previous segments; septal lines often depressed; aperture at the extremity of the ultimate chamber, round, usually bordered by minute radiating grooves.

1. POLYMORPHINA LACTEA, *Walker and Jacob.*

Plate 3, fig. 49.

Serpula lactea, Walker & Jacob, in Adams' Essays (Kanmachers' Ed.) p. 634, pl. 14, fig. 4.

Shell oval. elongated; chambers few in number; septal lines but slightly depressed.

Note—This is the *Polymorphina Liassica* of Strickland, Q. J. Geol. Soc., vol. ii, p. 30.

2. POLYMORPHINA COMPRESSA, *D'Orbigny.*

Plate 3, fig. 50.

Polymorphina compressa, D'Orbigny, For. Foss. Vien. p. 233, pl. 12, fig. 32—34.

Shell oval or oblong, compressed; chambers bi-serial, long, oblique, ventricose.

PLATES TO ILLUSTRATE
MR. CHARLES MOORE'S PAPER
ON THE
MIDDLE AND UPPER LIAS
OF THE
SOUTH WEST OF ENGLAND.

In each plate, the small lines placed by the figures, are intended to denote their natural size, the magnifying power employed in drawing the Foraminifera (Plates I, II, & III) is stated in the "Explanation of Plates."

EXPLANATION OF PLATES.

PLATE I.

The reference letter *b* represents the end view of the shell shewing the aperture, except where stated otherwise.

Fig.

1. *Lituola cenomana*, D'Orbigny, sp., magnified 35 diameters.
2. *Webbina irregularis*, D'Orbigny, adherent specimen, 20 diams.
3. „ „ D'Orbigny, detached specimen, 20 diams.
4. *Nodosaria radicula*, Linné, sp., 35 diams.
5. „ *humilis*, Roemer, 35 diams.
6. „ *raphanus*, Linné, sp., 35 diams.
7. „ *raphanistrum*, Linné, sp., 35 diams.
8. „ *paucicostata*, Roemer, 35 diams.
9. „ *hispida*, D'Orbigny, 35 diams.
10. *Lingulina carinata*, D'Orbigny, 35 diams.
11. „ *tenera*, Bornemann, 35 diams.
12. *Dentalina communis*, D'Orbigny, 35 diams.
13. „ „ „
14. „ *pauperata*, D'Orbigny, 35 diams.
15. „ *plebeia*, Reuss, 35 diams.
16. „ *filiformis*, D'Orbigny, 35 diams.
17. „ *obliqua*, Linné, sp., 35 diams.
18. *Vaginulina legumen*, Linné, sp., 25 diams.
19. „ *lævigata*, Roemer, 25 diams.
20. „ *striata*, D'Orbigny, 25 diams.

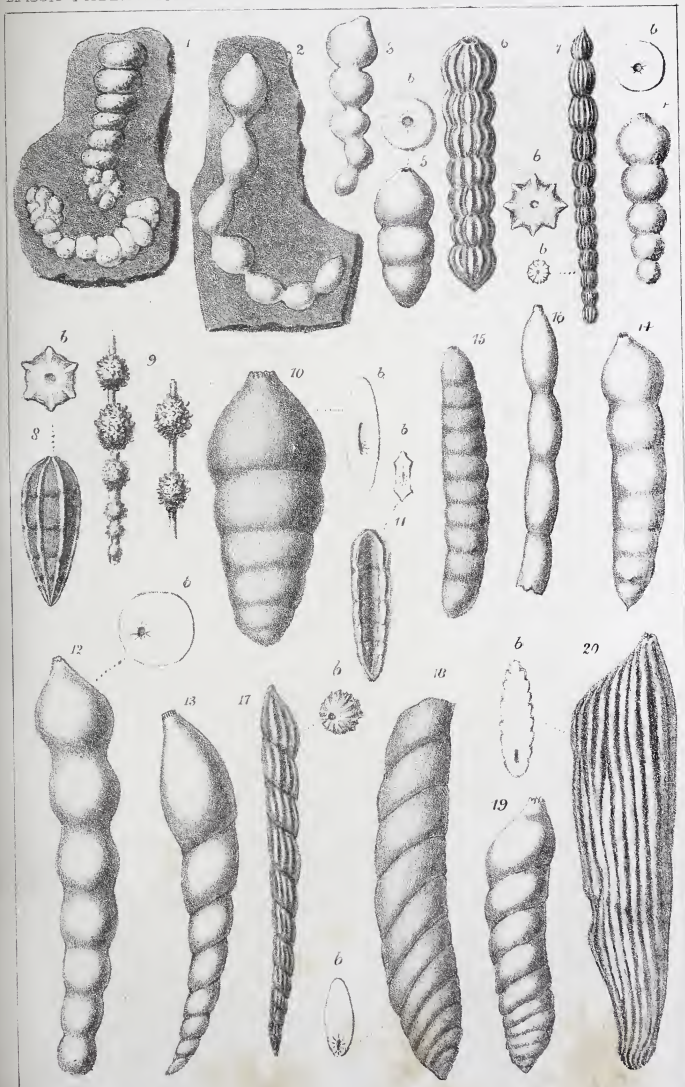
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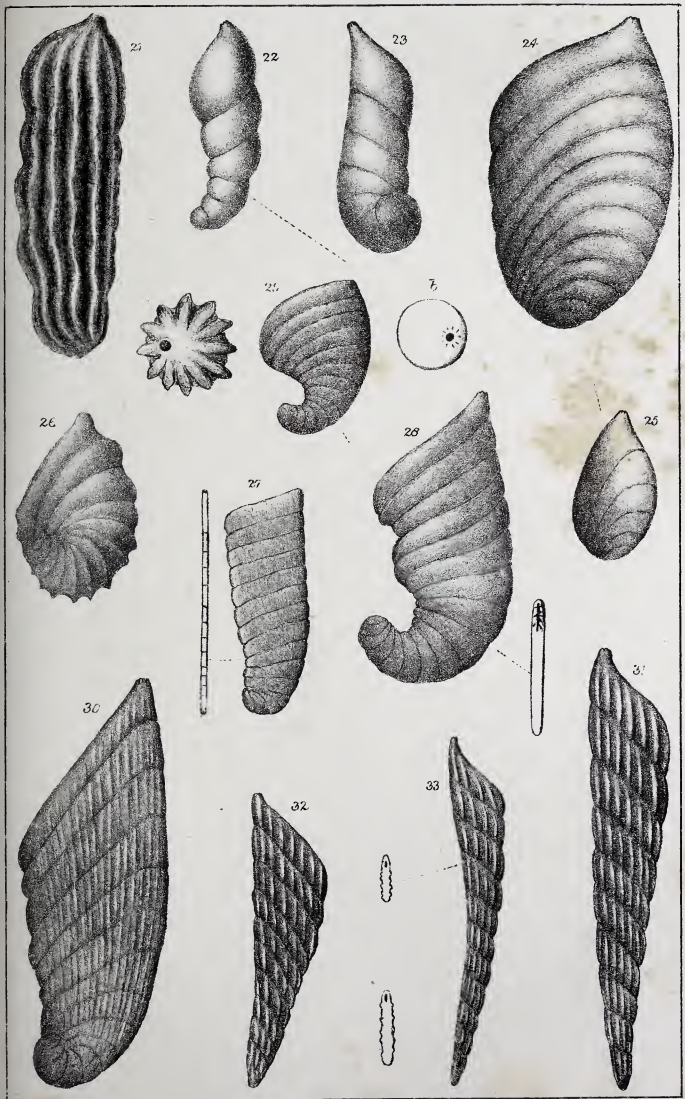
PLATE II.

Fig.

21. *Marginulina raphanus*, Linné, sp. magnified 25 diameters.
22. „ *glabra*, D'Orbigny, 35 diams.
23. „ *ensis*, Reuss, 35 diams.
24. *Planularia pauperata*, Parker & Jones, (large var.) 25 diams. *b* lateral edge.
25. „ „ 25 diams.
26. „ „ (?) var. 25 diams.
27. „ *longa*, Cornuel, 25 diams. *b* edge view.
28. „ *cornucopiæ*, sp. nov. 25 diams.
29. „ „ 25 diams.
30. „ *Bronni*, Roemer, 25 diams.
31. „ *reticulata*, Cornuel, 25 diams.
32. „ „ „ 25 diams.
33. „ „ „ 25 diams.



H.B. Brady del. ad nat.

PLATE III.

Fig.

34. *Planularia harpula*, D'Orbigny, sp. magnified 25 diameters.
35. „ „ D'Orbigny, 25 diams.
36. *Cristellaria rotulata*, Lamarck, sp. 25 diams.
37. „ *cultrata*, Montfort, sp. 25 diams.
38. „ *acutauricularis*, Fichtel & Moll, sp. 25 diams.
39. „ *crepidula*, Fichtel & Moll, sp. 35 diams.
40. „ *rhomboidea*, Czjzek, 35 diams.
41. „ „ „ 35 diams.
42. „ „ „ 35 diams.
43. „ *costata*, D'Orbigny, 35 diams.
44. *Flabellina rugosa*, D'Orbigny, 35 diams.
45. „ „ „ 35 diams.
46. „ „ „ 35 diams.
47. *Frondicularia complanata*, Def., 35 diams. *b* lateral edge.
48. „ *striatula*, Reuss, 35 diams. *b* lateral edge.
49. *Polymorphina lactea*, Walker & Jacob, 75 diams.
50. „ *compressa*, D'Orbigny, 75 diams.

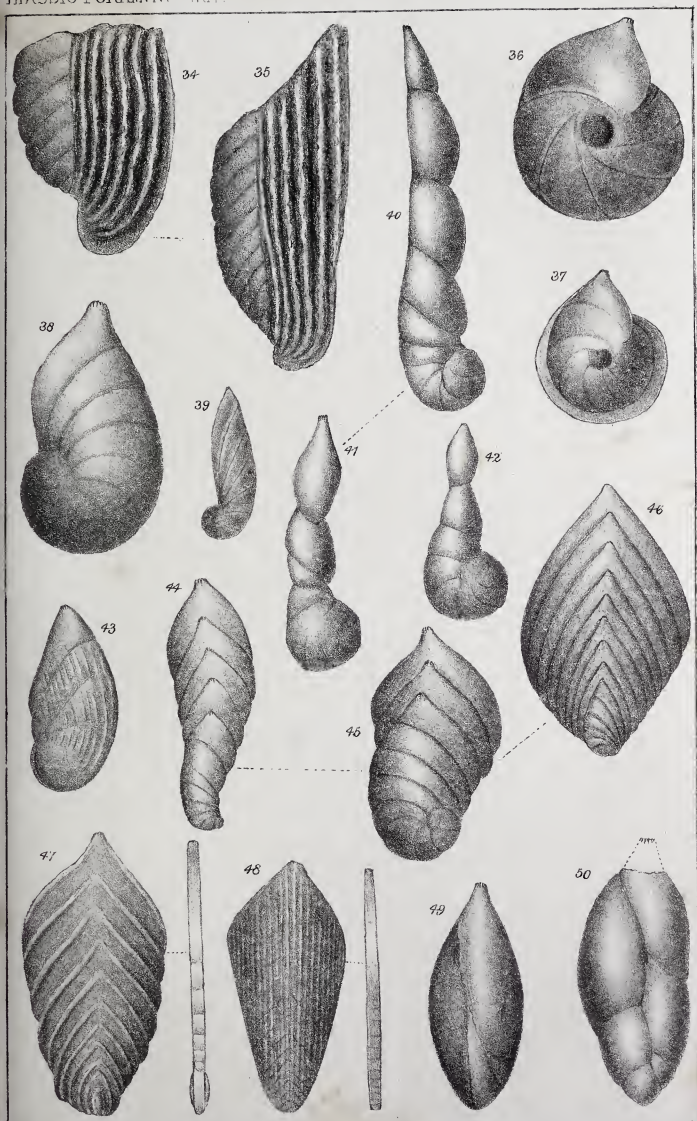

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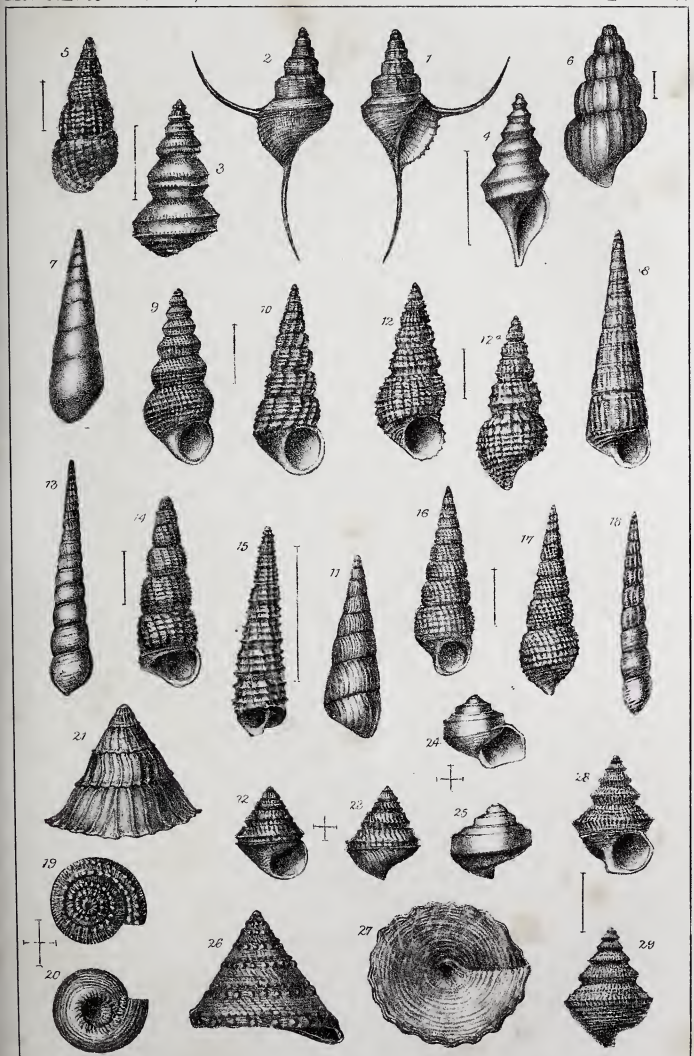
PLATE IV.

Fig.

1. *Alaria unispinosa*, n. s. front view, nat. size.
2. „ „ back view.
3. „ *coronata*, n. s. back view, enlarged.
4. „ *angulata*, n. s. front view, enlarged.
5. *Cerithium asperulum*, n. s. back view, enlarged.
6. „ *minor*, n. s. back view, enlarged.
7. „ *planum*, n. s. back view, nat. size.
8. „ *pyramidalis*, n. s. front view, nat. size.
9. „ *Camertonensis*, n. s. front view, enlarged.
10. „ *gradatum*, n. s. front view, enlarged.
11. „ *sub-lineatum*, n. s. back view, nat. size.
12. „ *Ilminsterensis*, n. s. front view, enlarged.

12*a* „ „ back view, enlarged.

13. *Turritella similis*, n. s. back view, nat. size.
14. *Cerithium coronatum*, n. s. front view, enlarged.
15. „ *varicosum*, Desl., front view, enlarged.
16. „ *liassicum*, n. s. front view, enlarged.
17. „ „ back view, enlarged.
18. *Turritella anomala*, n. s. back view, nat. size.
19. *Solarium crenulatum*, n. s. top view, enlarged.
20. „ „ base, enlarged.
21. *Onustus spinosus*, n. s. nat. size.
22. *Trochus similis*, n. s. front view, enlarged.
23. „ „ back view, enlarged.
24. „ *carinatus*, n. s. front view, enlarged.
25. „ „ back view, enlarged.
26. „ *nodulatus*, n. s. front, shewing mouth.
27. „ „ base, nat. size.
28. „ *concinnus*, n. s. front view, enlarged.
29. „ „ back view, enlarged.

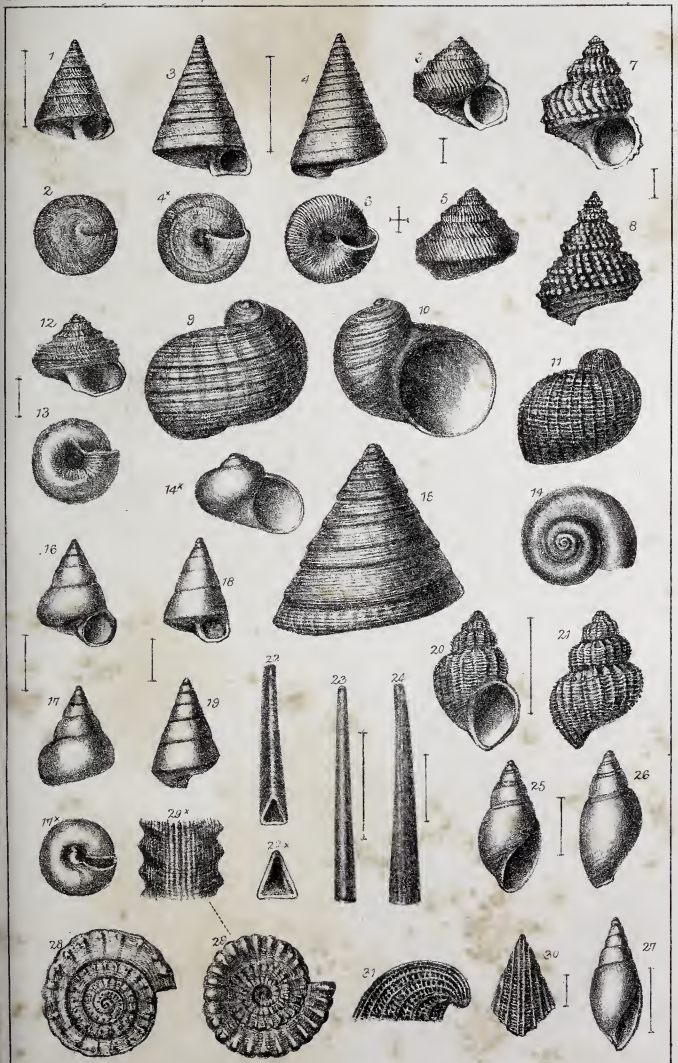


A.F. Hallick del. W. West lith.

PLATE V.

Fig.

1. *Trochus flexicostatus*, n. s. front view, enlarged.
2. „ „ base.
3. „ *lineatus*, n. s. front view, enlarged.
4. „ „ back view, enlarged.
4×. „ „ base, ditto.
5. „ *Pethertonensis*, n. s. back view, enlarged.
6. „ „ shewing mouth, enlarged.
6× „ „ base of ditto.
7. „ *mammilaris*, n. s. front, shewing mouth, enlarged.
8. „ „ back of ditto.
9. *Neritopsis transversa*, n. s. back view, nat. size.
10. „ „ front view.
11. „ *Spekei*, n. s. back view, rather enlarged.
12. *Pleurotomaria costulatum*, n. s. front view, enlarged.
13. „ „ base of ditto.
14. „ *heliciformis*, Desl., top view.
14× „ „ front view.
15. „ *Comptonensis*, n. s. back view.
16. *Pitonillus turbinatus*, n. s. front view, enlarged.
17. „ „ back view.
17× „ „ base of ditto.
18. „ *linctus*, n. s. front view, enlarged.
19. „ „ back view.
20. *Purpurina ornatissima*, n. s. front view, rather enlarged.
21. „ „ back view.
22. *Dentalium? trigonalis* n. s. rather enlarged.
22× „ „ triangular aperture, enlarged.
23. „ *gracile*, n. s. enlarged.
24. „ *liassicum*, n. s. enlarged.
25. *Actæonina Ilminsterensis*, n. s. front view, enlarged.
26. „ „ back view.
27. *Cylindrites Whitfieldii*, n. s. front view, enlarged.
28. *Discohelix Dunkeri*, n. s. top view.
29. „ „ shewing base.
29× „ „ back view, enlarged.
30. *Rimula punctata*, n. s. front view, enlarged.
31. „ „ side view, enlarged.

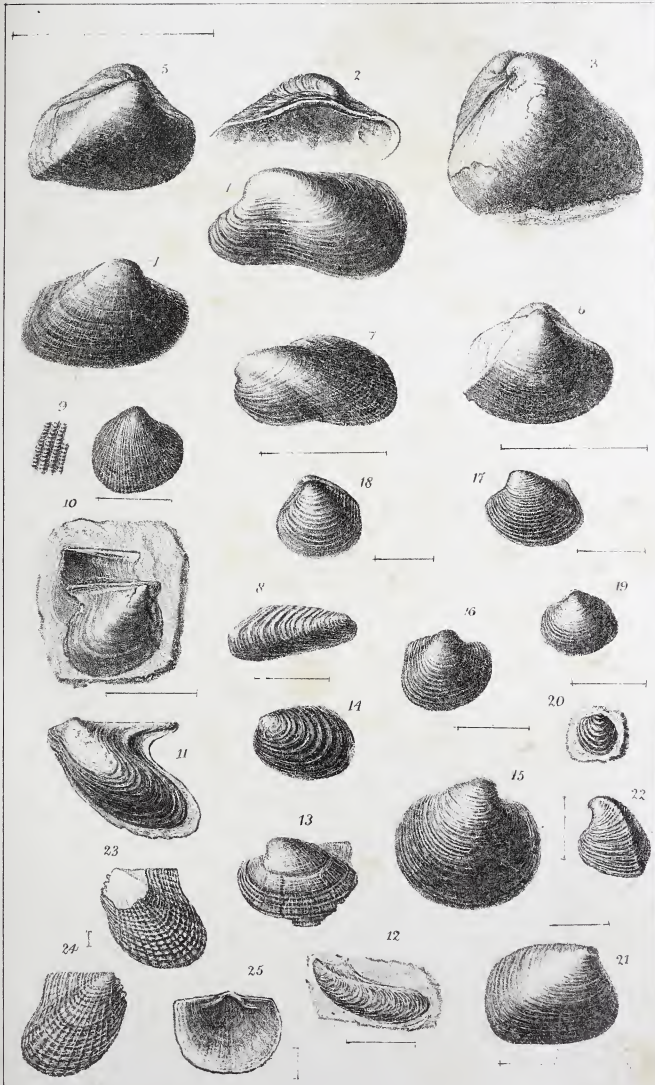


A.F. Holden del. W. West lith.

PLATE VII.

Fig.

1. *Hippopodium ovalis*, n. s. nat. size.
2. „ „ shewing the ligamental area.
3. *Isocardia liassica*, n. s.
4. *Cucullæa bilineata*, n. s.
5. *Cypricardia intermedia*, n. s. reduced.
6. „ *pellucida*, n. s. reduced.
7. *Modiola ornata*, n. s. rather enlarged.
8. „ *dorso-plicata*, n. s. enlarged.
9. *Cardita liasiana*, n. s. enlarged.
10. *Perna dubia*, n. s. nat. size.
11. *Gervillia oblonga*, n. s. rather enlarged.
12. „ *incurva*, n. s. enlarged.
13. *Arca interrupta*, n. s. nat. size.
14. *Inoceramus plicatns*, n. s.
15. *Unicardium globosum*, n. s. half nat. size.
16. *Posidonomya Bronnii*, Goldf.
17. *Corbula Somersetiensis*, n. s. rather enlarged.
18. *Astarte duplicata*, n. s. rather enlarged.
19. „ *parallela*, n. s. nat. size.
20. „ *Oppeli*, n. s. nat. size.
21. „ *Camertonensis*, n. s. nat. size.
22. *Opis curvirostris*, n. s. rather enlarged.
23. *Avicula imbricata*, n. s. left valve, much enlarged.
24. „ „ right valve, ditto.
25. ? ? Incorrectly drawn.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