

5. *On the OCCURRENCE of SPECIES of the GENUS DIPHYPHYLLUM, Lonsdale, in the LOWER CARBONIFEROUS STRATA of SCOTLAND, with a DESCRIPTION of some NEW SPECIES and NOTICES of VARIETIES.* By JAMES THOMSON, Esq., F.G.S., &c. (Read March 24, 1886.)

[PLATES IV. & V.]

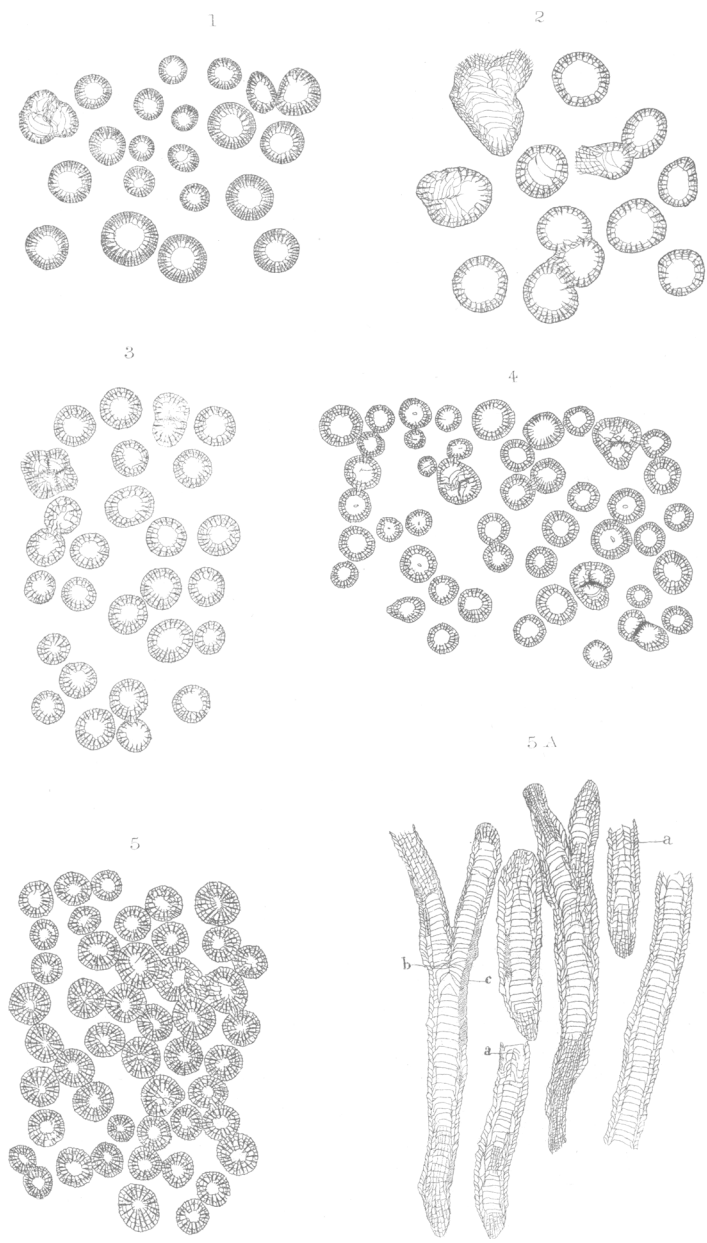
(Abridged.)

THE object of this communication is to offer evidence in favour of the recognition of the genus *Diphyphyllum*, which was defined many years since by Lonsdale, and which has not been definitely accepted by any palæontologist, with the exception of M'Coy. It is proposed to give a slight history of the genus and species, and then to notify the occurrence of all the species with varieties in somewhat remarkable deposits in the Lower Carboniferous series of Scotland, and to describe two new species and a variety of one of them.

The facts now brought forward clearly prove the truth of Lonsdale's diagnosis of the genus, which enters the family Cyathophyllidæ of the Rugosa, and also necessitate the introduction into the generic diagnosis of the words "increase by gemmation and by fissiparity."

The genus *Diphyphyllum* was defined by Lonsdale in Murchison, Keyserling, and De Verneuil's 'Geology of Russia and the Urals' (appendix, p. 622), and the type of the species *D. concinnum*, Lonsd., is in the collection of the Geological Society of London. The definition was as follows:—"A stony lamelliferous polypidom; lamellæ exceeding 12, biplated; branched, branches dichotomous; internal structure, triareal—1, central area intersected by flat, convex, or irregular diaphragms, no persistent axis; 2, intermediate area traversed vertically by lamellæ, interspaces crossed obliquely or downwards by extensions of the diaphragms and subordinate plates; 3, outer area traversed by lateral extensions of lamellæ, interspaces crossed by arched or vesicular laminæ inclined upwards and outwards; stems not uniformly thickened by external secretions, but occasionally united when in juxtaposition." In explanation Lonsdale notices that acicular points arise from the upper surface of the diaphragms (tabulæ), and sometimes are continuous through the diaphragms above for a short distance, but there is no persistence of this structure so as to form a columella. The corallites are in ramified masses.

*Diphyphyllum concinnum*, Lonsd., is defined as follows in the above-mentioned work, p. 624, pl. A. fig. 4:—"Stems cylindrical, nearly smooth; crossed externally by close, fine, waved lines, and stronger, unequal, distant bands; lamellæ numerous, variable; inner surface of plates furrowed strongly upwards and outwards; central area, diaphragms flat, convex or irregular; intermediate area, principal lamellæ exceeding 30, more or less waved; intermediate very unequal; interstitial prolongations of diaphragms inclined sharply downwards, accessory plates nearly horizontal; outer area, lamellæ

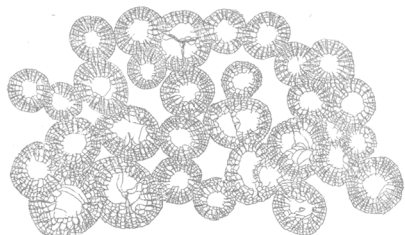


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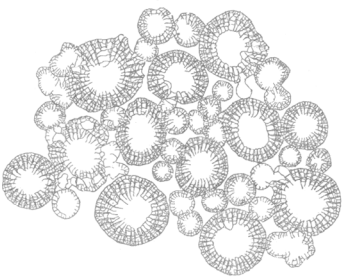
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DIPHYPHYLLUM.

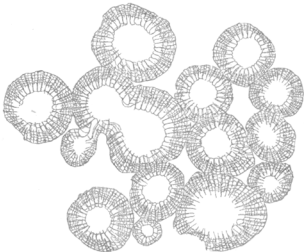
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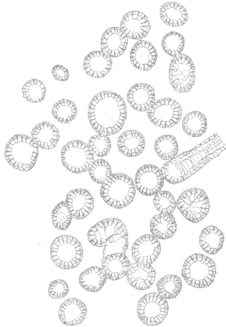
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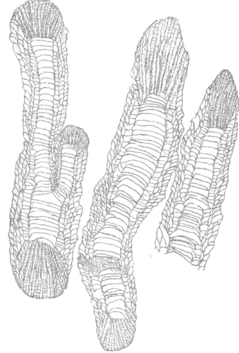
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DIPHYPHYLLUM.

variable in strength and range, interstitial plates largely vesicular; terminal cup deep, lined by edges of the lamellæ, no central boss." Relative proportions of areas not constant. Diameter of corallites 4 to 4.5 lines.

*Localities.* Carboniferous limestone, Kamensk, Siberian side of the Oural, and Bristol, England.

M'Coy found species of the genus and recognized the increase by fission or fissiparity; he published his definitions in *Ann. & Mag. Nat. Hist.* ser. 2, vol. iii., and subsequently in his 'Palæozoic Fossils of Great Britain,' p. 88 (1855). *Diphyphyllum latiseptatum* and *D. gracile* were there added to the English coral-fauna.

M'Coy notices how rare dichotomous branching is amongst the Cyathophyllidæ, and that this form of increase distinguishes *Diphyphyllum* from *Cyathophyllum*. He states that there is no axis, and that the corallites are biareal, the large central area being occupied by a strong simple transverse diaphragm, deflected at the circumference, surrounded by a narrow, outer vesicular area. Outer wall thick, radiating lamellæ numerous, not reaching the centre. In *D. latiseptatum* there are 28 primary septa and 28 smaller ones; *D. gracile*, which is a small form, has not one half the septal number of the other species. There is no doubt that M'Coy thoroughly understood Lonsdale's definition, and that his own specific diagnoses are correct.

From the time when M'Coy wrote, down to the present day, nothing but doubt and denial have been associated with the genus so well distinguished by Lonsdale. Milne-Edwards and Jules Haime (*Hist. Nat. des Corall.* vol. iii. p. 434, 1860), considered Lonsdale's species to be the same as M'Coy's *D. latiseptatum*, and that the genus was founded upon specimens of *Lithostrotion* in which the axis had been lost. They do not mention the fissiparous increase of the corallites at all. Prof. Hall (*Pal. New York*, vol. ii. p. 113) describes *Diplophyllum* and separates it from *Diphyphyllum*, recognizing the affinities of the genera.

Billings (*Canadian Journ.*, March 1859) debated the fissiparous method of increase in Lonsdale's genus, and yet separated it from *Lithostrotion* on account of the defective axial structures. He, moreover, considered Hall's genus to be synonymous with Lonsdale's, which it is not.

De Koninck gives an excellent history of the genus in his *Rech. sur les Anim. foss. du Terr. Carb. de la Belg.* pt. 1, p. 33 (1874). He shows how Lonsdale separated the genus from *Lithostrotion* on account of the absence of a columella, and criticizes Milne-Edwards and Jules Haime. He does not, however, admit that fissiparity occurs, and maintains that the appearance is due to the rapid coalescence of young individuals which have been really produced by gemmation. He agrees in this respect with M. Ludwig (*Zur Pal. des Ourals*, p. 14, pl. ii. figs. 4, 5, 7). De Koninck, however, considers that Milne-Edwards and Jules Haime have admitted the fissiparity, as did, of course, M'Coy. He reflects upon the mistakes of D'Orbigny and De Fromental in using the generic name given by Lonsdale for very

different corals from those to which he intended to apply it, namely the fasciculate Lithostrontions. Nevertheless, M. de Koninck's reading of Lonsdale's definition of *Diphyphyllum* (*op. cit.* p. 33) does not satisfy those who believe in the fissiparity of the individuals of its species. This is to be regretted, because it is now shown by the Scottish specimens that Lonsdale was correct; and, moreover, in order to complicate matters, there are also forms in the Scottish Carboniferous which agree with De Koninck's insufficient generic diagnosis, and which may be termed Lonsdale's *Diphyphylla*, increasing by gemmation only, and with more or less united corallites (see the concluding sentence of this communication).

The specimen of *Diphyphyllum concinnum*, Lonsd., figured by De Koninck does not show fissiparity; but similar slabs are to be obtained in the Scottish Lower Carboniferous, and fissiparity is seen now and then in them, the greater part of the increase being due to gemmation. De Koninck also considers M'Coy's *D. latiseptatum* to be synonymous with *D. concinnum*, the difference being due to vigorous growth of the first-named coral.

Lindström, in his useful index to the generic names of the corals of Palæozoic formations (Bihang till k. Svenska Vet.-Akad. Handl. Bd. 8, no. 9, 1883), states that *Diphyphyllum*, Lonsdale, 1845, has *Eridophyllum*, Ed. & H., as a synonym. This is an error, for *Eridophyllum* differs very decidedly; it does not increase by fissiparity and has rootlets.

The presence of several forms which must come within the genus *Diphyphyllum*, Lonsd., in the Lower Carboniferous strata of Scotland is placed beyond a doubt, and the difficulty is to distinguish species from varieties. Certainly there are four groups of species and some varieties which have been collected, and they may be divided as follows:—

1. The *D. concinnum* group, with numerous primary and smaller septa, not less than from 45 to 60 in number; endotheca moderate.

2. Large forms with long and shorter septa, about 40 in number; endotheca in two distinct circles. A new species, *D. cylindricum*, comes in here, with a second, *D. Blackwoodi*.

3. Large forms with numerous septa and much endotheca, filling largely the interseptal loculi. Here come in *D. latiseptatum*, M'Coy, and two varieties, var. *giganteum* and var. *interruptum*.

4. Small forms with small corallites with few septa: *D. gracile*, M'Coy.

The following old and new species and varieties of the genus *Diphyphyllum*, Lonsd., occur in the Lower Carboniferous of Scotland:—

*DIPHYPHYLLUM CONCINNUM*, Lonsd. (Pl. IV. fig. 1.)

A variety with smaller corallites than the type, and about 44 septa; diameter 6 millim. by 8 millim., in the instance of the largest corallites. The distribution of the endotheca, tabulæ, and acicular points is as in the type, and everything is on a smaller scale. The corallites are tall and wide apart. Gemmation appears to be more frequent

than fissiparity, and this may occur so that the parent corallite becomes trilobed in transverse outline, and the fission is double instead of single. That this is not a junction of buds can be proved by studying the growth of the septa from the dividing laminae.

*Locality.* Lower Carboniferous, Scotland. Kirtle Bridge and Blackridge, Dumfries.

Var. *FURCATUM* (Pl. IV. fig. 2). This variety has slightly smaller septa and wider central space than the type. It does not occur in dense masses.

*Locality.* Near Fenwick, Ayrshire and Corrieburn, Dumbarton.

*DIPHYPHYLLUM BLACKWOODI*, sp. nov. (Pl. IV. fig. 3.)

The corallum is in dense fasciculate masses, with corallites of different sizes, cylindrical, tortuous, close or not, rarely in lateral contact. Epitheca delicate. Diameter 4 to 6 millim. Fossula with a small primary, often indistinct. Septa 15 to 20, according to the size of the corallite, with a similar number of smaller ones (30 to 40 in all), the larger extending inwards considerably, but leaving a wide central space; they are very thin and delicate near the equally thin wall, and are stouter and decidedly bilaminate at their junction with the innermost endotheal ring; they may extend beyond that. The smaller septa are short, thin near the wall and thicker near the outer endotheal ring. Acicular points rarely exist—in one corallite out of 14. Endothea stout between the septa and vesicular; the inner circle of it is often festooned. A vesicular structure is often seen near the wall in the interseptal loculi. Tabulae large, horizontal in the central area and inclined at the edges towards the underlying tabula; sometimes bent upwards and then having a relation to the fissiparity, which is both single and double.

*Localities.* Auchenmead, Beith, near Fenwick, Ayrshire; Boghead, Lesmahagow, Lanarkshire.

Var. *APPROXIMATUM*. (Pl. IV. fig. 4.)

This has the "rods" very frequently developed.

*Locality.* Boghead, Lesmahagow, Lanarkshire.

In a coral with closer corallites than the last, and which might almost be considered to be a variety of it, the septa of the principal series extend so far inwards, and the endothea is so much less like internal walls, that I consider it to form a new species:—

*DIPHYPHYLLUM CYLINDRICUM*, sp. nov. (Pl. IV. figs. 5, 5 A.)

Corallum in dense fasciculate masses, corallites tall and cylindrical, epitheca thin, with narrow growth-rings. Septa few, 18 to 20 large and as many small, the large passing far in and reducing the dimensions of the central area and tabulae. The small septa extend about one fourth of the distance of the others. The vesicular endothea is delicate, in two fairly distinct circles in the interloculi, and some delicate inclined stereoplasm occurs. Fissiparity is frequent and is of both kinds; gemmation also occurs.

*Locality.* Boghead, Lesmahago; Roughwood and Thirdpart, Beith, Ayrshire.

*DIPHYPHYLLUM LATISEPTATUM*, M'Coy. (Pl. V. fig. 6.)

This form must now be separated from *D. concinnum*, for the specimens show a large corallite with 52 septa in all, longer primary septa than in *D. concinnum*, and a very considerable vesicular endotheca filling the interseptal loculi, and much more of it than in the species determined by Lonsdale. Both kinds of fissiparity are present.

*Localities.* Corrieburn, Dumbarton, and Fenwick, Ayrshire.

There are two varieties of this species, var. *giganteum* (Pl. V. figs. 7 and 8) and var. *interruptum* (Pl. V. fig. 9).

*DIPHYPHYLLUM GRACILE*, M'Coy. (Pl. V. fig. 10.)

This is the smallest species of the genus, and the Scottish specimens are fairly undistinguishable from the type. The septal number is small, and there is fissiparity as well as gemmation to be observed in the method of increase of the individuals. The corallites are in tortuous, ascending, and irregular bifurcating masses.

*Localities.* Cotcastle near Strathaven; Braidwood and Brockley, Lesmahagow; Roughwood and Cunningham, Bedland Dalry, Ayrshire.

*List of Scottish Lower Carboniferous Species and Varieties of Diphyphyllum, Lonsd.*

1. *Diphyphyllum concinnum*, Lonsd., variety.
2.   "       "       var. *furcatum*.
3.   "       *Blackwoodi*, sp. nov., and var. *approximatum*.
4.   "       *cylindricum*, sp. nov.
5.   "       *latiseptatum*, M'Coy, and vars. *giganteum* and *interruptum*.
6.   "       *gracile*, M'Coy.

Some of these forms are found in large masses and environed and covered by volcanic ash. It is not too much to believe that some of the variability of the species may have been produced by the rather frequent slight changes of external conditions which must have accompanied the vulcanicity of the Lower Carboniferous age. Indeed, the volcanic ejectamenta appear to have finally destroyed the life of the individuals over the area, for the species are not found in a higher geological horizon.

The examination of the numerous species and varieties of the genus established by Lonsdale enables the truth of his description and diagnosis to be appreciated. His only mistake was an omission; for when he stated that the species increased fissiparously, he did not also state, what has been shown here, that gemmation also occurs. The description given of the tabulæ by Lonsdale is correct, and so is that of the acicular points sometimes becoming rods which do not extend for any great height in the centre of the corallum. These



points rise from the surface of a tabula, and when there are rods they transfix, as it were, several tabulæ. The rods are rarely seen, but, by searching, some will be found in a somewhat definite percentage of corallites. The triareal nature of the corallites is to be recognized, but it is a term which has become disused, especially as the endotheca only gives characters of second-rate importance as a rule.

The fissiparity is much better shown in the specimens herein described than it was in those seen by Lonsdale, and there are three kinds of the process. In some corallites bending in and figure of 8 occurs, as in the Mesozoic and Recent Corals, and division took place at the narrowing. But usually a ridge grows across the corallite, and septa are formed on either side, and then the ridge, which, for a time, has been partly the wall, separates into two portions. The third method is singular, for two ridges grow towards the centre of a corallite, and one reaches the other at right angles near the axis, and thus the appearance of a trilobed budding is presented; but it is evident that septa only grow from the ridges, and that would not be the case in buds. After separating, the new corallites grew upwards away from one another. The ridges, which have so much to do with the two commonest kinds of fissiparity, are the extension inwards of oppositely placed large septa; the inner ends unite and shut off the two parts of the corallite, and septa grow from the faces looking towards the new central areas. In another form it appears as if a tabula turned up or grew up at its outer edge and stretched across the corallite at the calice; it came up to the bottom of the visceral cavity, and then septa grew from both sides of it and fission occurred.

Fissiparous growth is a very rare phenomenon amongst the Rugose Corals, and, so far as is known, *Diphyphyllum* is the only genus in which it occurs. The alliances of the genus need hardly be noticed here, as they have been discussed by Milne-Edwards and Jules Haime, and especially by De Koninck in the work already quoted.

The presence in Scotland of a species of a genus which would come within that which should receive De Koninck's *D. concinnum* (non Lonsdale) has been discovered of late, and it necessitates the redefinition and renaming of the Belgian type, so as to separate it from the fissiparous form. This new genus will form the subject of a future communication.

#### EXPLANATION OF PLATES IV. & V.

##### PLATE IV.

- Fig. 1. *Diphyphyllum concinnum*, Lonsd., transverse section showing fissiparity.  
2. ———, var. *furcatum*.  
3. ——— *Blackwoodi*, Thoms., transverse section.  
4. ———, var. *approximatum*, transverse section.  
5. ——— *cylindricum*, Thoms., transverse section; 5 A, longitudinal section of corallites.



PLATE V.

Fig. 6. *Diphyphyllum latiseptatum*, M'Coy, transverse section.

7. ———, var. *giganteum*, transverse section.

8. ———, ———, longitudinal section of corallites.

9. ———, var. *interruptum*, transverse section.

10. ——— *gracile*, M'Coy, transverse section.

DISCUSSION.

Prof. DUNCAN, after drawing attention to Mr. Thomson's industry, stated that the communication settled the long-disputed value of *Diphyphyllum*, Lonsd. Lonsdale diagnosed the genus from indifferent specimens, and yet clearly established the absence of a columella and the presence of fissiparity in the forms. Mr. Thomson's beautiful specimens prove that Lonsdale was correct, and in addition show that there was also gemmation. It is now evident that the opinions of Milne-Edwards and Jules Haime about the genus are incorrect. In drawing attention to the different aspects of the calices of the *Rugosa* and of sections made lower down in the corallites, Prof. Duncan remarked that Mr. Thomson placed too great a classificatory value on the endothecal structures, which vary in the same coral.

Dr. HINDE inquired whether the diagrams exhibited related to distinct species or represented characters drawn from different species. Is it the case that both fissiparity and calicular gemmation occur in the same species?

Prof. DUNCAN thought the diagrams were intended to be general.

Prof. RUPERT JONES expressed himself favourably with regard to the paper and the specimens.

The PRESIDENT expressed his regret that Mr. Thomson was not present to receive the personal congratulations of the masters of palæontological science upon his interesting communication.