

On Gryphæa Incurva and its Varieties.

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Few fossil shells are better known to Geologists, or to the populace of the districts in which they occur, than those which form the subject of the present paper. The abundance in which they are found in the Vale of Gloucester, in the classical sections of the Lias, as at Purton and Fretherne, and in the superficial soils as exposed by agricultural operations, renders them familiar to all, and accounts for their having received popular names. The generic denomination, in scientific language, is derived from the Greek word ΓΡΥΨ or ΓΡΥΨΙΟΣ, "incurved or inflected," which well describes the most striking characteristic of the commonest form—the *Gryphæa incurva*. The popular names, "Devil's toe-nails" and "Cuckoo shells," are of more obscure origin. The ordinary specimens of *G. incurva*, when viewed in profile with the concave valve almost concealed from view, readily enough suggest the idea of talons, and in the absence of any other monster sufficiently formidable to bear them, known to the unlearned, are naturally considered to be "membra disjecta" of the father of evil himself. The larger and more strongly incurved specimens, may in like manner, suggest to some imaginations the idea of horns, which appendages are supposed to be worn by members of a secret society, to whom the note of the bird of Spring is held to be particularly obnoxious, accounting therefore for the connection of its name with the shell in question. They were formerly calcined to make a lime water, which was considered a sovereign remedy for a malady to which cattle are subject, called the red-water. It would have been difficult to select a group of shells which could better exemplify the utility of such a series of illustrated monographs, as that to which the Club proposes to devote its resources, as will be shown in the present paper, which will treat only of the Gryphites of the Lias.

In adopting the name *Gryphæa*, we do not lose sight of the fact, that in all probability, the inhabitants of the shells to which it is restricted were true oysters; but there is connected with it, so well defined an idea of an oyster of peculiar type, which first makes its appearance in the Liassic formation, that the convenience of its retention is obvious, and the question whether it should take generic or sub-generic rank, is of trifling importance. This group of shells consists of those which, from regularity of form, uniformity of character, and presumed difference of habit, were separated from the oysters under the name of *Gryphæa*, by LAMARCK, in his "Système des Animaux sans Vertèbres," in 1801, but as he was apparently misled, by having studied the adult shell only, and conceiving that it had always been free, therefore gave in his generic definition undue prominence to this assumed fact, we adopt the following description of SOWERBY, from his Mineral Conchology, as generally, though not absolutely, more concise and correct.

GRYPHÆA.

"A free, (except when very young,) unequal-valved, inequilateral "bivalve, larger valve involutely curved, concave, smaller valve flattish, "beakless; hinge, a transversely striated pit, containing an internal "ligament, without teeth or crenatures."

The Liassic species, recognised by most English writers, to which the foregoing generic terms apply, are those to which we have now to address ourselves, and may be stated as follows:—

Gryphæa incurva, Sowerby.

G. suilla, Schlotheim.

G. obliquata, Sowerby.

G. Maccullochii, Sowerby.

G. depressa, Phillips.

G. cymbium, Lamarck.

all of which, labelled as above, are to be found in most collections of importance throughout the kingdom, and are more or less common (as we believe) in this district.

Upon enquiring where, as tyros, we may find pictorial illustrations of the differences between them, we learn that we must refer to the works cited as follows:—

For *G. cymbium*, to the *Encyclopédie Méthodique*; the *Petrefacta Germaniæ* of Goldfuss; the *Coquilles Fossiles des Environs de Paris*, of Deshayes; Sowerby's *Mineral Conchology*; or Phillips' *Geology of Yorkshire*.

For *G. depressa*, to the last-named work.

For *G. incurva*, to two of the former works; to the *Petrefacten of Zieten*; and *Parkinson's Organic Remains*.

For *G. suilla*, to *Goldfuss*.

For *G. obliquata* and *Macullochii*, to *Sowerby's Mineral Conchology*.

It is scarcely necessary to observe, that all these works are of so expensive a character, as to place them beyond the reach of the great majority of geological students; that they are all out of print, and not always attainable by those who *can* afford to purchase them; hence, therefore, the desirability of carrying out the design we have formed. It will be seen in the sequel, that we shall have occasion to refer to various other supposed species, described by continental authorities.

The first which claims our notice in stratigraphically ascending order is the *Gryphæa incurva*, of *Sowerby*, or *arcuata*, of Foreign Writers, the latter being the name under which it was described by *Lamarck*, the typical form of which has been figured by the following, amongst many other authors:—

- Bourget*, 1742, *Traité des Petrefactions*, Paris. Plate 15, figure 92.
- Walcot*, 1779, *Description of Petrifications near Bath*. P. 51, f. 34.
- Encyclopédie*, 1789. P. 189.
- G. arcuata*, *Lamarck*, 1801, *Système des Animaux sans Vertèbres*. P. 398.
- G. arcuata*, *Parkinson*, 1811, *Organic Remains*. Vol. III. p. 209, P. 59, f. 4.
- G. incurva*, *Sowerby*, 1815, *Mineral Conchology*. Vol. II. p. 23, P. 112, f. 1, 2.
- G. arcuata*, *Lamarck*, 1819, *Animaux sans Vertèbres*. Vol. VI. P. 198, No. 4.
- G. incurva*, *Defrance*, 1829, *Dictionnaire des Sciences Naturelles*. XIX. P. 536.
- G. arcuata*, *De Blainville*, 1825, *Manuel de Malacologie et de Conchyliologie*. P. 59, f. 4.
- G. incurva*, *Zieten*, 1830, *Die Versteinerungen Wurtemberges*. P. 65, pl. 49, f. 1.
- G. arcuata*, *Deshayes*, 1831, *Descriptions des Coquilles Caractéristiques des Terrains*. P. 98, pl. 12, f. 4, 6.
- G. arcuata*, *Goldfuss*, 1835, *Petrefacta Germaniæ*. Pl. 8, f. 1, 2.
- G. arcuata*, *Roemer*, 1836, *Die Versteinerungen des Nord Deutche: Oolithengebirges, Hanover*. P. 62.
- G. arcuata*, *Schmidt*, 1846, *Petrefacten-Buch*. P. 61, pl. 18, f. 3.

Ostrea arcuata, Deshayes, 1849, *Traité Elementaire de Conchyliologie*. Pl. 56, f. 8, 9.

Ostrea arcuata, D'Orbigny, 1850, *Prodrome de Paléontologie Stratigraphique*. Vol. I, p. 220.

It is, in fact, the shell invariably figured as the best type of the subgenus to which it belongs, and cannot fail to be recognised from the rudest figure, or from the following description, which is here somewhat amplified from SOWERBY.

SPECIFIC CHARACTER.

“Elongated, very involuted, right side” presenting a more or less “strongly marked, or an obscure lobe,” (when viewed with the smaller valve placed downwards, and the umbonal portion turned away from and at right angles to the front of the observer;) “lesser valve oblong,” “externally concave.”

This description applies only to the ordinary adult form, than which none would appear at first sight to be more easily determinable, but the following list of what are considered by some authors of repute to be distinct species, and merely synonymes of one, by others, will at once give an idea of the notable modifications and changes of form, of which this species is susceptible, the shells named in it representing every imaginable gradation between the outlines of the Common Oyster, and those of the most perfectly developed *G. arcuata*.

<i>G. Maccullochii</i> of Zieten.	...	...	Table 49, fig. 3.
<i>G. læviuscula</i>	„	...	„ „ „ 4.
<i>G. ovalis</i>	„	...	„ „ „ 1.
<i>G. Maccullochii</i> of Sowerby.	...	...	„ 547, „ 1, 2, 3.
<i>G. gigantea</i>	„	...	„ 391.
<i>G. obliquata</i> , Goldfuss.	...	...	„ 85, „ 2.
<i>G. obliquata</i> of Sowerby.	...	...	„ 112, „ 3.
<i>O. irregularis</i> , Goldfuss.	...	...	„ 79, „ 5.
<i>O. læviuscula</i> ,	„	...	„ „ „ „
<i>O. ungula</i> , Münster, Handbuch, jeune.	„	...	„ 325.
<i>O. semicircularis</i> , Roemer.			
<i>O. irregularis</i> , D'Orbigny, 1853.			Prod. VI. p. 238.
<i>O. intermedia</i> , Terquem.			
<i>G. depressa</i> , Phillips.			
<i>G. lobata</i> , Buvignier.			

Although Oysters have been found in much older formations, as exemplified by the unique specimen of *Ostrea nobilis*, from the carboniferous limestone of Belgium, which may be seen in the British Museum, with others from the Triassic “Saliferian” of St. Cassian,

they amount in number of species, in the opinion of our talented colleague, MR. S. P. WOODWARD, to three only, and it is first in Jurassic strata, that they make their appearance in any remarkable number or variety.

Taking into consideration this fact, with that of the universally admitted variety of forms attributable to one species: to those who have interested themselves in the theory of transmutation, as originally propounded by LAMARCK, subsequently by the Author of the *Vestiges*, and since, more practically by DARWIN, in his *Treatise on the Origin of Species*, the elaboration of figures, and the minute details here presented, although apparently uselessly repeated, may yet assume an aspect of interest which they could not otherwise possess. *Ostrea Interstriata* (*Plicatula*, of Emmerich,) of the White Lias, and the small oyster, which covers the slabs of Lower Lias at Wainload, Westbury, Penarth, &c. associated with *Modiola minima*, recognized by BUCKMAN and other local writers, as *Ostrea Liassica*, are the earliest known to us in this district. Distinctly Gryphoid forms occur considerably higher in the series, and are most abundant from the zone of *Ammonites Bucklandi*, to that in which it is supposed to be replaced by *Gryphæa obliqua*; but any one who has carefully examined these in considerable numbers, and can therefore fully appreciate the infinite diversity of form which they assume, rendering the determination of the differences between Oysters and Gryphites exceedingly perplexing, may possibly, in the sequel, feel disposed to adopt the suggestion of QUENSTEDT, that *Ostrea Liassica* may really be the ancestral precursor of the species under consideration. As the true relations of these forms can only be properly illustrated by examples, we must now refer to figures of the specimens selected for that purpose.

Figures 1, 1^a, 1^b, Plate 1, represent specimens of ordinary type from Purton, near Sharpness Point.

Figures 2, 2^a, 2^b, Plate 1, are half grown, and 3, 4, 4^a, more advanced forms, in neither of which is the beak obliquely incurved, but is very nearly central,—the lateral lobe is scarcely traceable in either of these specimens, while it will be observed that the smaller valves differ much in character. On comparing figures 2 and 4 with fig. 3, that of 3 is seen to be exceedingly massive, composed also of very thick plates, and rising prominently above the margin of the lower shell, whilst those of figures 2^b and 4^a, being formed of thin laminæ, are concave, and, as seen in profile, with scarcely any portion of them visible above the margin of the lower valves. All these are from the *Ammonites Bucklandi* bed at Purton, where they occur in immense numbers, and in the best possible state of

preservation, both in the limestone layers and in the clays. Figures 3 and 4 may appear of greater width than usual in proportion to their length, but if studied in the inexhaustible series always to be found in the locality indicated, the observer may speedily convince himself, that every conceivable form intermediate to these, exists there, and that these extreme forms, as well as others hereafter to be described, are not only united, but virtually inseparable. Figures 1, 1^a, 1^b, and 2, Plate 2, are taken from two specimens of MR. W. C. LUCY'S collection, from the *Pentacrinites tuberculatus* zone, at Fretherne. The side furrow upon these is remarkably distinct, and may be traced to the extreme apex of the beak, giving rise to a corresponding ridge in the smaller valve. This peculiarity, which instantly forces itself upon the attention of the observer, who has previously visited Purton Cliff, as it seldom or never presents itself in specimens from that locality, has doubtless its physiological value. The smaller specimen, Fig. 2, Plate 2, exhibits most of the characters of *Gryphæa obliqua*, but placed in juxtaposition with the larger, the possibility of its being other than a less advanced stage of the same species, cannot for a moment be entertained. These with Figures 1, 1^a, 1^b, Plate 5, and Figures 3 and 4, Plate 4, represent full grown individuals, than which very few attain to greater size; and it is noticeable, that the patriarchal giants of their race, presenting the most distinctive characters of *G. incurva*, are not found where examples are most readily procurable, and in the largest number, but in higher stages than the *A. Bucklandi* or *P. Tuberculatus* zones, particularly in the lower portion of the yellowish grey clays, which lie between the zone of *Ammonites obtusus*, and that of *Ammonites oxynotus*. Exceedingly good specimens have been obtained from excavations in Gloucester, which have been placed at our disposal by the kindness of MR. HENRY ARKELL; they are also frequently obtained from farm drain-cuttings in the neighbourhood.

Figures 3, 3^a, 3^b, and 4, 4^a, 4^b, Plate 2, represent specimens of the dwarfed variety, which occurs in the upper portion of the yellowish grey clays above alluded to, where they assume a somewhat marly character, as seen exposed on the estate of T. B. LL. BAKER, Esq. at Hardwicke, in this county, on the surface of a piece of land called Southfield, not far from the canal bank, on the left hand descending from Gloucester, crossing the sixth bridge. Several specimens were found in a small depression in the soil, which will readily be seen upon entering the field. These dwarfs are placed in comparison with the form last figured, not for the sake of contrast, but in natural ascending order, as its successor and legitimate representative, presenting all its essential characters, exhibiting all its marks of perfect development

and old age, being overgrown by the same parasites,* which, like them, have succumbed to the changes of the conditions of existence common to all of them, and differ from *their* predecessors, only in diminished proportions. Both the assumed adult forms before referred to, *G. incurva* and *obliqua*, occur sparingly in the *A. oxynotus* beds, whilst the young form here exhibited, Figures 2, 3, and 4, Plate 3, is very common, and is doubtless that, which at a more advanced age, has received the name of *G. suilla*, to which we shall have occasion hereafter to more particularly refer.

The next four specimens produced are from beds still higher in the series, in the group which probably represents the *Ammonites raricostatus* zone of Oppel, well exposed in "Skirts' cutting" on the Oxford, Worcester, and Wolverhampton Railway. Fig. 2, 2^a, 2^b, Plate 4, is from "Skirts' cutting," where it occurs with *Ammonites planicostatus* and *Hippodidium*. Figure 3, Plate 4, is from the *Hippodidium* bed, described by MR. GAVEY in the Quarterly Journal of the Geological Society, associated with *Ammonites raricostatus*.

Figure 2 being evidently a half-grown form closely resembling the variety Figures 1, 1^a, 1^b, Plate 4, intermediate to *G. Maccullochii* and *cymbium* last figured, it is worthy of notice that while Figure 3, Plate 4, approaches very nearly in outline to GOLDFUSS's figure of *G. cymbium*, Plate 85, Figure 1, Fig. 4, Plate 4, re-assures us that we have still before us *Gryphæa incurva*. It has become more elongated in proportion to its width, but preserves every other character; while Figs. 2 and 3, making allowance for dissimilarity of age, differ from it only in having lost almost every trace of the lateral furrow. Closely associated with these forms, differing only in the same degree as *Gryphæa*, Var. *striata* of Goldfuss, from *Gryphæa incurva rugosa*, is the specimen represented by Figures 2, 2^a, 2^b, Plate 5, which still more nearly approximates to *Gryphæa cymbium*, before mentioned. This specimen, which is the only one we have seen from the stratum in which it was found, is from the zone of *Ammonites Henleyi*, and may be considered to be the last appearance of what we believe to be any variety of *G. incurva* in the lower lias, unless Figures 3, 3^a, 3^b, Plate 5, from a specimen lent us by the Council of the Worcester Naturalists' Society, deposited in its Museum by MR. GAVEY, without naming the locality from which it was derived, should prove to be, as is probable, from the *Ammonites Ibex* beds of Mickleton, which would bring us almost to the base of the middle lias. These specimens agree perfectly with those figured

* *Anomie* and *Serpulæ*.

by GOLDFUSS, as *G. Maccullochii*; but for ourselves, after carefully comparing a great number of similar forms from other beds, and the figures given by GOLDFUSS, SOWERBY, and TERQUEM, we can discover only such differences of degree, and not of kind, as have induced us to consider all the forms hitherto presented to be mere varieties of *Gryphæa incurva*. SOWERBY's figure of the Shell upon which he based his species of *Gryphæa Obliquata*, corresponds in general character with our own figures 5, 5^a, 5^b, Plate 3, taken from specimens of the same type; but we must remark that his drawing is as incorrect, as the specimen itself from which it was made must have been imperfect, lines of the ligamental fossa being continued in the engraving over the apex of the shell, from which the lines of growth commence!

Figures 6, 6^a, 6^b, 7, 7^a, 7^b, Plate 3, Figures 1, 1^a, 1^b, 2, 2^a, 2^b, Plate 4, represent forms intermediate to the last, to the various forms called *G. cymbium*, by GOLDFUSS, and to *G. Maccullochii*, of other Authors, found in various beds ranging from that of *Ammonites Bucklandi*, at Purton, to those exposed in the brickyard at Honeybourne Station; these, and the specimens exhibited in conjunction with them, agree perfectly with many published figures to which the distinctive appellations quoted have been assigned; but with the series at our disposal before us, it is impossible to separate them, even as well marked varieties, from *Gryphæa incurva*.

We will now take into consideration, the actual vertical range of this species, which extends we believe nearly to the base of the Liassic formation, and much lower than the beds in which it first becomes known to us by the name, which we have hitherto applied to its commonest form. This question we shall be better able to discuss after the examination of other forms, which occur within the same or neighbouring limits. Upon close inspection, almost every specimen of *Gryphæa*, will show that it has been in its earliest stage, attached by the flattened or scarcely rounded extremity of the beak, to a foreign body, and it is noticeable that the symmetrical development of the adult, appears to have mainly depended upon the period at which it became free, the comparative duration of which, in various individuals, being indicated by the extent of area so rounded or flattened. Most of those hitherto exhibited and figured, must have freed themselves comparatively early, as in none of them is the once attached surface, sufficiently large to break considerably the regular curve of its outline, whilst in some of them, it is so obscure as to be traced with difficulty. Upon transferring to paper the outlines of that portion of the shell only, which could have existed at the time of its assuming its liberty, which

is easily done by tracing, in well cleaned examples, those lines of growth of which the edges converge at the point, where the profile curve of the external portion of the true apex commences, and from which the lines of the ligamental fossa recede, it will be clearly seen that it must once have so closely resembled the young of an oyster, as to render it difficult to distinguish the one from the other. Having now arrived at the conclusion that the young Gryphite must, for a period, more or less uncertain, resemble an oyster, it becomes interesting to ascertain how long such resemblance might endure, and to what extent it could proceed. In figures 5 and 5^a, Plate 2, we represent the upper surface and profile of a shell which is attached to a Gryphite by a base so large, furnished with an upper valve so rugose and convex, with ridges following, and corresponding with, the inequalities of the shell upon which it grew, exhibiting very obscure and irregular concentric lines of growth, and an appearance so completely that of an Oyster, and different to that of a Gryphite, that no one, who had never seen similar specimens, in a series of still further advanced stages, could admit its relationship in any degree to the latter: notwithstanding which, proof most complete to the contrary can be produced, by figures 6, 6^a, 6^b, Plate 2, representing the profile, upper, and lower surfaces of a shell of this description, which have become free at a more advanced age; whilst figures 1 and 1^a, Plate 3, show another, which, apparently unable to acquire its liberty, is developed, while still attached, into an indubitable Gryphite.

If we carefully examine the detached shell we may learn from it not only a portion of its own history, but so much of that of its neighbours, as will enable us to account for many of the peculiarities of these abnormal individuals. A reference to figure 4, Plate 4, will show, upon a little reflection, that in a shell of typical form, growing in the ordinary manner, its inhabitant enlarged the habitable space, by adding foliations to the front and sides of its shell, depositing at the same time, in the space nearest to the beak, which had become inconveniently contracted for its accommodation, could not be enlarged, and from which the animal's instinct led it to retire, a corresponding amount of shelly matter, and bringing forwards the proportionately expanding ligament, into its ever widening furrow, after itself. This furrow or pit is seen in figure 4, Plate 4, above referred to, and the shell itself well shows why the incurved portion of the beak, must have continued to increase in thickness and weight during the life of its tenant, whilst the opposite extremity of the chamber became thinner and weaker. It is apparent that the animal could not, under any circumstances, extend the space required for its habitation in a backward direction,

and it is equally clear that had it, while attached, extended it forwards in the manner which it adopts when free, and to the same degree in the same time, it must have recurved upon itself, until its further growth would have been arrested, and respiration impossible. Granting, therefore, that this be true, it follows that the animal possessed an intuitive perception of the exigencies of its position, and, to a certain extent, the power of accommodating itself to them.

We see, for instance, in the examples before us, that, unable to provide that normal degree of concavity which is proper to the larger valves, the creatures compensated themselves for the circumscription, by giving an unusual convexity to the smaller valve, a corresponding degree of lateral expansion to the larger, and retaining throughout the period of their existence, those modifications of form which were rightly special only to a portion of it.*

Here naturally arises the question, whether the young animal could of its own volition free itself from connection with the body to which it had attached itself, and this we think may be answered affirmatively, from the fact, that, in the majority of instances, that connection could have endured but for a short time. The primary point of adhesion must in general have been so small in the young fry, and applied to surfaces so even, that a very slight exertion of force of any kind, either voluntary or involuntary, would have sufficed to detach it; but we can readily conceive that in the event of adhesion taking place to uneven surfaces, as shown in figures 5 and 6, Plate 2, and fig. 1, Plate 3, where rugosities of the kind suggested exist in every part of the valves of each, the union between the two bodies, must have become so complex as to render separation impossible, except by the application of very considerable force.

In the event of contact remaining unnaturally prolonged, as in the case of *Ostrea læviusecula* and *irregularis* of Munster, the foregoing observations would in all cases properly apply.

Quenstedt's figures of *Ostrea irregularis* and *rugata* (Der Jura, table 3, figure 15, a, b, and f. 18, and those of Chapuis and Dewalque)† are so evidently taken from imperfect individuals of this species, that more than a reference to them is unnecessary, Quenstedt's figure 16 resembling so closely our figure 5, Plate 2, as to appear, upon a cursory view, to have been copied from the same specimen. The shells usually labelled as *G. suilla*, appear to be selected from the small flat-looking examples before referred to as occurring abundantly in certain localities with

* Compare relative length and breadth of Figure 1 and Figure 4, Plate iv.

† Description des Fossiles des Terrains Secondaires de la Province de Luxembourg.

Ammonites oxynotus, figures 2, 3, and 4, Plate 3, and which are nothing more than the young of *Gryphæa incurva*, probably var. *obliqua*. We have obtained large series of these at the brick-pits near Lanthony Priory, Gloucester, and upon the canal banks between Lanthony Bridge and the second mile post, the adult form being comparatively rare in the stratum. The shells figured as *G. suilla* by Goldfuss, are also immature forms, no longer considered by most Palæontologists to be other than varieties of *G. incurva*, although they seem to occur in such vast numbers, not advanced beyond this stage of growth, in particular strata, as to form their characteristic shells. Quenstedt, treating of the Malmstein of his Lias Alpha, says significantly, with regard to the resemblances of this shell to others, "Here, in the space between the worked stone, we meet for the first time with distinct Gryphites which are very nearly allied to *arcuata*, nevertheless, it is true, not yet with their doubled, crooked, incurved beak upon them. Their precise determination is also rendered difficult, on account of their appearing for the most part as Casts. I doubt not that *G. arcuata* proceeds from these, although they are smaller and flatter." "Hehl allows them to continue under Zieten's name of *G. ovalis*; others call them *G. suillus* of Schlothheim, because those from the Haimberge, near Göttingen, are somewhat broader. *G. obliquata* of Sowerby also, T. 112, f. 3, often agrees very well with them. We cannot arrive at a firm foundation with all such form-comparisons, since they again differ amongst themselves in an extraordinary degree. Here stratigraphical position must assist us, or we proceed entirely in error." (Page 54, *Der Jura*.) "He refers to *Ostrea rugata*, which occurs with *Ammonites angulatus*, little wrinkled casts with crooked, strongly incurved beaks, but which belong rather to the group of *O. rugata*," described by him in the same work, at page 60. Zieten's figure of *G. ovalis* is here useful for comparison, and Quenstedt, at page 46, suggests the same between it and his *O. rugata*, a more thin and delicate shell, which appears at a still earlier period. His *O. irregularis* and *O. rugata* are both referred to his *Ammonites psilnotus* beds,—our *Am. planorbis* beds—the first, described as a small, but frequently recurring oyster attached to *Plagios-toma* and *Monotis* (*avicula*), *inæqualvis*, and growing upon them, but upon separation quickly assuming the manner of growth of the Gryphites: the second as occurring at "Hüttlingen, between the Malmstein and the *G. Arcuata* beds, forming a thick bank, entirely filled with its thin wrinkled shells," which forcibly call to mind *G. arcuata*, although the strata of the Arietenkalk," (our *A. Bucklandi* beds) "are those in which this fully developed shell first appears." He nevertheless maintains that it is traceable even lower than the Malmstein beds, we presume, in the form

before mentioned. We may incidentally mention here, that in his description of *G. incurva*, he says it ought to be named *G. rugosus*, as having been first figured under that denomination in the last century, by Lang, in his *Historia Lapidum, &c.* T. 48, f. 1 and 2. He attributes all such modifications of this form as *G. obliqua*, and *Macculochii* to this species; the most remarkable of these to difference of age; and consequently to the greater or less expansion of base, at the time of the larger valve acquiring its freedom: in illustration of this he gives a figure, T. 9, f. 9, (which is an exaggeration of our own Figure 6, Plate 2,) with the following observations:—"As such causes producesimilar results in all the Jurassic Gryphites, I do not think these last should be considered oysters, although they bring to mind *O. irregularis*, before mentioned. (Page 48, Jura.) What is most remarkable is only this, that the axes of upper valves, not truncated, but, exogyraform, are turned outwards. How easy for such abnormalisms to become hereditary, and so, apparently to degenerate into another species."

OPPEL, in his "Mittlere Lias Schwabens," under his *Ostrea Amalthei*, makes the following remarks, on separating these shells into distinct species:—"Goldfuss figures, an *O. irregularis*, from the lias marl, of Linz, and we have similar examples in our lower Numismalis-marl, with *G. cymbium* and *G. obliqua*. In Table 4 and 8 I have figured such a one, to which is attached *Ostrea cymbium*; nevertheless, this oyster passes completely into *Gryphæa*, when its point of attachment becomes somewhat smaller, and changes with its growth from *G. cymbium* to *G. obliqua*, and the latter to *O. irregularis*; so that when many examples are placed together I am not able to define the distinct limits between *O. irregularis* and *G. cymbium*. As we have similar variations of form between *G. arcuata* and *G. calceola*, so are *O. irregularis*, as well as *G. obliqua*, to be considered as individuals of *G. cymbium*, whose large, attached surface, has deranged the entire form of the shell."

ZIETEN figures, as *G. incurva* var. *lata*. the *G. obliquata* of these pages, stating that it is found with *G. incurva* in great numbers, particularly at Betzgemuth, near Boll, while OPPEL treats it as a distinct species, and makes it the leading shell of a particular zone, above the *A. oxynotus* bed, and immediately underlying the Lias Gamma of Quens-tedt. With OPPEL'S observation, as applicable to our own district, we entirely disagree, as we find specimens of *G. obliqua* plentifully with *G. incurva* wherever it occurs, (of which it can easily be proved to be but the half grown stage,) exhibiting all the eccentricities of which that form is susceptible.

The shell which he calls *G. obliqua*, and places doubtfully in his

A. "Jamesoni-bed," we shall mention with the *Gryphæa* of the marlstone series.

CHAPUIS and DEWALQUE, in their "Description des Fossiles des Terrains Secondaires de Luxembourg," consider the following to be Synonymes of *Ostrea irregularis* of Münster in Goldfuss, "1835, Petrefacten, plate 79, figure 5," which they adopt as occurring in the "Sable et Grés de Martinsart," and the "Marne de Jamoigne," (the first and second stages of their inferior lias,) which corresponds nearly enough with its stratigraphical position in other localities, and consequently admits the application of the observations of OPPEL and QUENSTEDT, already cited, in which it is treated as merely a variety of *G. incurva*, of

- Ostrea Laeviuscula* Münster, fig. 6, plate 79;
- O. ungula* Münster, 1835, Handbuch, 325, (jeune);
- O. semicircularis* Römer, 1836, plate 3, fig. 6;
- O. irregularis*, D'Orbigny, 1850, Prod. t. 1, p. 238;
- O. intermedia* Terquem, (MS.) 1853.

LYCETT, with regard to the *Gryphæa Buckmani*, in our transactions, remarks—"The adherent species will be found to exhibit greater variability than the others; it may consequently be inferred that the form is connected with a position which was accidentally attained by variation of the attached shell."*

It is useless to make further references to published descriptions of this oyster-like form, as most recent authorities coincide with the opinions which are here stated, and which derive additional support from a fact made known to us, since the commencement of these pages by an observer upon whose trustworthiness we can safely rely, MR. TOMES, of Welford Hill, viz. that a perfect Gryphite form with the shell, well preserved, closely resembling young specimens of the *G. obliqua* or rather *G. Maccullochii* varieties, occurs in the White Lias of Bridgend, Glamorganshire, Figures 5, 5^a, 5^b, Plate 1, proving most

* Goldfuss, at the conclusion of his descriptions of Gryphites, makes the following observations:—

"It is evident, that in the Gryphites of the Liassic formation only, are combined those characters by which they can be distinguished as species from Oysters. Indeed, in those of the Oolitic formation, their near relationship to the Oysters is plainly shown; and in the Cretaceous, as well as in the Tertiary formations, are found several kinds, in the individuals of which the presence or the absence of the distinguishing character of Gryphites, appear to be attributable merely to accidental variations of form, for this reason, both *Ostrea truncata* and *Gryphæa navicularis*, are sometimes considered Oysters, sometimes Gryphites."

In reference to *Ostrea vesicularis*, tab. 81, fig. 2, *a* to *p*, from the Chalk, the young form of it, as there shown, is precisely that of a Gryphite, whilst with age it assumes the expanded, flattened form of the Oyster; he also remarks, that—

"Count Münster distinguishes from *G. truncata* (tab. 81, fig. 2, c, g, f.) the broad thin individuals with striated and flat upper shells, as *Ostrea vesicularis*, (tab. 81, fig. 2, a, b, c.) the first named, in fact, frequently assuming the narrow boat-shaped form of *G. arcuata*." So interminable is the variety of which the entire family is susceptible.

satisfactorily that it exists considerably lower than even Quenstedt had ventured positively to place it.

There can be no doubt, that the great confusion of ideas which has existed with regard to what we consider to be one species, as evidenced by the hosts of synonymes for it, to which we have been compelled to refer, arose from that love of species making which characterized most of our earlier Palæontologists. No sooner did an abnormal form present itself, than it was seized upon and *named* as a new species, whilst the examination of the series would have shown its true connection with common types. In species of which the number varies so much individually, as in the oyster tribe generally, this precaution is most essential, to enable us to arrive at safe conclusions in this respect: the most *symmetrical* forms having been set up as types, whilst, in point of fact, these are rather exceptional than otherwise.

We can convince ourselves in the instance of *G. incurva* that this shell is capable of assuming every shape between that of a flat oyster and one of so different a development, as to have suggested the propriety of conferring upon the individuals exhibiting it, a distinct *generic* name. It has been shown, how the entire character of the shell has been affected, by circumstances which enforced upon it a more or less permanent adhesion to the body to which it had primarily attached itself;—that the lateral furrow, upon the presence or absence of which specific differences have been supposed to depend, is one of the most fallacious characters upon which they can be based. We can perceive that the differences between the assumed species of *G. incurva*, *obliquata*, *Maccullochii*, and *cymbium*, are less than those existing between the young, half-grown, or adult states of either. We know that other creatures, inhabiting the same sea zones, pass upwards from the point at which they first appear, through a greater, or at least as great, a stratigraphical range as either of these. Do we not then rightly pause before we draw sharp lines of demarcation, whilst neither the facts presented to us in the formation under consideration, nor our knowledge of physiological facts, as exemplified in the existing life of our own epoch, afford us any valid pretext for so doing?

To show in the clearest possible manner the nature of the differences to which we have just alluded, we here refer to a diagram constructed expressly for the purpose, representing *Gryphæa incurva* of the best known type, and fullest dimensions. By uncovering the drawing from its upper portion downwards, may be made to appear in succession, first, its oyster condition; secondly, that of *Gryphæa suilla*; thirdly, that of *G. obliqua*, *young*; fourthly, that of *G. obliqua*, *adult*; fifthly, *G. incurva*, *half-grown*; sixthly, ditto two-thirds grown; seventhly, *adult*; eighthly,

in its most aged form. A comparison of any of the forms we have referred to, may, by placing almost any two shells of different sizes in juxtaposition, so that the curves of their beaks shall be as nearly as possible parallel, will exhibit the same difference of degree between them, in quite as satisfactory a manner.

The names by which the numerous varieties have been hitherto known, and under which they are figured, may of course always admit of a certain use, as those of *varieties* only of *G. incurva*, as which they ought to be generally recognised. We have only further to remark, that the repetition of the differences of character specified by various writers in the forms which it has been our principal object to prove to be varieties of one species only, would be, in connection with the artistic illustrations so ably rendered by Mr. Bone, and the preceding observations, superfluous. We simply invite attention to the fact, that not only is there no clear distinction between them when studied in a fairly selected series; that no particular form is special to any portion of the Lias of which we have yet treated stratigraphically; but that in our district, wherever *Gryphites* numerous occur, all the forms most widely diverging from the ordinary type of *G. incurva* are found, presenting differences from it, so infinitely modified as to make arbitrary separation between them of specific value, quite as unintelligible as absurd. These observations may be applied with equal propriety to other species and genera of shells equally common in the Liassic strata.

The accident which prevented the writer being present to read this paper, has also prevented his perfecting his references to the next species in stratigraphical order, which will be made the subject of a further communication to the Club.