ART. XIV. HELIOPHYLLUM AND “CYSTIPHYLUM,”
CORALS OF HALL’S “ILLUSTRATIONS OF
DEVONIAN CORALS.”

By CARROLL LANE FENTON AND MILDRED ADAMS FENTON
(Plates XVII-XXIV)

INTRODUCTION

In an earlier paper¹ we reviewed the circumstances attending publication of Hall’s “Illustrations of Devonian Fossils” and its separate brochure on corals. We assigned both publications to the year 1876, partly because of the date on title pages, and partly because a letter from Rominger, which was found in Hall’s personal copy of the coral brochure, indicated that its plates were published before Rominger’s paper on fossil corals. That letter, dated by month and day but not year, was handed to the late Dr. Stuart Weller for preservation in the University of Chicago Library, but cannot now be found.

At Dr. Stanley Smith’s request, Dr. Rudolf Ruedemann has investigated the date of Hall’s “Illustrations.” He finds that manuscript for its plate legends was not received until December 21, 1876, indicating that the book itself did not appear before 1877. Dates in our paper should be changed accordingly. The date on which Rominger’s work actually was published still is undetermined.

Our first paper on corals of Hall’s “Illustrations” described the tabulates. This study is devoted to the rugose genus, Heliophyllum and to Cystimorphs currently termed Cystiphyllum, of which Hall figured several new species and subspecies, as well as others described before 1877. We have added a few forms which are associated with and are closely related to the species of Heliophyllum mentioned by Hall.

The form of description agrees with that of our paper on tabulates, making this paper a text to Hall’s plates. Illustrations have been


Issued October 22, 1938.
limited to sections and a few figures showing the shape or growth of new or debatable groups. Prospective republication of Hall's original figures in the "Type Invertebrate Fossils of North America (Devonian)" makes detailed illustration of external characters unnecessary. They have been discussed in detail, partly because they aid in identification of some species and subspecies; partly because such discussion may help clarify the uncertain relationships of external and internal characters in rugose corals. It is especially appropriate because we sometimes were forced to identify some sectioned hypotypes by comparing them externally with Hall's holotypes and syntypes.

While this paper was in press, Dr. J. W. Wells published his study of "Individual Variation in the Rugose Coral Species Heliophyllum halli E. & H." Dr. Wells reduced Hall's species and subspecies to formae of H. halli which supposedly represent only individual, or fluctuating variation. He applied Hall's names to these formae and names several new ones, supposedly of the same sort.

While we do not deny that H. halli s. s. may contain individual variants which resemble his named species and subspecies, we have not found them. More important, Dr. Wells' five figures of internal structures are indistinct and do not enable us to identify his formae from the Ludlowville of Skaneateles Lake with our own hypotypes, which dominantly are from the Moscow of western New York. Lacking sections of Wells' specimens, we prefer to retain the interpretations advanced in this paper and to suggest that if fluctuating formae of H. halli are named, they should have designations other than those of Hall's species and subspecies.

Acknowledgments

Grants from the American Association for the Advancement of Science and the American Academy of Arts and Science financed this study. Mr. E. R. Eller collected some of the specimens used as hypotypes, while Drs. Charles C. Adams and Rudolf Ruedemann, of the New York State Museum, lent those of Hall's types which are in that institution. Dr. Wells has answered many questions regarding his interpretations of Heliophyllum.

2 Palaeontographica Americana, vol. 2, no. 6 (1937).
SYSTEMATIC REVISION

Generic Descriptions

Genus Heliophyllum Hall


Original Description: “There are others in which these dissepiments run upward and inward, as represented in plate 26, figures 3, 4, 4a; and as the species have also some difference of habit [from *Cyathophyllum*] they constitute at least a subgenus, if not a wholly distinct group. The name HELIOPHYLLUM, has been applied by Mr. James Hall to a specimen of this kind in his cabinet and may well be retained. It is represented in his N. Y. Geological Report, fig. 3, p. 209, and is probably near the Cyathophyllum Helianthoides of Goldfuss, plate 20, fig. 2.

“...Heliophyllum will then contain species having generally the transverse septa of the Cyathophylla, but with the intermediate dissepiments running oblique upward and inward. Plate 26, figure 3, is a section of the same turbinate species, figured by Mr. Hall; and figs. 4, 4a, are views of sections of a massive Astraeoid species.”

Milne-Edwards and Haime’s Description (Translation): “Polyp simple, subturbinate. Septa well developed, giving rise laterally to lamellar prolongations which advance from the wall to the center, pursuing an arched and ascending direction, in this way forming irregular tabulae on the vertical axis; these lamellar prolongations are united, near the periphery of the corallum, by vertical dissepiments.

“...Heliophyllum very clearly is distinguished from other Cyathophyllids by the very remarkable structure of its interseptal spaces.”

(Authors’ translation.)

Revised Description: Corallum simple, proliferating or massively compound with calycinal or marginal calycinal gemmation. Septa long, straight or flexuous, in two distinct series; they may stop short of the axis, ending freely or turning to form phyllothecal plates or tubes; may reach the axis and join in fascicles; may twist into a rudimentary, irregular or reticulate streptocolumella, or even may form a heavy streptocolumella reinforced by stereoplasm.

In some species the septa disintegrate marginally into radial series of cysts. Carinae opposite: present on septa in all but early neanic stages. Tabulae incomplete or complete, differentiated into a central and outer series. In the former they are horizontal or convex; in the
latter they generally are concave. Dissepiments small, numerous and cystose; in some species they lie between or cross irregularly radial structures here termed interseptal plates. Stereozones well developed in some species, forming structures which vary both specifically and with growth stages.

Remarks: Heliophyllum probably finds its closest relative in Eridophyllum Milne-Edwards and Haime\(^3\) (= Crepidophyllum Nicholson and Thompson and Craspedophyllum Dybowski, \textit{fide} Smith)\(^4\). In this genus of compound—and probably solitary—corals, the carinae are opposite and at right angles to the septa, which bend and form a continuous axial tube or aulos. A similar structure appears in neanic stages of \textit{H. obonicum teres}, and elongate, flexed and united septa (phyllothecæ) are present in \textit{H. halli}, with development of an indistinct periaxial zone. Yet the structures are so much inferior to those of \textit{Eridophyllum} that there seems little danger of confusion.

Longitudinal sections of \textit{Heliophyllum} are, in some species, virtually identical with those of \textit{Xylodes} Lang and Smith, of the Silurian. \textit{Xylodes}, however, lacks a stereozone and, in transverse section, shows septa which either are non-carinate or have carinae arranged alternately at the angles of zigzag septa, while septa of \textit{Heliophyllum} are straight or flexuous and carinae are opposite. Thus the character of the carinae, not their mere presence, serves to distinguish the genera.

Genus Cystiphyllum Lonsdale


Remarks: Lang and Smith, and Smith, have found that \textit{Cystiphyllum siluriense} is a Tryplasmid coral whose septal rays are derived from primarily acanthine septa. Devonian Cystimorphs, on the other hand, are derived from ancestors with lamellar septa, and therefore are not congeneric with \textit{C. siluriense}. No new generic term may be applied to them, however, because Wedekind has distinguished


genera of Devonian Cystimorphs whose essential structure cannot be determined from his descriptions and figures.

Under these conditions, we are forced to use *Cystiphyllum* as a generic name for some of the corals described in this paper, even though it is inappropriate. To indicate this fact, we have placed the name in quotation marks. Fortunately, uncertainty as to generic identity apparently does not affect the relationships and differences between Hall's species, with which this study is concerned.

**Specific Descriptions**

To facilitate reference to the “Illustrations of Devonian Corals,” each species or variety is given a separate heading conforming to that publication, changes or corrections being given in the bibliography, description or remarks.

**Heliophyllum hallii** Milne-Edwards and Haime; Hall, Ill. Dev. Foss. Corals, pl. 23, figs. 1-5, 12; pl. 25, figs. 1-7, 1877.

**Heliophyllum hallii** Milne-Edwards and Haime (Fig. 6; plate XVII, figs. 1-5; plate XVIII, fig. 1.)

*S. helianthoides* Hall, Geol. N. Y., pt. 4, p. 209, no. 48, fig. 3, 1843, (*not Cyathophyllum helianthoides* Goldfuss).


Not *Heliophyllum hallii* Stewart, Geol. Soc. Am. Spec. Pap. 8, p. 37, pl. 6, figs. 7-8, 1938.


**Original Description (Translation):** “Corallum turbinate or cylindro-conical, in general rather elongate and slightly curved at the base; surrounded by an epitheca and presenting slight expansions. Calyx circular and moderately deep; septal fossette small; septa very thin, crowded, rather large at the top or increasing in size upward and denticulate on their free margins, slightly unequal in alternating series, somewhat twisted in the center; they number more or less than 80. In a vertical section one sees that the lateral prolongations of the septa are arched and ascending; those that occupy the upper part of the interspaces (loges) terminate on the free border of the septa but
those which lie lower unite centrally to form irregular tabulae; these prolongations, which incompletely close the interseptal spaces, are spaced more or less than one millimeter apart and are united by simple, crowded dissepiments which cut them at right angles. Height 5 or 6 cm.; diameter of the calyx 4 cm."

*Revised Description:* Corallum solitary, thickly subturbinate, moderately and generally uniformly curved; constrictions numerous but amounting to 20 per cent. or more of the diameter only in gerontic stages. Epitheca thin but generally continuous; costae prominent; symmetry and insertion of septa well displayed by costae and septal grooves. Fossa occupies 60 to 80 per cent. of the calyx; marginal zone convex and undefined. Fossula indistinct. Septa discernibly in two series, but subequal in thickness and height; denticulations marked but not coarse. Diameter of largest hypotype (gerontic) 62.5 mm.; of two ephebic hypotypes, 36 and 38 mm.

Transverse sections slightly less than 20 mm. in diameter show 48 to 52 septa in two sharply distinguished series. Primaries reach the central region or even the axis, bending and fusing with others; in some cases they show junction of cardinal and counter septa with closure of the fossula by the third pair of septa in the cardinal quadrants. More commonly, there is indiscriminate flexuous union, as in plate XVII, figure 5, the primaries occupying a rhomboidal or rhombo-ovoid region in which secondary calcification gives them thicknesses reaching 1.3 mm. Dissepiments are marginal, carinae lacking or incipient; interseptal plates are lacking.

One section 28 mm. in diameter shows 72 septa; primaries and ends of a few secondaries are heavily calcified; primaries deflect and join (or end) 0.5 to 2 mm. from the axis. Carinae well developed; dissepiments numerous and closely spaced marginally; interseptal plates incipient or lacking. Other ephebic sections show 64 to 68 septa which generally lack secondary thickening; a few are united by phyllothecal extensions.

In gerontic sections (plate XVII, figures 1 and 4) the septa number 80 to 94 and phyllothecae become well developed. The fossula persists, but is very indistinct. Septa remain continuous, and in neither gerontic hypotype is there trace of interseptal plates. Dissepiments apparently more numerous, but definitely thinner than at lower levels; thickness of carinae somewhat reduced.

Longitudinal sections show few ontogenetic changes except the development of carinae and thinning and crowding of dissepiments. Tabulae are markedly incomplete, convex and cystose; differentiation into inner and outer series definite but not complete in all coralla, and clearly distinguishable only where the outer series is set apart by phyllotheca, which appear not to form a true aulos.

*Remarks:* Milne-Edwards and Haime's description mentions no characters which distinguish *Heliophyllum halli* from several other
Figures 1-8. Lateral views of specimens of *Heliophyllum*, showing characteristic differences in shape. All figures × 0.5.

Fig. 1. *H. arachne* Hall. A hypotype showing typically oblique growth. Hamilton (Moscow), D.L. and W. R.R., 1.5 miles east of East Alexander, N. Y. (6776 Carnegie Museum.)

Fig. 2. *H. arachne* Hall. A hypotype with exceptionally oblique growth. Position in life doubtful. Hamilton (Moscow), D.L. and W. R.R., 1.5 miles west of East Bethany, N. Y. (6775 Carnegie Museum.)

Figs. 3-4. *H. reflexum* Hall. Two hypotypes. Hamilton (Moscow), D.L. and W. R.R., 1.5 miles east of East Alexander, N. Y. (6784-6785 and 6777 Carnegie Museum.)

Fig. 5. *H. decorosum* sp. nov. Holotype. Hamilton (Moscow), Leicester (= Moscow), N. Y. (6751-6753 Carnegie Museum.)

Fig. 6. *H. halli* Milne-Edwards and Haime. A large but otherwise typical specimen. Hamilton (Moscow), Leicester, N. Y. (7348-7350 Carnegie Museum.)

Fig. 7. *H. asperum* sp. nov. A paratype of moderate diameter and greater than average height. Hamilton (Moscow), D.L. and W. R.R., 1.5 miles east of East Alexander, N. Y. (7335-7336 Carnegie Museum.)

Fig. 8. *H. halli irregulare* Hall. A typical, irregular specimen. Hamilton (Moscow), western N. Y. (37722 Walker Museum.)
subturbinate and turbinate members of the genus. Chief reliance is placed on their figure 6, which shows a longitudinal section in which tabulae seem to constitute one series and are highly convex. These characters rule out the externally similar *H. decorosum* n.sp., while they join with shape to eliminate *H. obconiculum* Hall. The specimens selected as hypotypes agree with this section more closely than do any others that we have found, and also compare well with Hall's plate 25, figures 2 to 3 and 5 to 7.

No attempt has been made to solve the doubtless complicated synonymy of this species. Lambe\(^5\) considers *H. eriense* Billings, *H. cayugense* Billings, *H. canadense* Billings, *H. colbornense* Nicholson, *H. proliferum* Nicholson and *H. proliferum* Hall as synonyms of "*Cyathophyllum* halli"; but the last two definitely may be eliminated from that category, while the first four are without descriptions or figures on which conclusions may be based.

**Occurrence:** Hamilton (especially Moscow), western and central-western New York, Thedford regions of Ontario, and probably in the Ohio Valley. Specimens on which redescription is based are from the Hamilton of western New York.

**Hypotypes:** 3778, 3779 Walker Museum; 6706-6719 and 7348-7353 Carnegie Museum.

---

**Heliophyllum degener** Hall,
Ill. Dev. Foss. Corals, pl. 25, figs. 8-11, 1877.

**Heliophyllum halli degener** Hall (Plate XVII, figs. 6-8; plate XVIII, fig. 2.)

**Heliophyllum degener** Hall, Ill. Dev. Foss. Corals, pl. 25, figs. 8-11, 1877.

**Description:** Corallum irregularly subturbinate, with more moderate rate of expansion than that of *H. halli*. This expansion persists into ephelic stages, at heights of 30 to 55 mm. above the base. Beyond this it is replaced by periodic but persistent constriction which reduces the diameter by one-fourth to one-half in gerontic stages. Epitheca thin, discontinuous or gerontically absent; calyx shallow to deep. Fossa generally indistinct externally though well marked in sections. Septa fine to coarse, subequal marginally.

Internal characters are shown by plate XVII, figures 6 to 8. Septa number 70 throughout and, especially in ephelic stages, commonly show union at the edge of the tabular zone and thickening of the

primaries within it. The primaries unite by phyllothecae and the fossa is enclosed. Dissepiments are closely spaced; carinae are thicker than those of *H. halli*. Highly convex, outwardly downcurved tabulae are pronounced through ephelic stages.

**Remarks:** While this may be a physiologic variant, the association of internal characters with defective epitheca and gerontic constriction is so constant as to indicate at least subspecific rank. Hall himself questioned the value of the form, designating it as "*n. sp.?*" Similarity between the axial region of *H. halli degener* and that of *H. halli* indicates close relationship with the latter species.

**Occurrence:** Hamilton, Skaneateles Lake (type locality), East Alexander and other localities in western New York.

**Syntypes:** Am. Museum of Natural History; **Hypotypes:** 37758 Walker Museum and 6729-6735 Carnegie Museum.

---


**Heliophyllum halli irregulare** Hall (Fig. 8; plate XVIII, fgs. 3-6.)


**Description:** Corallum irregularly subturbinate, with moderate rate of expansion and numerous constrictions which, in some cases, amount to .35 or .40 of the diameter preceding them. Epitheca comparatively thick and heavily wrinkled; costae generally indistinct in wrinkled specimens. Calyx generally constricted in specimens more than 30 mm. long; fossa deep and steep-sided; marginal zone narrow, poorly defined, and steeply inclined. Primary septa generally very coarse, numbering 30 to 38 in calyces 27 to 30 mm. in diameter; commonly they visibly fail to reach the axial region. In such specimens, the secondaries appear as weak ridges or are indistinguishable even in the marginal zone. In some, however, the septa are subequal marginally and the primaries approach the axis and unite in fascicles as shown in Hall's figure 3.

A transverse section 8.8 mm. in diameter shows 21 short marginal septa without carinae and with few dissepiments. One measuring 17.5 mm. shows 58 thin, continuous carinate septa whose primaries stop short of an axial region 4.5 to 5.3 mm. in diameter. Another, 28 mm. in diameter, has similar septa, with carinae numerous and relatively thick.

Primaries are 9.5 to 11 mm. long, the secondaries 5 mm. or less. All end freely, structures which in sections appear as phyllotheceal plates actually being highly convex, incomplete tabulae. Carinae well
developed but not thick; dissepiments widely spaced. There is no perceptible sclerotheca and virtually no stereozone.

Remarks: Externally, this subspecies may be distinguished from *H. asperum* sp. nov. by its more nearly continuous epitheca, by its narrow, convex marginal zone and its failure to develop two sharply marked series of septa, secondaries being either obscure or virtually as strong as the primaries. The principal hypotype shows the former condition, with septa stopping short of the center, and therefore closely resembles the specimen of Hall’s figures 1 to 2. Another (37722 Walker Museum) has subequal septa reaching almost to the axis, and corresponds to Hall’s figure 3. It is doubtful, however, that reliable identifications can be made without sections.

Occurrence: Hamilton (Moscow), Darien (type locality), East Alexander, Leicester and elsewhere in western New York.


**Heliophyllum decorosum** sp. nov. (Fig. 5; plate XVIII, figs. 7-9.)

*Heliophyllum halli* Hall, op. cit., pl. 23, figs. 1-3 (?).  
*Heliophyllum proliferum* (?) Hall, op. cit., pl. 26, fig. 5 (?).

*Description:* Corallum generally solitary, though some specimens show parricidal calycinal gemmation; subturbinate though considerab – lly and commonly irregularly curved. Constrictions more pronounced than those of *H. halli*, but less than those of *H. halli degener*; epitheca thicker than that of *H. halli*, with low costae. Width of fossa less than half its depth, its sides steep, its floor concave from presence of a wide false columella. Fossula indistinct. Septa number 4 to 5 in 5 mm. at periphery of holotype, which is constricted, 3 at periphery of an expanded, gerontic paratype; they are equal except within the fossa.

A transverse section 14 mm. in diameter shows 56 septa, of which 9 reach the axial region and twist, uniting most of the remaining 19 primaries. Secondaries are 4 to 5 mm. long; some of them join and fuse with adjoining primaries. Carinae well developed. Fossula pronounced but asymmetrical. There is a sharply bounded stereotheca, ovo-rhomboidal, within which the septa are secondarily thickened until they form a compact mass. Interseptal plates rudimentary.

Transverse sections 36 to 38 mm. in diameter show 64 to 66 thin, continuous septa in two series. The secondaries reach more than half the distance to the axis; some primaries stop 1 to 4.5 mm. from it
while others, 6 to 10 in number, reach the axial region and twist, uniting many of the shorter primaries. There is no discernible secondary thickening in the holotype; interseptal plates are lacking.

A longitudinal section shows the tabulae of the inner series to be flat or moderately concave and partially continuous. Those of the outer series are convex, the two series being bounded by incipient stereothecal plates and calcareous deposits on the septa themselves which are more prominent than the stereothecae. Each of these might be termed a false aulos; their development is well shown in plate XVIII, figure 7.

Remarks: Identification of Hall's large syntypes of *H. irregulare* with this species is based upon the published section, which closely resembles two gerontic paratypes (6756 and 6766-6767 Carnegie Museum). The hypotype of *H. "halli"* illustrated in Hall's plate 23, figure 1 was compared externally with the small paratype of *H. decorosum*; specimens of figures 2 to 3 have not been traced, but are tentatively identified from illustrations.

Two specimens showing parricidal calycinal gemmation compare closely with the syntype of *H. proliferum* Hall illustrated, with query as to species, in Hall's plate 26, figure 5. Since sections show typical *decorosum* structure with only a few rudimentary interseptal plates, they, and Hall's specimen, are referred to this species.

Occurrence: Hamilton (Moscow), Leicester, East Alexander, East Bethany and Reserve, N. Y.


**Heliophyllum arachne** Hall, Ill. Dev. Foss. Corals, pl. 24, figs. 8-12, 14, 1877.

**Heliophyllum arachne** Hall (Figs. 1-2; plate XXII, figs. 1-2.)

*Heliophyllum arachne* Hall, Ill. Dev. Foss. Corals, pl. 24, figs. 8-12, 14, 1877.

?*Heliophyllum reflexum* Hall, op. cit., pl. 23, figs. 7-11.

Description: Corallum broadly subturbinate; generally oblique rather than curved, though a few large corals are curved in the manner of *H. halli* and show parricidal calycinal gemmation. Epitheca relatively thick; costae low, rounded and indistinct except near the base. Calyx generally greater in diameter than is the corallum, because of oblique growth; fossa less than half its diameter; marginal zones flat or convex but well defined. Septa subequal or in two series; they are coarse with thick denticulations. Fossula rarely distinguishable externally.

A transverse section 27 to 30 mm. in diameter shows 62 septa; a
Figures 9-13. Lateral views of *Heliophyllum obconicum* Hall and its new subspecies, *teres*. All figures × 0.5.

Fig. 9. *H. obconicum* Hall. A hypotype of average diameter, showing gerontic change in direction of growth. Hamilton (Moscow), D.L. and W. R.R., 1.5 miles East of East Alexander, N. Y. (6822-6823 Carnegie Museum.)

Fig. 10. *H. obconicum* Hall. A hypotype showing more rapid expansion and basal curvature. The epitheca is very thin. Hamilton (Moscow), Leicester, N. Y. (6811-6812 Carnegie Museum.)

Fig. 11. *H. obconicum teres* subsp. nov. A paratype of moderate and nearly uniform diameter. Hamilton (Moscow), Livingston Co., N. Y. (20793 Walker Museum.)

Fig. 12. *H. obconicum teres* subsp. nov. The holotype, showing constrictions in growth. Hamilton (Moscow), LeRoy, N. Y. (6835-6840 Carnegie Museum.)

Fig. 13. *H. obconicum teres* subsp. nov. A gerontic paratype with extreme constriction of growth. Hamilton (Moscow), Genesee County, N. Y. (33393 Walker Museum.)
calyx reaching 49.5 mm. shows 78. Secondaries are 5 to 7 mm. long; primaries stop or fuse at distances of 2 to 4.5 mm. from the axis. Fossula pronounced. Sterezone subrhomboidal with greatly thickened septa. Interseptal plates are well developed in the fossular region, where they reach lengths to 4.5 mm.; elsewhere they are few and small. In late ephelic stages there is some disintegration of septa, also in the alar quadrants adjoining the fossula, but septa of the counter quadrants are continuous to the margins and so link the species with *H. decorosum*.

**Remarks:** The large syntype of *H. reflexum* Hall (his plate 23, figures 8 to 11) resembles this species more closely than it does the associated syntypes of *H. reflexum*. The specimen of Hall's figure 7 also may be a young corallum of *H. arachne*.

**Occurrence:** Hamilton (Moscow), Genesee valley (type locality), East Alexander and cuts 1.5 miles west of East Bethany, N. Y.

**Syntypes:** Am. Museum of Natural History; Hypotypes: 6771-6776 Carnegie Museum.

---

**Heliophyllum hallii** (?) var. *obconicum* Hall,
ILL. DEV. FOSS. CORALS, pl. 25, figs. 12-13, 1877.

**Heliophyllum obconicum** Hall (Figs. 9-10; plate XIX, figs. 1-5; plate XX, figs. 8-10.)

**Heliophyllum hallii** (?) var. *obconicum* Hall, ILL. DEV. FOSS. CORALS, pl. 25, figs. 12-13, 1877.

**Heliophyllum hallii** Hall, op. cit., pl. 23, figs. 5, 12; pl. 25, fig. 4.

**Description:** Corallum conical or conico-turbinate; slightly and regularly curved; constrictions of very slight magnitude. Epitheca thicker than that of *H. hallii*, but the low rounded costa show septal insertion clearly. On the theca, dissepiments describe lines which are concave upward or describe “saddles” less pronounced than those of *H. hallii*. Fossa, in expanded specimens, is less than half the calycinal diameter; the marginal zone is gently convex or even flattened and is abruptly defined. In constricted specimens its character prevails but the fossa may occupy but one-third the diameter. Fossula distinguishable in the fossa only. Septa sharply and coarsely denticulate, equal only marginally; false columella but slightly elevated.

Transverse sections 8 mm. or less in diameter show 46 to 48 septa, with an enclosed fossula. Secondaries are 0.6 to 1 mm. long; primaries reach the central region, become flexuous, and either end freely or are united in fascicles of 2 to 4. Carinae and interseptal plates lacking. Stereotheca ovoid and within 1 mm. of the periphery.

Sections 32 and 34 mm. in diameter (maxima, for these specimens,
Figures 14-19. *Heliophyllum obconicum* form *confluens* Hall. A series of specimens showing gemmation and fusion of corallites to form colonial coralla. Hamilton (Moscow), D.L. and W. R.R., 1.5 miles west of East Bethany, N. Y. (37762, 37767, 37763, 37760, 37764 and 37759 Walker Museum.) All figures $\times 0.5.$
46 and 53.5 mm.) bear 79 and 78 septa. Secondaries 9 to 11 mm. long; they end freely or join adjacent primaries. The latter reach the axis or stop within 2.5 mm. of it; they turn, join and send out phyllothecal plates, the whole forming a variably complex network.

Carinae prominent; dissepiments weak and irregular in direction. In some specimens, they hardly are distinguishable from the interseptal plates. These are abundant and well developed in the marginal zone, obscuring some of the weaker secondary septa and even giving rise to pseudosepta. The stereotheca is pronounced, and septa within it are considerably thickened.

Late ephebic and gerontic sections differ in the greater number of septa (84, 84 and 87 in three typical specimens), in the lengthening of secondaries (to 17 mm. in a diameter of 48 mm.), in the extreme development of interseptal plates, and in division of the septa themselves. In many cases these divide into series of 3 flexuous plates which become cystose and are linked by the carinae. In others, the septa degenerate into a network of cysts and plates in which no order can be discerned, though the carinae may remain solid and distinct.

Tabulae are incomplete, convex and cystose throughout, though divided into two series. Their irregularity increases with growth.

Remarks: This species is externally distinguished from H. decorosum by its conical shape, small fossa and flattened marginal zone. Internally, the heavy stereotheca, abundant interseptal plates, and degeneration of septa themselves distinguish it.

Occurrence: Hamilton (Moscow), Skaneateles Lake (type locality), East Alexander, East Bethany, Leicester and other localities in western New York.


**Heliophyllum confluens** Hall,

Ill. Dev. Foss. Corals, pl. 26, figs. 3-4; pl. 27, 1877.

**Heliophyllum obconicum** form **confluens** Hall (Figs. 14-19; plate XXI, fig. 1.)

?*Cyathophyllum* (Strombodes?) *turbinatum* Hall (not Goldfuss), Geol. N. Y., pt. 4, no. 49, fig. 1, 1843.

**Heliophyllum confluens** Hall, Ill. Dev. Foss. Corals, pl. 27; (not pl. 26, figs. 3-4), 1877; Grabau and Shimer, N.A. Index Foss., vol. 1, p. 68, fig. 103, 1909.

?*Cyathophyllum* multijugatum Davis, Kentucky Foss. Corals, pl. 80, fig. 17; probably pl. 89, fig. 2 and pl. 92, fig. 4, (not pl. 87 and pl. 88, fig. 1), 1887.

Description: Corallum compound, originating by basal or marginal gemmation, by fusion of adjoining corallites, or by a combination of
both methods. Peritheca formed by fusion of heavily wrinkled epithecæ. External characters much like those of *H. obconicum* except that some corallites are more widely expanded. Internal characters differ from those of that species only in moderate shortening of secondary septa, general absence of secondary thickening, and development of a more pronounced axial network. Both theca and epitheca commonly disappear within the corallum; septa join at low angles or even achieve moderate degrees of confluence. Dissepiments commonly fuse to unite corallites.

**Remarks:** Strict application of priority would apply the name *confluens* to the specimen of Hall’s plate 26, figures 3 to 4. That specimen, however, was not available for study, and it departs from the obvious intention of the name in having corallites which are not confluent but are separated by ridges which appear to be thecae. Thecae are not present in the specimen of plate 27 and many septa are confluent. For these reasons, and its availability, this specimen is made lectoholotype, but since its fractured condition forbids sectioning, description is based on hypotypes from the Hall collection which were compared with it. No opinion on the identity of the specimen of plate 26, figures 3 to 4 can be given.

Resemblance in structure between these and *H. obconicum* is close. Some of them join the lectoholotype in showing fusion of originally distinct corallites, which give force to the structural evidence that *confluens* is a physiologic form of *H. obconicum* rather than a subspecies. The name thus is retained as a matter of convenience; those who wish names to have taxonomic significance, or who elevate all subspecific groups to species, may wish to discard it.

**Occurrence:** Hamilton (Moscow), York (type locality), East Bethany and other localities in western New York.

**Lectoholotype:** 18974; **Hypotypes:** 37759-37760, 37762-37765, 37767 Walker Museum and 6881-6883 Carnegie Museum.

**Heliophyllum obconicum teres** subsp. nov. (Figs. 11-13; plate XIX, fig. 6; plate XX, figs. 1-7; plate XXI, figs. 2-3; plate XXII, fig. 3.)

**Description:** Corallum elongate-conical to columnar, very slightly curved. Epitheca comparatively thick; costæ indistinct. Fossa deep (9.7 mm. in a specimen whose diameter is 27.5 mm.) and steep-sided; marginal zones flattened, steeply inclined and sharply bounded internally. Septa equal in the marginal area; they number about 4.3 in 5 mm. on ephabetic margins.

Transverse sections 12 to 13 mm. in diameter show 52 to 56 septa;
though but 11 and 12 mm. from the bases, they show interseptal plates and splitting of some septa. Secondaries are about 3 mm. long; primaries 1 to 1.6 mm. from the axis and bend into open phyllothalic tubes like those made diagnostic of *Crepidophyllum* (= *Eridophyllum*) by Nicholson. Sclerotheca pronounced; septa thickened within it. Carinae thick. Fossula well developed.

Sections measuring 15.3 and 14 mm., respectively, show the central tube almost closed and beginning to disappear; at 23 and 24 mm. it is lacking, though twisting and fusion of septa leaves an open axial area. Septa in these stages number 64 and 70; they are thickened within the now indefinite stereotheca, while the carinae show secondary thickening to the periphery.

In late ephellic and gerontic growth, septa are added to a final number of 76 to 80. Interseptal plates are further developed, in some cases becoming thicker than the septa themselves, causing the latter to appear more degenerate than they really are.

Longitudinal sections show strong but discontinuous bands of carinae ascending at angles of 65 to 80 degrees. There also are downward-curving bands of stereoplasm, most marked in the zones where dissepiments are finest, most abruptly downcurved, and most cystose. Tabulae of the inner series are incomplete and cystose; those of the outer series are demarked by stereoplasmic bands and range from concave to convex on upward surfaces.

**Remarks:** The most obvious peculiarities of this subspecies are its almost columnar shape, the phyllothalic tube in neanic stages, and the greater persistence of septa as compared with *H. obconicum*. Their partial degeneration and the great development of interseptal plates effectively link it with that species.

In transverse section, the phyllothalic tube (aulos) of neanic stages almost duplicates that of *Heliophyllum subcaespitosum* Nicholson, genosyntype of *Crepidophyllum* Nicholson and Thomson, now referred to *Eridophyllum* Milne-Edwards and Haime, though its aulos is less nearly perfect than that of *E. archiacei* (Billings) and *E. seriata* Milne-Edwards and Haime.

Though not represented among Hall’s illustrations, this subspecies must be included here for contrast with the true *H. obconicum*.

**Occurrence:** Hamilton (Moscow), LeRoy (type locality), East Alexander and other localities in western New York.

**Holotype:** 6835-6848; **Paratypes:** 6849-6880 Carnegie Museum; 20793, 33393 and 33394 Walker Museum.

**Heliophyllum halli reflexum** Hall, Ill. Dev. Foss. Corals, pl. 23, figs. 6-11, 1877.

**Heliophyllum reflexum** Hall (Figs. 3-4; plate XXII, figs. 4-5, plate XXIII, fig. 1.)

**Description:** Corallum subconical or irregularly conical, generally with great expansion in ephoric and gerontic stages; constrictions commonly of minor magnitude. Epitheca complete, thick, wrinkled. Calyx expanded; fossa deep, with convex streptocolumella and sloping sides; marginal zone convex and poorly defined. Septa subequal marginally, but secondaries stop on sides of fossa.

A transverse section 15 mm. in diameter shows thin continuous septa, the secondaries 3.5 mm. or less in length. Primaries enter a streptocolumella in which they twist into a streptocolumella, though all are united by deposits of calcite so that the whole zone forms a solid mass in which structures are indistinct.

A transverse section 22 mm. in greatest diameter shows 64 continuous septa, the secondaries 5 mm. or less in length. There are incipient interseptal plates; carinae are well marked. The stereozone is ovo-rhomboidal, with septa well distinguished though united and a streptocolumella 5 mm. in diameter. In addition to the twisted ends of the septa, it includes stereoplasmic material which forms a solid mass. The fossula is distinctly present, though not fully closed.

A longitudinal section shows the greatest depth of the calyx to be about half the height of the corallum. Tabulae are divided into two series; the inner bounded by a false inner wall (pseudotheca) formed by downbending of tabulae (cyathotheca) reenforced by sclerothecal deposits, the outer by a broken sclerotheca from which obconical sclerothecal lamellæ extend upward and outward to the margins. Carinae few and nearly vertical; dissepiments unequal in size, cystose. Streptocolumella not well shown.

**Remarks:** This description is based on specimens compared with the small, reflexed corallum of Hall’s figure 6, here designated the lectoholotype. The figure itself errs only in showing the septa somewhat too coarse and too clearly divided into two series on the marginal zone.

The large specimen of Hall’s figures 8 to 11 is questionably assigned to *H. arachne*. Identity of that of figure 7 is uncertain, though it also resembles *arachne* more closely than it does the lectoholotype and hypotypes of *reflexum*.

Continuous septa and paucity of interseptal plates link this species...
with *H. decorosum*, from which, however, it is clearly separated by the streptocolumella with its initially reticulate and finally massive stereoplasmic reinforcements.

**Occurrence:** Hamilton (Moscow), Darien and Livingston County (type localities), East Alexander and elsewhere in western New York.

**Lectoholotype:** 3441 N. Y. State Museum; **Syntypes:** 4459 Am. Museum of Natural History (=*H. arachne*?) and 3441 N. Y. State Museum (=*H. arachne*?); **Hypotypes:** 6777-6787 Carnegie Museum.

**Heliophyllum (?) asperum** sp. nov. (Fig. 7; plate XXI, figs. 4-6.)

**Description:** Corallum irregularly subturbinate, with numerous expansions, contractions and changes of axial direction. Epitheca thick, continuous or discontinuous; costae indistinct. Fossa generally more than half the diameter of the calyx, deep to shallow. Marginal zone commonly flattened and inclined; in a few cases it is so steeply inclined as to be continuous with the fossal sides. Septa in two very distinct series, secondaries being low and narrow while primaries are high, coarse and sharply denticulate. Fossula not distinguishable externally.

A transverse section 13 mm. in diameter shows only primary septa, 26 in number. They are flexuous; some are barely 2 mm. long while others reach the axial region and end freely or fuse. Dissepiments are present, but carinae are not. Another specimen, at 12.4 mm., shows a few secondaries, though primaries are but 2 to 5.5 mm. long and end freely. At 15 mm. this same specimen shows 29 primaries, most of which reach the axial region; secondaries are very thin and but 1.6 mm. or less in length. Dissepiments have the V-shape characteristic of the species; carinae are present but are few and commonly indistinct.

A section 33 mm. in diameter cuts 80 septa, the secondaries reaching lengths of 11 mm. and ending freely. Primaries twist slightly, end freely or in fascicles in a manner resembling those of *H. obconicum* and are complicated by a stereocolumella which becomes reticulate in section. There is a subrhomboidal, broken sclerotheca, with stereothecal elements; thickening of septa and dissepiments extends beyond this false inner wall and results in an indistinct stereothecal band about 8.5 mm. from the axis. Dissepiments are subangular to V-shaped, crowded in some zones and sparsely spaced in others; there are many interseptal plates though few septa disintegrate. The fossula is distinct.

A gerontic section, just beneath the fossa, shows further development of V-shaped dissepiments and interseptal plates. The pseudocolumella is eccentric, and involves both stereoplasm and twisted septa, especially of the cardinal quadrants.

Paratypes differ chiefly in details of the stereotheca and sclerotheca.
A longitudinal section shows the tabulae incomplete and cystose, with the outer series poorly defined or absent. Carinae are steeply inclined. Dissepiments crowded, varying in direction of inclination.

Remarks: The most distinctive features of this species are its abundant, V-shaped dissepiments, its long interseptal plates, and its stereocolumella. It is included here because of its external resemblance to *H. halli irregulare* Hall, though its real relationships appear to be with *H. obconicum teres*. In fact, one specimen assigned to this species because of its coarse primary septa, V-shaped dissepiments, streptocolumella and combined stereosclerotheca, shows close resemblance to *teres* even though it lacks the neanic phyllothechal tube.

Occurrence: Hamilton (Moscow), Near East Alexander (type locality) and Leicester, New York.

Holotype: 6884-6887; Paratypes: 6888-6893 and 7335-7347 Carnegie Museum.

**Heliophyllum proliferum** Hall,
Ill. Dev. Foss. Corals, pl. 26, figs. 1-2, 5(?), 1877.

**Heliophyllum proliferum** Hall (Homonym; invalid)


Remarks: *Heliophyllum proliferum* Hall 1877 is preoccupied by *H. proliferum* Nicholson 1874, of the Onondaga. The two do not seem to be synonyms.

Hall's *H. proliferum* includes two species. The coral of his figure 5 has been doubtfully assigned to *H. decorosum* sp. nov. That of his figures 1 to 2 closely resembles, in external characters and proliferation, the syntype of *H. confluens* shown in plate 26, figures 3 to 4. Both, in turn, resemble an elongate, constricted, compound species of *Heliophyllum* found rarely in western New York. Without sections, however, identification is impossible, for there are other (doubtfully compound) species whose external characters—chiefly expansion rate, angularity of expansions and epithecal smoothness—also resemble the figures. *Heliophyllum proliferum* Hall thus is a homonym, lacks description and is not recognizably illustrated. Though types exist they were not available for study, and the species must be abandoned.

Occurrence: Hamilton (Moscow), Darien and Livingston County, New York (type localities).
Syntypes: $^{4461}_1$ and $^{4161}_2$ Am. Museum of Natural History. The second is referable to *H. decorosum* sp. nov.

**Figures 20-22.** Lateral views of three specimens of "Cystiphyllum." All figures $\times 0.5$.

**Fig. 20.** "C." *conifolius* Hall. A hypotype showing typical form, septal ridges and thick growth lines. The epitheca is exceptionally well developed. Hamilton (Moscow), Leicester, N. Y. (7411-7412 Carnegie Museum.)

**Fig. 21.** "C." *americanum* Milne-Edwards and Haime. A hypotype, typical of the invalid species, "C." *varians* Hall. Hamilton (Moscow), Leicester, N. Y. (20800 Walker Museum.)

**Fig. 22.** "C." *americanum* Milne-Edwards and Haime. A columnar specimen of large size, comparable to the figured types. Hamilton (Moscow), Leicester, N. Y. (7354-7357 Carnegie Museum.)
Heliophyllum (Zaphrentis) exiguum Billings; Hall, Ill. Dev. Foss. Corals, pl. 32, figs. 1-4, 1877.


Zaphrentis? exiguum (Billings)


Heliophyllum (Zaphrentis) exiguum Hall, Ill. Dev. Foss. Corals, pl. 32, figs. 1-4, 1877.

Heliophyllum? exiguum var. Hall, op. cit., pl. 32, figs. 5-7.


Remarks: Examination of the syntypes and other specimens, none of which is suited to sectioning, fails to add much to Billings' original description or to give validity to Hall's unnamed variety. A few specimens show clearly the “arched striæ” on septa which account for the original reference of the species to Heliophyllum. They are comparable, however, to structures found on the septa of several Zaphrentids and in the genotype of Zaphrentis itself as interpreted by O'Connell, and are associated with the deep fossula and abortive cardinal septum found in that genus. To it the species is tentatively assigned as an indication of apparent general relationship. More cannot be done without specimens both more numerous and better suited to sectioning than any now at hand.


"Cystiphyllum" americanum Milne-Edwards and Haime (Figs. 21-22; plate XXII, figs. 6-7; plate XXIII, figs. 2-8; plate XXIV, figs. 1-3.)

Cystiphyllum cylindricum Hall (not Lonsdale), Geol. New-York, pt. 4, p. 209, figs. 1-2, 1843.


Cystiphyllum corrugatum Hall, op. cit., pl. 29, figs. 14-16.


Original Description (Translation): “Corallum elongate, cylindroturbinate, straight or slightly curved, covered with a thin epitheca and presenting more or less marked growth wrinkles. When the epitheca is removed one perceives, now and then, very fine costal striae which are equal, uniformly distributed, and straight. Calyx circular, with weak boundaries, concave; septal rays distinct, extending to the center in the form of fine ridges which number about 100. Height 8 or 9 centimeters; diameter of the calyx, 4 or 5. A vertical section shows a texture wholly vesicular but very dense in the outer region; vesicles which occupy the periphery of the corallum are, in general, small and oblique downward and inward; those at the center are larger, unequal, somewhat horizontal, and larger above; the strongest are 3 mm. in length and 1 or 1.5 high while the small ones are not more than 1 mm. in width.”

Revised Description: Corallum cylindroturbinate with moderate rate of expansion and varied yet rather regular curvature. Constrictions numerous, angular, and commonly of magnitude exceeding 0.3 of the diameter. Epitheca thin, complete or incomplete, commonly removed by corrosion or erosion before fossilization or after it. Fossa shallow to deep; marginal zone concave to convex, undefined. Septal rays poorly developed in some specimens; in others they number 90 to 100 and cross the dissepiments to the axial region.

Transverse sections show a marginal band of cysts 1 to 3 mm. in greatest diameter and oval to concentric in shape; the dissepiments enclosing them are thin and generally lack septal rays. The size of dissepiments and cysts decreases centrally; thickness of the former increases; septal rays form prominent “teeth” on their inward faces, and cysts become irregularly oval or even round. At 5 to 12 mm. from the periphery (in sections 17 to 43 mm. in diameter) there is an irregular but commonly heavy sclerotheca formed partly by crowding together of small dissepiments and partly by deposition of stereoplasm upon and within them (plate XXIII, figures 6 to 8). Inside this wall, cysts and dissepiments enlarge—or more properly, merge with incomplete, highly convex, cyst-forming tabulae 1.5 to 12 mm. in width, whose outermost members bear septal rays. Constriction is accomplished primarily by reduction of the dissepimental zone; except in
extreme cases the tabulae retain normal size and cover almost normal areas.

Longitudinal sections show the dissepiments arranged in broadly funnel-shaped series approximating the "cystosepiments" of Grabau. The false inner wall is either cylindrical though broken (plate XXIV, figure 1), or is resolved into another series of funnels variably spaced and either distinct or connected; their individual deposits are as much as 2.6 mm. thick. Tabulae merge with dissepiments on levels between these funnels and (apparently) in them. Some tabulae are concave; others reach convexities of about 200 degrees, forming cysts that are circular in transverse section.

Remarks: Some American identifications of this species are limited to specimens which lack the calyx, or in whose calyces the septal rays are indistinct, and apply Hall's names corrugatum and varians to those in which the septal rays are prominent. Milne-Edwards and Haime, however, both specify and illustrate septal rays, so that such distinction is invalid. Since no other characters have been found which distinguish "C." corrugatum and the bulk of "C." varians, both (with the exception noted under "C." varians) are reduced to synonymy with "C." americanum.

In tentatively reassigning to this species Hamilton material from Ontario, Ohio and New York identified as C. vesiculosum Goldfuss by Nicholson, Stewart and Lambe we do not imply that the latter species is lacking from the American Devonian. So far as published figures go, "C." americanum may be (as Lambe and Stewart maintain) a synonym of "C." vesiculosum. The question cannot be decided without cutting authentic specimens of Goldfuss's species and a large series of Hamilton and Onondagan Cystimorphs of the general americanum-vesiculosum type. Until that can be done, it is unwise to attempt further amalgamation of species.

Occurrence: Hamilton (especially Moscow), Lake Skaneateles (type locality), Leicester (= Moscow), York, Eighteen Mile Creek, East Bethany, East Alexander and many other localities in western New York.

Hypotypes: (Hall's) 11819 Walker Museum and 4449 Am. Museum of Natural History; (Fenton and Fenton's) 3280 N. Y. State Museum (Hall's syntypes of C. varians); 20800 Walker Museum, 7354-7380 and 7393-7395 Carnegie Museum.
Cystiphyllum varians Hall,
Ill. Dev. Foss. Corals, pl. 28, fig. 8; pl. 29, figs. 1-13, 1877.

"Cystiphyllum" varians Hall (Invalid)


Remarks: The existing types of this species include six specimens: a transverse section, figured on plate 28; a longitudinal section shown on plate 29, figure 13; and four coralla—figures 1 to 5 and 10 to 12, plate 29. Specimens of figure 6 and 7 to 9 have not been traced.

All complete coralla are characterized by septal rays which, for Cystimorphs, are unusually prominent. Hall evidently placed emphasis on this character, and in the explanation of plate 28, figure 8, he remarks that it shows "the cysts arranged in concentric circles, forming cups as in Chonophyllum, and also . . . that the incipient rays are developed into continuous lines in the interior." Since this is all there is of description, this specimen (4452 Am. Museum of Natural History) probably must be held to determine the species, becoming the lectoholotype on which "C." varians must, if possible, be accepted.

That it can be is doubtful. The specimen is a small fragment, polished at one end; the section as published suggests a poorly preserved specimen of Heliophyllum. It at least is a cyathophyllloid, with true septa and dissepiments that are convex inwardly. The name may be held in abeyance pending adequate study of this fragment; but since it appears inadequate for reliable determination, we recommend that the species varians be dropped as without recognizable description or figure: a virtual nomen nudum of fifty years' standing.

The remaining syntypes, properly referable to "Cystiphyllum," show all essential characters of "C." americanum and no peculiarities other than exceptionally irregular growth. They therefore are assigned to that species.

Occurrence: Hamilton (Moscow), York, Leicester and other localities in western New York.


“Cystiphyllum” americanum Milne-Edwards and Haime.

Remarks: Since specimens closely resembling Hall’s figures show the characters of “C.” americanum and are distinguished only by obconical shape and strong septal striae (both variable characters), corrugatum is considered a synonym of Milne-Edwards and Haime’s species.


Syntypes: 4451 Am. Museum of Natural History.


“Cystiphyllum” conifollis Hall (Fig. 20; pl. XXIII, figs. 9-10; plate XXIV, figs. 4-7.)


Description: Corallum irregularly subcylindrical, with many constrictions of considerable magnitude and erratic curvature. Epitheca thick, wrinkled, complete or incomplete. Fossa shallow to moderately deep; septal rays prominent and coarse, numbering 5 in 5 mm.

Transverse sections show an outer zone of large dissepiments and cysts terminated by an irregular, heavily stereoplasmic false inner wall in which dissepiments are more closely spaced. Cysts formed by the dissepiment-like tabulae range to 6 mm. wide in a corallite whose diameter is 16 mm. Septal rays are absent to thick, as many as 3 being noted on one dissepiment.

Longitudinal sections range from compact structures like that of plate XXIII, figure 10 to open, massive ones of plate XXIV, figure 6. Both show secondary thickening of dissepiments and tabulae; the latter shows vertical stereothecal deposits in addition to the thickened funnels, perhaps characteristic of gerontic development.

Remarks: This species is readily distinguished by its coarse structure, columnar form and irregular growth. It appears to have no close relatives among Hamilton species of “Cystiphyllum” in the New York region, but is much closer to certain Onondaga species whose identity is undetermined.
Occurrence: Hamilton (chiefly lower Moscow), Eighteen Mile Creek, Leicester, East Alexander and other localities in western New York; Hamilton of Thedford region and Bosanquet, Ontario. Type localities are Leicester (= Moscow) and Bosanquet.


Cystiphyllum (Chonophyllum) sulcatum Billings; Hall, Ill. Dev. Foss. Corals, pl. 32, figs. 16-20, 1877.

Chonophyllum(?) sulcatum (Billings) (Plate XXII, fig. 8; plate XXIV, figs. 8-9.)


Not Cystiphyllum sulcatum Davis, Kentucky Foss. Corals, pl. 125, figs. 1-3, 1889.

Cystiphyllum (Chonophyllum) sulcatum Hall, Ill. Dev. Foss. Corals, pl. 32, figs. 16-20, 1877.

Description: Corallum short, obliquely turbinate, expanding without marked constriction from an acutely pointed base that furnished attachment only during neanic stages. Beyond that, rapid growth on the fossular side must have caused the corallum to sink to the position indicated on plate XXIV, figure 9. Epitheca thick and continuous, with distinct costae. Calyx oval, shallow, floored by a continuous lamina which is either vesicular or smooth. Over much of this surface, in most specimens, there are pronounced septal ridges and grooves and one to four fossulae, of which one predominates in length and depth. These fossulae and ridges persist in all laminae; dissepiments distinguishable throughout.

Remarks: Silicified specimens available are unsuited to sectioning, but are sufficient to confirm Hall’s illustration of a series of eccentric, subconical laminae which seem to equal the “série de planchers infundibuliformes superposés et invaginés, dont la surface présente un grand nombre de rayons cloisonnaires” specified by Milne-Edwards and Haime as the essential character of Chonophyllum. They do not give sections of the genoholotype, C. perfoliatum Goldfuss, nor does Wedekind, whose figures of C. planum Wedekind and C. patellatum
(Schlotheim) do not show the dissepimental area. The reference of *sulcatum* (Billings) to *Chonophyllum* therefore must be provisional.

**Occurrence:** Onondagan, Port Colburne and elsewhere, Ontario, Clarence and perhaps Mendon, New York. Rominger adds Falls of the Ohio and Mackinac Island, Michigan.

**Syntypes:** 3439a National Museum Canada; **Hypotypes:** 4140 Am. Museum of Natural History.

**Note**

In the explanations of plates, localities on the Delaware, Lackawanna and Western Railway, which are 1.5 miles east of East Alexander and 1.5 miles west of East Bethany, New York, have been given as East Alexander and East Bethany respectively.
EXPLANATION OF PLATE XVII.

All figures X 1.6.

Figs. 1-5. *Heliophyllum hallii* Milne-Edwards and Haime.

Fig. 1. Transverse (gerontic) section of a hypotype in which phyllothecal extensions are poorly developed. Hamilton (Moscow), Little Beard Creek, near Leicester, N. Y. (6714 Carnegie Museum.)

Fig. 2. Longitudinal (ephebic to gerontic) section of the same hypotype. Note the incomplete periaxial zone. (6713 Carnegie Museum.)

Fig. 3. Transverse (neanic) section of the same specimen. (Drawn from 6709 Carnegie Museum.)

Fig. 4. Transverse (gerontic) section of a rapidly expanding specimen with both curved septa and phyllothece. Hamilton (Moscow), Little Beard Creek, near Leicester, N. Y. (6708 Carnegie Museum.)

Fig. 5. Transverse neanic section of the same specimen. (6707 Carnegie Museum.)

Figs. 6-8. *Heliophyllum hallii degener* Hall. Transverse sections (early ephebic, ephebic and late ephebic stages) of a typical hypotype with very thin epitheca and constricted gerontic growth. Note pronounced fossular complex, thickened primary septa and ephebic development of the periaxial zone. Hamilton (Moscow), East Alexander, N. Y. (6734, 6732, 6735 Carnegie Museum.)
EXPLANATION OF PLATE XVIII.

All figures × 1.6, except fig. 2 which is × 0.8.

Fig. 1. *Heliophyllum halli* Milne-Edwards and Haime. Transverse (neanic) section of the large specimen shown in text figure 6. Like figure 5 of the preceding plate, it shows heavy calcification in the tabular region. Hamilton (Moscow), Little Beard Creek, near Leicester, N. Y. (7351 Carnegie Museum.)

Fig. 2. *Heliophyllum halli degener* Hall. Hall’s figure 8 of plate 25, showing absence of epitheca and gerontic constriction. Hamilton, Skaneateles Lake, N. Y. (4456 Am. Museum of Natural History.)

Figs. 3-6. *Heliophyllum halli irregularare* Hall.

Fig. 3. Transverse (ephebic) section of the hypotype shown in text figure 8. Hamilton (Moscow), western N. Y. (37722 Walker Museum; section 6747 Carnegie Museum.)

Fig. 4. Transverse ephebic section of a specimen with more rapid rate of expansion. Hamilton (Moscow), Little Beard Creek, near Leicester, N. Y. (6744 Carnegie Museum.)

Figs. 5-6. Transverse (early and late neanic) sections of a hypotype. Hamilton (Moscow), Little Beard Creek, near Leicester, N. Y. (6749-6750 Carnegie Museum.)

Figs. 7-9. *Heliophyllum decorosum* sp. nov.

Fig. 7. Longitudinal section through ephebic to gerontic region of the holotype, shown in text figure 5. Hamilton (Moscow), Little Beard Creek, near Leicester, N. Y. (6755 Carnegie Museum.)

Fig. 8. Transverse (ephebic) section of the same, showing primary septa uniting in the axial region. (6754 Carnegie Museum.)

Fig. 9. Transverse (ephebic) section of an aberrant paratype, with heavily calcified primary septa. (6761 Carnegie Museum.)
EXPLANATION OF PLATE XIX.

All figures, except 4 and 5. × 1.6.

Figs. 1-5. Heliophyllum obconicum Hall.

Figs. 1-2. Transverse (late neanic and ephebic) sections of a specimen with moderate rate of expansion. Note secondary calcification of tabulae within the stereothecal ring. Hamilton (Moscow), East Bethany, N. Y. (6819 and 6821 Carnegie Museum.)

Fig. 3. Transverse (late ephebic) section of the rapidly expanding specimen of text figure 10 showing cardinal and counter septa, union of septa and development of septal plates. Stereotheca more pronounced than it appears in the photograph. Hamilton (Moscow), Leicester, N. Y. (6815 Carnegie Museum.)

Fig. 4. Hall's figure 4 of plate 25 showing septal plates, thickened septa and carinae. Hall assigned this specimen to H. halli. Magnification unknown.

Fig. 5. Semi-diagrammatic drawing of disintegrating septa, septal plates and secondary calcification of septa and dissepiments in a sector of figure 3. × 3.

Fig. 6. Heliophyllum obconicum teres subsp. nov. Longitudinal section of a paratype with very moderate rate of expansion; between the arrows is an exceptionally persistent false aulos. Hamilton (Moscow), near LeRoy, N. Y. (6868 Carnegie Museum.)
EXPLANATION OF PLATE XX.

All figures × 2.

Figs. 1-7. *Heliophyllum obconicum teres* subsp. nov.

Fig. 1. Transverse (neanic) section of the holotype. Note aulos and stereotheca. (6841 Carnegie Museum.)

Fig. 2. Transverse (late neanic) section of the same. Aulos and stereotheca pronounced, though the latter shows poorly in the photograph. (6842 Carnegie Museum.)

Fig. 3. Transverse (ephobic) section of the same. The aulos is virtually obsolete, and septa are united in groups with some twisting. (6846 Carnegie Museum.)

Fig. 4. Transverse (late ephobic) section of the same. No trace of the aulos remains. (6847 Carnegie Museum.)

Figs. 5-6. Transverse (early and late ephobic) sections of a paratype in whose neanic stages a distinct but imperfect aulos is present. Hamilton (Moscow), near LeRoy, N. Y. (6857 and 6860 Carnegie Museum.)

Fig. 7. Transverse (ephobic) section of another paratype in which septal plates and dissepiments suggest those of *H. asperum* n. sp. Hamilton (Moscow?), Livingston County, N. Y. (33394 Walker Museum; section 6880 Carnegie Museum.)

Figs. 8-10. *Heliophyllum obconicum* Hall. Three transverse sections in the early neanic region of the hypotype shown in text figure 9. They show early irregularity and grouping of septa. Hamilton (Moscow), East Alexander, N. Y. (6824-6826 Carnegie Museum.)
EXPLANATION OF PLATE XXI.

Fig. 1. *Heliophyllum obconicum* form *confluens* Hall. Transverse section of a hypotype showing well developed septal plates. Hamilton, western New York. (37765 Walker Museum; section 6881 Carnegie Museum.) \( \times 1.6 \).

Figs. 2-3. *Heliophyllum obconicum* *teres* subsp. nov. Transverse (neanic) sections of the paratype of text figure 11, having a small aulos. Hamilton, Livingston County, N. Y. (20793 Walker Museum; sections 6861 and 6862 Carnegie Museum.) \( \times 1.6 \).

Figs. 4-6. *Heliophyllum asperum* sp. nov.

Fig. 4. Transverse (ephebic) section of the holotype. Hamilton (Moscow), East Alexander, N. Y. (6886 Carnegie Museum.) \( \times 2 \).

Figs. 5-6. Transverse (early neanic and ephebic) sections of a paratype. Hamilton (Moscow), East Alexander, N. Y. (7337 and 7339 Carnegie Museum.) \( \times 2 \).
EXPLANATION OF PLATE XXII.

All figures × 1.6, except fig. 8 which is × 0.8.

Figs. 1-2. Heliophyllum arachne Hall.

Fig. 1. Transverse (early ephebic) section of a hypotype, with normal secondary calcification of primaries within the stereotheca. Comparison of this with plate XVI1, figure 9 shows the close relationship of H. arachne to H. decorosum. Hamilton (Moscow), East Alexander, N. Y. (6774 Carnegie Museum.)

Fig. 2. Transverse (ephebic) section of a second hypotype, in which secondary calcification has progressed into the dissepimental region. Hamilton (Moscow), East Alexander, N. Y. (6772 Carnegie Museum.)

Fig. 3. Heliophyllum obconicum teres subsp. nov. Longitudinal section of a hypotype in which the septa are much twisted axially. Hamilton (Moscow), East Alexander, N. Y. (6850 Carnegie Museum.)

Figs. 4-5. Heliophyllum reflexum Hall. Transverse (ephebic) sections of two hypotypes showing thickly calcified sterezone and streptocolumella. Hamilton (Moscow), East Alexander, N. Y. (6787 and 6782 Carnegie Museum.)

Figs. 6-7. "Cystiphyllum" americanum Milne-Edwards and Haime. Transverse (early ephebic and constricted gerontic) sections of a large hypotype. Note heavy calcification and septal ridges. Hamilton (Moscow), Leicester, N. Y. (7362 and 7363 Carnegie Museum.)

Fig. 8. Chonophyllum? sulcatum (Billings). Hall's plate 32, figure 16, showing characters of the calyx.
EXPLANATION OF PLATE XXIII.

All figures X 2.

Fig. 1. *Heliophyllum reflexum* Hall. Longitudinal section of a typical specimen showing structure of the stereozone and streptocolumella. Hamilton (Moscow), East Alexander, N. Y. (6778 Carnegie Museum).

Figs. 2-8. *"Cystiphyllum" americanum* Milne-Edwards and Haime.

Fig. 2. Transverse (ephobic) section of a small specimen of irregular growth. Hamilton (Moscow), Leicester, N. Y. (7372 Carnegie Museum.)

Fig. 3. Transverse (late neanic) section of a long, thin corallum in which the sclerotheca is imperfect. Hamilton (Moscow), Leicester, N. Y. (7367 Carnegie Museum.)

Fig. 4. Longitudinal section through the early ephobic portion of the same specimen. (7368 Carnegie Museum.)

Fig. 5. Transverse (gerontic) section of the same; sclerotheca undeveloped. (7369 Carnegie Museum.)

Fig. 6. Transverse (early ephobic) section of a specimen in which both sclerotheca and tabular area are heavily calcified. This specimen is typical of the invalid "C." varians Hall, plate 29, figures 1 to 13. Hamilton (Moscow), Leicester, N. Y. (7378 Carnegie Museum.)

Fig. 7. Transverse (gerontic) section with pronounced sclerotheca. The corallum shows pronounced expansions and constrictions; this section represents an expanding phase. The whole is typical of the invalid "C." corrugatum Hall. Hamilton (Moscow), Leicester, N. Y. (7395 Carnegie Museum.)

Fig. 8. Transverse (early ephobic) section with thick sclerotheca. The corallum closely resembles "C." americanum? of Hall, plate 30, figure 10. Hamilton (Moscow), Little Beard Creek, near Leicester, N. Y. (7374 Carnegie Museum.)

Figs. 9-10. *"Cystiphyllum" conifollis* Hall. Transverse and longitudinal sections through the ephobic region of a corallum in which dissepiments are small and closely spaced. Hamilton (Moscow), Leicester, N. Y. (7417 and 7416 Carnegie Museum.)
EXPLANATION OF PLATE XXIV.


Figs. 1-2. Longitudinal and transverse (ephebic to early gerontic) sections of the large corallum shown in text figure 22. Note the discontinuous sclerothecal tube. Hamilton (Moscow), Leicester, N. Y. (7358 and 7359 Carnegie Museum.) \( \times 1.6 \).

Fig. 3. Longitudinal section showing marginal calicular gemmation in the gerontic corallum of which a transverse section appears in plate XXIII, figure 6. Hamilton (Moscow), Leicester, N. Y. (7379 Carnegie Museum.) \( \times 1.6 \).

Figs. 4-7. Cystiphyllum conifolius Hall.

Fig. 4. Transverse (ephebic) section of a coarsely cystose corallum. Hamilton (Moscow), Leicester, N. Y. (7405 Carnegie Museum.) \( \times 2 \).

Fig. 5. Transverse (late neanic) section of a heavily calcified specimen. Hamilton (Moscow), Leicester, N. Y. (7400 Carnegie Museum.) \( \times 1.6 \).

Fig. 6. Longitudinal section through the ephbic region of the same specimen. (7400 Carnegie Museum.) \( \times 1.6 \).

Fig. 7. Transverse (gerontic) section of the same specimen. (7400 Carnegie Museum.) \( \times 1.6 \).

Figs. 8-9. Chonophyllum? sulcatum (Billings). Hall's plate 32, figures 19 to 20, showing calyx and curvature. \( \times 0.8 \).

View This Item Online: https://www.biodiversitylibrary.org/item/216091
DOI: https://doi.org/10.5962/p.329862
Permalink: https://www.biodiversitylibrary.org/partpdf/329862

Holding Institution
Smithsonian Libraries

Sponsored by
Biodiversity Heritage Library

Copyright & Reuse
Copyright Status: In Copyright. Digitized with the permission of the rights holder
Rights Holder: Carnegie Museum of Natural History
License: https://creativecommons.org/licenses/by-nc-sa/4.0/
Rights: https://www.biodiversitylibrary.org/permissions/

This document was created from content at the Biodiversity Heritage Library, the world’s largest open access digital library for biodiversity literature and archives. Visit BHL at https://www.biodiversitylibrary.org.

This file was generated 10 August 2022 at 12:32 UTC