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CATALOGUE
OF THE
FOSSIL CEPHALOPODA

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PART I.

CONTAINING PART OF THE SUBORDER

NAUTILOIDEA,

CONSISTING OF THE FAMILIES

ORTHO CERATIDÆ, ENDOCERATIDÆ, ACTINOCERATIDÆ,
GOMPHOCERATIDÆ, ASCOCERATIDÆ,
POTERICERATIDÆ, CYRTOCERATIDÆ,
AND SUPPLEMENT.

BY

ARTHUR H. FOORD, F.G.S.

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PREFACE.

THE magnificent Collection, a part of which forms the subject of the present Catalogue, was carefully studied by the late Dr. S. P. Woodward, who devoted himself to the Mollusca and took a special interest in the Cephalopoda during the seventeen years (from 1848 to 1865) in which he was connected with the Geological Department. In subsequent years many large and important accessions have been made from time to time to this series, but owing to want of space only a small portion of the Collection was ever exhibited in the British Museum, Bloomsbury. In the fine Exhibition Gallery at present devoted to this Class the Collection can be admirably seen and studied in a series of sixteen table- and fourteen wall-cases, and the specimens are now being specially mounted and labelled in such a manner as will form a salient feature in the Geological Department.

It is confidently hoped that the present Catalogue may prove a substantial contribution to our knowledge of the Class, and that the addition of descriptions will enhance its value to the student. Mr. Foord has diligently worked at the literature of the subject, and has spared neither time nor labour in clearing-up the many difficult points connected with the priority of names and in the verifying of generic and specific determinations. His facility as a draughtsman has also enabled him to delineate readily the many minute points in the form or structure of these camerated

shells which he has observed during his long and careful study of the group.

The other Parts, describing and illustrating the remainder of the Nautiloidea (including Lituitidæ, Trochoceratidæ, Nautilidæ, and Bactritidæ), the Ammonoidea and Dibranchiata, will follow as speedily as possible.

HENRY WOODWARD.

Department of Geology,
31st Dec. 1888.

INTRODUCTION.

THE classification of the Nautiloidea adopted in this volume will be found to differ in some of its details from the systems hitherto employed, the more recent writings of Noetling, Zittel, Mojsisovics, and Hyatt having furnished the basis of the changes introduced¹. The arrangement of the groups described in the following pages is primarily zoological, secondarily stratigraphical, each genus being dealt with separately, from its appearance to its extinction.

Of the systems of classification of the Cephalopoda lately proposed, that of Professor Hyatt (which he states was suggested to him by the late Professor Louis Agassiz) is of such interest and importance as to deserve more than a passing notice. Hyatt considers that the generic terms *Cyrtoceras*, *Gyroceras*, *Lituites*, *Nautilus*, are merely "descriptive terms for the different stages in the development of an individual, and also the different stages in the development or evolution of the adult forms in time. In other words, each of these genera as now used includes representatives of all the different genetic series of Tetrabranchs, which are either young shells in the corresponding stage of growth, or adult shells in the corresponding stage of evolution." He finds "that genetic affinities on a large scale are best exhibited by the siphuncle, particularly by the funnels² of the septa, which are more invariable than any other parts of the shell." Accordingly Professor Hyatt has employed this feature as a means for distinguishing his larger groups, which he thus defines³:—1. HOLOCHOANOIDA, "having long funnels which completely close the intervals between the septa." This group is subdivided into (*a*) *Prochoanites*, or those with the necks of the septa turned forwards, *e. g.* *Bathmoceras*;

¹ See Table A, p. xxii.

² This term is used by Hyatt to denote the recurved ends—"necks"—of the septa. See footnote at p. 130, where it is shown that "funnels" is not a convenient term to use in this sense.

³ Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 260.

(b) *Metachoanites*, or those with the necks of the septa turned backwards, and thus forming a complete shelly tube, *e.g.* *Endoceras*, *Trocholites*. 2. **ELLIPOCHOANOIDA**, species with short necks and the siphuncular tube completed by an "intervening connective wall of distinct structure from the septal funnels." The **ELLIPOCHOANOIDA** are subdivided into the "true *Microchoanites*, which embrace the *Actinoceratidæ*, and most of the true Nautiloids, including *Nautilus*; and the *Macrochoanites*, which may be said to include *Bactrites* and such straight forms as are transitional to *Ammonoidea* and all the *Nautilinidæ*, and also the *Clymeninæ*, which have similar long funnels." Another term, *Cloiochoanites*, is employed by Hyatt to include "the transitional forms of the *Goniatitineæ*, which have the short type, or partly cloiochoanitic funnel elevated upon a median siphonal saddle . . ." He adds:—"An important factor in this classification is the dorsal suture, and we find that the position of a genus may often be determined in any given series by the peculiarities of this part; whether it is present or absent, and whether it has, or has not, a small annular lobe, or 'spindle lobe,' or a small saddle in the median line of the dorsum."

Hyatt next discusses the embryonic relations of the structure of the septa and of the siphuncle, and mentions the difference between the Nautiloids and the Ammonites exemplified in these structures, the one commencing with a globular initial chamber (protoconch of Owen), the other with a conical initial chamber and a cicatrix. He remarks that generally among the Palæozoic Cephalopod types much greater differences exist, in regard to the septa, the position of the siphuncle, and so on, than among the Mesozoic forms, thus indicating that the evolution of forms was quicker in the Palæozoic epoch than at subsequent periods, and from these circumstances he concludes that "types are evolved more quickly and exhibit greater structural differences between genetic groups of the same stock, while near the point of origin, than they do subsequently." It must not be forgotten, however, that the Palæozoic epoch was of much longer duration than the Neozoic. In the smaller divisions (Families and Genera) of Hyatt's scheme of classification an important place is assigned to the characters of the sutures for distinguishing the different groups. In some groups, however (notably the *Orthoceratidæ*), the less stable characters presented by the ornamentation of the shell are for a like purpose employed.

While there can be no question as to the value of Professor Hyatt's work, and the thoroughness of research which he has brought

to bear upon the class he has with so much boldness and originality attempted to reclassify, the extremely revolutionary nature of the changes he has proposed in the minor divisions of his system (involving the wide separation of many forms hitherto associated together) challenges the enquiry as to whether our knowledge of the developmental history of the Cephalopoda is not as yet far too imperfect to justify such a radical departure from existing systems. The suppression of the familiar names *Cyrtoceras* and *Gyroceras* seems quite unnecessary, and seeing that the names *Orthoceras* and *Nautilus* are retained, in a restricted sense, in Hyatt's scheme, there seems to be no good reason why the two former should not have been similarly used¹. The reasons are assigned in another part of this Catalogue for the adoption of Hyatt's arrangement of the Gomphoceratidæ (*infra*, p. 214), and also some of his divisions of the Cyrtocerata as subgenera of *Cyrtoceras* (*infra*, p. 262). In the remarks upon the genus *Gonioceras* occasion is taken to observe that, considering the imperfect condition of the specimens upon which that genus has been founded, it would be premature to form any conclusions as to its affinities, as Professor Hyatt has done. And, again, the genus *Eudoceras*, Hyatt², which is regarded by its author as related to *Gonioceras*, is very imperfectly known. Mr. C. E. Beecher³ makes the following observations upon "*Trochoceras?* (*Gonioceras?*) *pandium*," Hall, the type of the genus *Eudoceras*:—"No additional specimens of this species have been obtained since the original publication in 1879, and its generic relations are still uncertain."

Some authors, basing their classification upon the difference in the structure of the initial chamber in the Ammonoidea and the Nautiloidea, have placed the former in the Dibranchiata, on the ground that the nucleus (protoconch) in the Ammonites agrees with that of *Spirula* rather than with that of the Nautiloids⁴. Hyatt,

¹ See an able paper by Prof. Hyatt read before the American Association for the Advancement of Science, Minneapolis Meeting, Aug. 1883, entitled 'Fossil Cephalopoda in the Museum of Comparative Zoology' (Cambridge, Mass.); also the memoir previously quoted.

² Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 287.

³ Pal. New York, vol. v. pt. ii. Suppl. 1888 (contained in vol. vii. of that work), p. 37.

⁴ Munier-Chalmas, Comptes Rendus hebdom. de l'Acad. des Sci., Dec. 1873; Douvillé (Bull. Soc. Géol. de France, 3^e sér. vol. viii. p. 239, 1880) comes to the same conclusion as Munier-Chalmas, but upon different grounds, viz.: the form of the aperture in *Ammonites* (*Morphoceras*) *pseudo-anceps*, which

however, has found the "shrivelled remains of the protoconch" in two species of *Orthoceras*—*O. elegans*, Münst., and *O. unguis*, Phill.; which he has figured in 'Science' (vol. iii. no. 22, Feb. 1, 1884, p. 126). But the importance of such a character for purposes of classification is very doubtful. As Dr. Zittel¹ has pointed out, no special systematic value has been attached to the presence or absence of the embryonic shell (nucleus) in the Gasteropods, which corresponds with the initial chamber (Anfangskammer) of the shells of Cephalopods.

It may not be out of place to refer here briefly to Dr. Paul Fischer's 'Manuel de Conchyliologie,' noticing first the larger divisions which he employs, and, secondly, his grouping of the forms comprehended in the suborder Nautiloidea. As to the groups that should be embraced in the order Dibranchiata, most zoologists and palæontologists are agreed, there being satisfactory evidence (ink-sac, hooklets of tentacles, &c.) that many fossil forms belonged to this two-gilled order of cuttle-fishes, whose appearance dates from the latter part of the Trias. Save in some of its minor divisions, with which we are not at present concerned, Dr. Fischer's arrangement of the Dibranchiata does not depart from that of other systematists. The remaining groups of the Cephalopoda are placed in two orders—the Ammonea, and the Tetrabranchiata². The first

he finds resembles that of a Dibranch (*Argonauta*). Eichwald also (Leth. Ross. vol. i. p. 1190) placed all the Palæozoic *Nautiloidea*, including *Orthoceras*, *Endoceras*, *Actinoceras*, *Gomphoceras*, *Ascoceras*, &c., in the Dibranchiata, reserving only four genera—*Lituites*, *Clymenia*, *Nautilus*, and *Goniatites*—to represent the Tetrabranchiata.

¹ Handbuch der Palæontologie, Band ii. Abth. i. p. 354.

² It has recently been proposed that Owen's terms Tetrabranchiata and Dibranchiata should be abandoned and that the Cephalopoda should be classified upon other characters than those of the branchiæ. The first suggestion of this kind known to me is contained in Dr. Waagen's well-known work on the "Salt-Range" Fossils of India (Mem. Geol. Surv. India—Palæontologia Indica, ser. xiii., Salt-Range Fossils, 1879, p. 21), where under the division Mollusca the author has omitted the word "Tetrabranchiata" in the heading to his chapter on the Ammonitidæ, and inserted the word Order with a query, thus:—"Order: ?—." Mr. F. A. Bather (Ann. Mag. Nat. Hist. April 1888, p. 302, and *ibid.* June 1888, p. 423) has suggested the abolition of the terms Tetrabranchiata and Dibranchiata, and the division of the Cephalopoda into three orders—Nautiloidea, Ammonoidea, and Coleoidea (κολεός, sheath), the last being his own. But no evidence has as yet been brought forward to prove that the fossil forms included by Owen in the Tetrabranchiata were other than four-gilled.

of these coincides with the Ammonoidea, which are thus separated from the Tetrabranchiata on the ground that they form a natural division of the Cephalopoda, which, while they present some characters common to the Dibranchs (spherical first chamber &c.), nevertheless possess others which ally them with the Tetrabranchs. The Tetrabranchiata are divided into two groups:—(a) the Prosiphonata (necks of the septa directed forwards), containing the Family Nothoceratidæ, represented by two genera, *Nothoceras* and *Bathmoceras* [*Conoceras*]; (b) the Retrosiphonata (necks of the septa directed backwards), comprising the two Families Nautilidæ and Ascoceratidæ, the former answering to the order Nautiloidea, Nothoceratidæ and Ascoceratidæ being excluded. The reason given by Fischer for including so many diverse forms in the same Family (Nautilidæ) is that the construction of the aperture (simple or complex) cannot be employed as a Family character, on the ground that every structural type, whether straight, arcuate, discoid, or helicoid, possesses forms which exhibit both kinds of aperture; and it is for this reason that he rejects the Family Gomphoceratidæ established by Pictet for Nautiloids with complex apertures. It is not, however, upon the character of the aperture alone, important as that is, that Families are constituted, but upon a combination of structural features—septation, peculiarities of siphuncle, coiling or uncoiling of the shell, &c.

Dr. Fischer has failed to recognize the close relationship between *Actinoceras* and *Huronia*, and the very characteristic and remarkable internal structure of the former, so amply illustrated by Bigsby¹, Stokes², Saemann³, and Barrande⁴. We still find also (p. 410) Salter's figure of the siphuncle of *Piloceras* as the sole illustration of that genus, though Billings⁵ long ago figured and described the siphuncle of *Piloceras Wortheni*, with the septa attached. Such imperfections as these, however, detract very little from the general excellence of Dr. Fischer's work, which is indisputable.

It was held by von Jhering (as quoted by authors) that *Tentaculites* was the prototype of the Cephalopoda. This view is supported with much confidence by Professor Hyatt⁶ upon embryonic

¹ Trans. Geol. Soc. ser. 2, vol. i. 1824.

² *Ibid.* vol. v. 1840.

³ Palæontographica, Band iii. 1854.

⁴ Syst. Sil. de la Bohême, vol. ii. 1866; plates cccxxiv., cccxxv., cccxxvii.

⁵ Palæozoic Fossils, vol. i. 1865, p. 256, fig. 240.

⁶ Proc. Amer. Assoc. Adv. Sci. vol. xxxii. 1883, p. 327.

grounds. He conceives that "the prototype of the Mollusca must have had a globose embryo attached to the apex, the apex composed of a living chamber opening into the protoconch or globose shell of the embryo, without septa, though possibly divided more or less by diaphragms. Diaphragms precede the formation of the septa in the embryo Ammonoid, and a cone formed by them appended to the bottom of the cæcum was figured in the author's 'Embryology of Cephalopoda' (Bull. Mus. Comp. Zool., Cambridge, Mass., 1872) and described by Munier-Chalmas as the prosiphon. This confirms von Jhering's opinion that *Tentaculites* was the prototype of the Cephalopoda, since it has similar embryo and diaphragms."

Dr. S. P. Woodward, in the 'Manual of the Mollusca,' inserts a footnote under the genus *Orthoceras* to the following effect:—that "*Theca* and *Tentaculites* are provisionally placed with the Pteropoda, [but] they probably belong here." Thus von Jhering was not alone in his opinion as to the affinities of *Tentaculites*, though Professor James Hall still adheres to the view that its true relations are with the Pteropoda, adding, however, that these bodies "in their comparatively thick, calcareous test, and the annulating marks which affect the interior, and are visible upon the cast, are quite unlike the thin hyaline shells of most of the existing forms of Pteropoda"¹.

The development of the siphuncle is thus described by Professor Hyatt. Assuming that the ancestral forms of the Cephalopoda had closed cæca instead of a siphuncle, and that these were the "initial stages" of the necks of the septa, he imagines that these cæca "becoming prolonged in descendant forms, were differentiated into the funnels, the remnants of the cæca and the thinner walls of the sheath proper connecting them were formed by the fleshy siphon. This is the condition of the siphon in the typical forms and in the tubular-siphoned *Orthoceras*, but in some aberrant genera [*Endoceras* and *Piloceras*] the fleshy siphon widens near the living chamber, becoming conical and forming a sheath. These sheaths lie in the large tube formed by the true funnels, and may deposit permanent diaphragms as in *Endoceras*."

Since Hyatt wrote the foregoing new light has been thrown upon this subject by the discovery of the initial chamber of *Endoceras*, by Dr. Gerhard Holm, of Upsala². The enormous size of this chamber, which is continuous with the siphuncular cavity, lends

¹ Pal. New York, 1879, vol. v. pt. ii. p. 159.

² See p. 130 of this Catalogue.

countenance to Dr. Zittel's view that the siphuncle was originally a remnant of the visceral sac. A similar opinion was enunciated by Dr. H. Woodward in his paper "On the Structure of Camerated Shells,"¹ in which after quoting Owen's statement regarding the connection between the *Nautilus pompilius* and its shell, to the effect that "A third point of attachment is to the bottom of the shell by the posterior extremity of the mantle, which probably presents a conical form in the embryo *Nautilus*," he continues, "If then, the siphuncle in the young stage forms the main point of attachment between the animal and its shell, we may reasonably argue that the siphuncle in the adult *Nautilus* is simply the evidence of an aborted embryonal organ whose function is now fulfilled by the shell-muscles, but which in the more ancient and straight-shelled representatives of the group (the *Orthoceratites*), was not merely an embryonal, but an important organ in the adult."

It has been observed, however, that the shell-muscles in *Nautilus* are incapable of bearing even a slight strain².

¹ Popular Science Review, vol. xi. 1872, p. 113.

² In proof of this the following interesting account of the behaviour of a living *Nautilus*, from recent observations, may be adduced.

The account is taken from a "Note on the Pearly *Nautilus*," contributed by Mr. Edgar A. Smith, F.Z.S. (Zool. Depart. Brit. Mus.), to the 'Journal of Conchology' for Oct. 1887, and runs thus:—"A specimen of *Nautilus pompilius*, captured at Port Blair, Andaman Islands, has recently been presented to the British Museum by Mrs. E. Kenny, who has given the following account of its movements during captivity:—

"It was caught at the surface, near the anchor-cable of H.M.S. 'Osprey,' in this harbour, in a fairly rough sea. The shell, when brought to me yesterday with the fish in it, appeared chipped and broken at the edge, from contact with the chain-cable. I at once placed it in a bucket of salt water (it had not been out of its element more than half an hour), and the fish seemed to begin to breathe strongly. The rough, skin-like covering to the mouth [the hood] of the shell appeared to rise, and on each side of it the gills commenced to work in regular pulsations. At the same time the tentacles were protruded in front, and gas or air was expelled, bubbling up at the surface of the water at regular intervals. The whole creature seemed to expand and grow looser, until quite suddenly it became detached from its shell entirely, and lay breathing or working at the bottom of the bucket. I may remark that once out of its shell, the fish showed no apparent desire to re-enter it. In the empty shell were seen a few small tadpole-like creatures, very active in their movements, whether parasites or not I do not know. These were washed off into a glass jar containing rum, and the fish was then put into the same jar.'

"Unfortunately the specimen was placed in fresh spirit before the above notes were read, the so-called parasites being thus unconsciously thrown away with

It will be observed that the term "septal chambers" is used in the text instead of "air-chambers," which is in common use to designate the chambers marked off by the septa in the shells of some Cephalopods. Regarding the contents of these chambers various opinions have been held. Valenciennes¹ argued that considering the manner in which the mollusc adheres to its shell, advancing as it grows, it is difficult to conceive that the chambers were not completely empty, because if there were any gas or liquid in them it could only have entered in the form of a secretion

the discoloured spirit. . . . It seems possible that the irritation created by these creatures [the parasites] may have been the cause of the *Nautilus* quitting its shell. If so, it tends to show that the animal possesses the power of *suddenly* detaching the shell-muscle from the shell. This is not surprising when the feebleness of the scar and the fact that a thin transparent membrane is secreted between the muscle and the scar upon the shell are taken into consideration. The muscle evidently has such a slight hold on the shell that a very small effort of contraction would release it. If the theory be correct that the *Nautilus* moves forward a certain space to form a fresh chamber, relaxing its hold on the shell by the lateral muscles of attachment, were there not some means of holding on there would be considerable risk of the shell falling away from its inhabitant. The siphon then, as suggested by Reeve, may be the means by which the shell is held in position during that process. It might be stretched the required length, or if movable within the siphonal tube it might be pulled forward the length of the compartment, to be parted off by a new septum, and still leave sufficient in the old siphonal tube to hold the shell from slipping away. When the specimen observed by Mrs. Kenny quitted its shell, it appears to have snapped the siphonal membrane, for only about half-an-inch is still attached to the body." The above opinion of Reeve (which was also von Buch's) is confirmed by MM. Vrolik and Van Breda in their observations upon the anatomy of the *Nautilus* (Ann. Mag. Nat. Hist. vol. xii. 1843, p. 173). These authors concluded from their dissection of a specimen "that the animal is attached to the shell only by the siphon. The two muscles, by which it should adhere to the shell, according to the opinion of many naturalists, are applied only to the horny membrane or girdle, which Owen has so well described in his remarkable work [Memoir on the Pearly *Nautilus*, 1832]. This membrane does not itself adhere to the shell, so that there is no difficulty in detaching the horny membrane in question without the slightest laceration, both from the surface of the muscles and from that of the shell between which it is situated."

In connection with this subject attention may be drawn to an interesting paper by H. Dewitz (Schriften der physikal.-ökonomisch. Gesell. zu Königsberg, 1880, Abth. ii. p. 165, figs. 2, 3), in which the occurrence of three oval muscular impressions is described upon a cast of the body-chamber of *Orthoceras regulare*, Schloth.

¹ "Nouvelles Recherches sur le Nautile Flambé (*Nautilus pompilius*, Lam.)," in Archives du Mus. d'Hist. Nat. 1839, p. 257.

emanating from the animal. More conclusive evidence on this head is furnished by Professor W. Vrolik, of Amsterdam, who (assisted by M. van Breda) dissected a *Nautilus*¹ and found that the chambers of the shell contained gas². Several chambers were opened under water and the gas was collected; it proved to contain a larger proportion of nitrogen than the atmospheric air. M. van Breda, who analyzed the gas, could not detect in it the slightest trace of carbonic acid. There is no doubt that upon this authority the chambered shells of Cephalopods have been called "air-chambers." Owen has expressed the opinion that the vacated chambers of the *Nautilus* served to reduce its specific gravity so as to enable it to rise from its habitual position at the bottom of the sea, "such vertical movements being executed, like the horizontal ones, by means of the hydrostatic mechanism worked by the muscular forces of the mantle and funnel"³.

Dr. H. Woodward considers the term "air-chambers" misapplied, because in a specimen of *Nautilus umbilicatus* ("preserved with the animal in spirits of wine") opened by him he found that the chambers, three of which he laid bare, contained "a large quantity of fluid"⁴. This was also the case with the specimen collected by Mr. George Bennett, which furnished the subject of Owen's classical memoir.

It is much to be regretted that recent opportunities of setting this question at rest should apparently have been neglected.

Turning our attention now to the order of succession of the principal types of fossil Cephalopods, it appears that those having the most simple construction were the most abundant and persistent,

¹ Ann. Mag. Nat. Hist. vol. xii. 1843, p. 173.

² Huxley states that he has observed gas in the pores of the internal rudimentary shell of *Sepia*, which "has necessarily been liberated by the tissues which secrete the shell, and not derived from any external source" (Lankester, in Encyclop. Britannica, 9th ed. vol. xvi. 1883, p. 671). Professor Lankester informs me in a letter that reference is here made to the newly hatched young, and that he can confirm Huxley's statement from his own observations.

³ Owen, "On the relative positions to their Constructors of the Chambered Shells of Cephalopods," Proc. Zool. Soc. Nov. 1878, p. 955.

⁴ "On the Structure of the Shell in the Pearly *Nautilus*," Brit. Assoc. Report, Liverpool, 1870; Biology Sect. p. 128.

Dr. Woodward tells me that many dozens of specimens of the newly imported shells of *Nautilus*, examined by him at the Docks, were, when shaken, found to contain fluid within their chambers, just as in the camerated shell of the Water-Spondylus (*S. varians*).

Orthoceras heading the list with a stratigraphical duration extending from the Cambrian to the Trias. *Cyrtoceras* which, so far as is known, appeared simultaneously with *Orthoceras*, or perhaps a little before it, existed for a slightly shorter period, viz. from the Cambrian to the Permian. These two genera attained their highest development in point of numbers and diversity of form in the Silurian. The limitations put upon the duration in time of the types here mentioned must, however, be received with great caution, because those probable "breaks in the geological record" which an unknown amount of denudation of rock surfaces has given rise to, must always restrain us in any attempt to draw hard-and-fast lines in assigning limits to the duration of fossil forms.

It was Barrande's opinion that *Orthoceras* and *Cyrtoceras* are connected with each other through the "brevicone" forms of the first-named genus, and Hyatt considers that the *Gomphoceratidæ* were derived from *Cyrtoceras* through the "lower forms" of *Gomphoceras* (with wide apertures), which are abundant in the Niagara group of North America¹. *Poterioceras*, which has a simple aperture, might perhaps with even more probability be assumed to be the connecting form between *Cyrtoceras* and *Gomphoceras*. Next in order comes a very remarkable type, *Mesoceras*², which Barrande³ considered of great importance in connection with the question of the gradual development of the parts of the shell of the Nautiloids and the mutual relations of the genera. The form of the aperture in *Mesoceras* is not simple, because it does not conform to the plane of the transverse section, neither is it complex as in *Gomphoceras*, because it has only a single orifice; most palæontologists therefore would regard its aperture as something transitional between a simple and a complex one. This is the opinion held by Barrande, who, however, draws attention to the fact that *Mesoceras* does not make its appearance until an epoch of the Bohemian Silurian is reached in which 60 species of *Gomphoceras*, with characteristically contracted and complex apertures, flourished, associated with a host of species of *Orthoceras*, with equally characteristic simple apertures. It would be rash to attempt to draw conclusions as to the derivation of this exceedingly aberrant and rare form upon the single specimen known, which consists only of a cast of the body-chamber.

¹ See *Tetrameroceras Conradi*, at p. 241 of this volume.

² See *infra*, p. 244.

³ Syst. Sil. de la Bohême, vol. ii. Texte v. 1877, p. 1422.

The partly coiled, partly uncoiled forms, such as *Lituities*, *Ophi-dioceras*, and *Ancistroceras*, in which the last whorl is produced into a straight line, sometimes (*Lituities* and *Ancistroceras*) of great length, are generally regarded as showing a retrograde condition of development, with a tendency to revert to the straight, or slightly curved, ancestral type. Some other forms—*Hercoceras*, *Trochoceras*, and *Adelphoceras*—present various anomalies of structure. In *Hercoceras*, which is a Nautilus-like shell, the aperture is very contracted owing to the incurvation of its margin; in *Trochoceras* the whorls have a tendency to be helicoidal, that is, they are not coiled in the same plane¹; and in the allied genus *Adelphoceras* the shell is also asymmetrical, with a very marked contraction in the aperture. Further consideration of these and some other forms (*Gyroceras*, *Trocholites*, &c.) must be, for the present, postponed, as the exigencies of space preclude the completion of the Nautiloidea in the present volume.

Attention may now be directed to the distribution of the Nautiloidea in space and time.

Barrande has laid much stress upon the fact of the very sudden appearance of the Cephalopods in the Palæozoic rocks, under various generic and specific types. Thus we have in Britain an *Orthoceras* and a *Cyrtoceras* appearing in the Tremadoc of Wales: in Canada the first occurrence of Cephalopods is marked by two fragments of *Orthoceras* (?) from the upper part of the Potsdam Sandstone² (Lower Lingula Flags): in Russia several types of Cephalopods make their appearance in the *Orthoceras*-Limestone, whilst in Bohemia the earliest types are met with in bande D 1 (Lower Ordovician). Although so rare in the Cambrian, Cephalopods begin to appear in considerable numbers in the Ordovician, Barrande having recorded (1870) in this System 474 species for all countries. Of these more than one half (261 species) belong to the genus *Orthoceras*. *Cyrtoceras* takes the second rank with 93 species, then follow *Lituities* with 45 species, and *Endoceras* with 41 species. The numbers of species of other genera—viz.: *Conoceras*, *Piloceras*, *Gomphoceras*, *Discoceras*, “*Nautilus*,” *Gonioceras*, *Tretoceras*, *Trochoceras*, and *Ascoceras*—occurring in the Ordovician are very insignificant compared with those just named. It will be under-

¹ Had not this asymmetry been observed in a great number of species, it might have been set down to pathological causes.

² Geol. of Canada, 1863, p. 102, figs. 10, 11.

stood that the numbers of species have been greatly augmented since Barrande's lists were published, especially in the genera *Orthoceras* and *Cyrtoceras*; but this would not materially affect the relative value of the figures just given. For the British and American species statistics have been prepared up to a comparatively recent date. For the former Professor Blake, in his work on the British Fossil Cephalopoda¹, records 62 species in the Ordovician. In the latter Miller² shows that up to the year 1882, 271 species of fossil Cephalopods had been described in the Ordovician rocks of North America. The Nautiloidea attained their greatest development in point of numbers of species in the Silurian. The Bohemian Basin alone has yielded to the labours of Barrande a total of 1062 species; of these *Orthoceras* counts 517 species, *Cyrtoceras* 328, *Gomphoceras* (including *Phragmoceras*) 124, and *Trochoceras* 49³. In North America about 151 species are enumerated in the Silurian, and in Great Britain and Ireland 204. All the old genera are represented in the Silurian, with the exception of the following:—*Endoceras*, *Piloceras*, *Gonioceras*, *Discoceras*, and *Conoceras*; while the following have to be added, viz.:—*Hercoceras*, *Adelphoceras*, and *Nothoceras*; but these are numerically unimportant, only one species each of *Hercoceras* and *Nothoceras* and two of *Adelphoceras* being known. The Devonian reached, a very considerable reduction takes place in the number of species, the total for all countries being given by Barrande⁴ (1877) at 242 species. When analysed these afford 131 species of *Orthoceras*, 59 of *Cyrtoceras*, 17 of *Gyroceras*, 14 of *Gomphoceras*, and 11 of *Bactrites*; the remainder being *Nautilus* 8, and *Trochoceras* 2 species. These figures would be somewhat below the mark at the present time, the N.-American species alone numbering, according to Mr. S. A. Miller, 167 species. The principal areas of Devonian species are North America, the Hartz, Westphalia, and the Rhenish Districts. The Carboniferous epoch saw the extinction of *Trochoceras* and *Bactrites*, whose places were taken, so to speak, by a number of forms, hitherto assigned to the genus *Nautilus*, well

¹ 1882, pt. i. p. 236, "Table of Distribution."

² 'Cat. of American Palæozoic Fossils,' 1877, and 2nd ed., Jan. 1883.

³ Syst. Sil. de la Bohême, 1877, vol. ii. Suppl. et Sér. tardive, p. 266. See also Geol. Mag. 1870, p. 486, in which an admirable summary is given of the contents of Barrande's volume on the 'Distribution of the Cephalopoda in Silurian Countries' (1870).

⁴ Syst. Sil. de la Bohême, vol. ii. Texte iv. Introduction, p. lvi.

represented in North America, Belgium, and Ireland. The other genera, extant in the Devonian, continued to exist, though in very much diminished numbers.

The works of de Koninck¹, Phillips², and M'Coy³ have made us acquainted with a great number of forms more or less closely related to *Nautilus*. De Koninck records 52 species from Belgium, amongst which are included several of those described by M'Coy, Phillips, J. Sowerby, and J. de C. Sowerby.

The genera *Orthoceras*, *Cyrtoceras*, and *Gyroceras* now exhibit a marked decline in the number of their species. In the Permian (Dyas) of Germany only 3 species of *Orthoceras*, 1 of *Cyrtoceras* (?), and 5 of "*Nautilus*" (including species belonging to the genera *Pleuromutilus*, Mojs., and *Pteronutilus*, Meeke) are recorded⁴. In the "Salt-Range" (Productus-Limestone, of Wynne) of India⁵, Dr. W. Waagen has described 10 species of "*Nautilus*" (*Pleuromutilus*, Mojs.), 1 of *Gyroceras* (admittedly doubtful), and 4 of *Orthoceras* (one undetermined). Mojsisovics⁶ records, in his work upon the Trias of Germany (Med. Triasprov.), 19 species of "*Nautilus*" (*Cenoceras*, Hyatt, pars), 5 species of *Temnocheilus*, 3 of *Trematodiscus*, and 7 of *Orthoceras* (one undetermined). It is impossible not to be struck with the apparently sudden extinction of *Orthoceras*. One of the species (*Orth. campanile*, from the Trias) described by Mojsisovics might well be compared for perfection of development with any of the most typical of its precursors in the Palæozoic rocks; nevertheless, so far as we know, it was one of the last of its race⁷.

In the search for connecting-links between the Nautiloidea and Ammonoidea our attention is arrested by the peculiar form *Bactrites*, which, though probably a true Nautiloid⁸, is connected

¹ 'Faune du Calc. Carb. de la Belgique,' 1878, prem. partie, "Poissons et genre Nautilé."

² 'Geology of Yorkshire,' 1836, pt. ii.

³ 'Synop. of the Carb. Foss. of Ireland,' 1844, and 'British Pal. Foss.' fasc. i.-iii., 1852-1855.

⁴ Zittel, 'Handb. der Palæontologie,' 1884, p. 387; Credner, 'Elemente der Geologie,' 1887, p. 508.

⁵ Mem. Geol. Surv. India—Palæontologia Indica, 1879, Ser. xiii., i.

⁶ "Die Cephalopoden der Mediterranen Triasprovinz," in Abhandl. d. k.-k. Geol. Reichsanst. 1882.

⁷ The well-known case of *Lingula* may also be cited as an example of the extraordinary persistence of certain types.

⁸ Hyatt, Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 303.

by its ventral sutures with the Ammonoidea through *Mimoceras*, Hyatt. Again, in the Clymenidæ and Goniatitidæ of the Devonian and the Carboniferous and in the Ceratitidæ of the Trias a very decided approach is made towards the complicated sutural line of the Ammonoidea. It is worthy of note also that the Goniatitidæ, which are in many respects Nautiloid in their characters¹, made their first appearance in the Devonian, and therefore after the Nautiloidea had attained their maximum of development, which took place in the Silurian epoch².

Concerning the first appearance and distribution of the earlier forms of life in the European area, it has been suggested by Dr. Hicks³ that they originated in the warmer or more equatorial regions, where it is probable that the principal changes in their development took place; and that they gradually migrated northwards as the thermal conditions became more favourable, owing to the subsidence of the land and the consequent spread of the seas in Northern latitudes. Here "the groups as they successively appeared always contained evidence of advance in development over those which had previously reached the areas."

The results of recent discoveries relating to the structure of the shells of *Endoceras*, *Piloceras*, *Actinoceras*, and *Ascoceras* will be found under the descriptions of those genera, with the exception of *Ascoceras*, some new facts having come to light regarding that genus since the description of it was printed: these facts are detailed in the Supplement (p. 334), at the end of the volume.

¹ Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 307. Meek (United States Geol. Surv. Terr. vol. ix., 1876, footnote, p. 491) makes the following interesting remarks bearing upon the same subject under the description of his subgenus *Pseudonautilus*, in reference to which he says:—"This type presents very curious and interesting intermediate characters between the *Nautilus* and *Goniatites* groups; that is, it has not only the lateral lobes of the septa of the latter, as we see in some other Nautiloid groups, but also the peripheral, or so-called dorsal lobe of *Goniatites*, while its siphon is removed from the peripheral margin, as in the Nautiloid forms. Still it is so near the outer margin that it would only have to be placed two or three times its own breadth farther out to bring it against the periphery, and thus make the shell a *Goniatite*, as that genus is usually understood. Such examples show how gradually the distinctions between genera and larger groups are found to fade away as our knowledge of the intermediate types extends."

² See Heilprin, 'Geographical and Geological Distribution of Animals,' 1877, p. 265 *et seq.*

³ Geol. Mag. new series, Dec. ii. vol. iii. 1876, p. 249.

The "Table of the Nautiloidea" (A, p. xxii) has been prepared with the view of showing the groups into which the species described in the following pages are subdivided. It will be observed that the present volume terminates with the *Cyrtoceratidæ*.

It seems scarcely worth while to separate the Nautiloidea into the two very unequal divisions proposed by Dr. Paul Fischer¹, viz.: Prosiphonata (= *Prochoanites*, Hyatt) and Retrosiphonata (= *Metachoanites*, Hyatt), since the former includes only the two aberrant genera *Conoceras*, Bronn² (= *Bathmoceras*, Barr.³), and *Nothoceras*, Barr.⁴, the first of which is imperfectly known. At present there is no representative of either of these genera in the British Museum.

Some difference of opinion prevails as to the systematic value of the groups into which the genus *Nautilus* has been from time to time divided. Meek⁵ expressed the opinion that some of its extinct forms "differ so materially from the typical Nautili, that they ought to be at least entitled to rank as distinct subgenera." Amongst these he distinguishes the following, giving a careful diagnosis of their characters:—*Nautilus*, Linn. (typical); *Temnocheilus*, M'Coy; *Trematodiscus*, Meek and Worthen; *Discites*, M'Coy; *Solenoccheilus*, Meek and Worthen; *Hercoglossa*, Conrad; *Pseudonautilus*, Meek. Waagen⁶ takes a similar view to that of Meek, saying that "there is no doubt that the Nautili as well as the Ammonites can be divided very properly into several groups, which, if properly defined, might very well prove to be of at least subgeneric value." Mojsisovics⁷, after remarking upon the difficulty of separating the Nautili into genera, or genetic groups, on account of the simplicity of the curvature of their septa, which thus offer no basis for classification, separates those of the Alpine

¹ 'Manuel de Conchyliologie,' fasc. iv. 1882, p. 404.

² 'Lethæa Geognostica,' Band i. 1837, p. 98.

³ Syst. Sil. de la Bohême, vol. ii. pt. i. 1867, p. 74; *ibid.* pt. iii. 1874, p. 792.

⁴ *Ibid.* pt. iii. 1874, p. 784. This genus must not be confounded with Eichwald's genus of the same name, 'Lethæa Rossica,' vol. i. 1860, p. 1193, which proved to be an imperfect specimen of an *Endoceras*.

⁵ United States Geol. Surv. of the Territories, 1876, vol. ix. p. 490.

⁶ Mem. Geol. Surv. India; Palæontologia Indica—Salt-Range Fossils—Ser. xiii., i. p. 43.

⁷ 'Die Cephalopoden der Mediterranen Triasprovinz,' 1882, p. 265.

Trias by means of the sculpture of their shells. He distinguishes two subfamilies—*Gyroceratinæ* and *Nautilinæ*—under the family *Nautilidæ*; and in the *Gyroceratinæ* he includes the Carboniferous genera *Temnocheilus*, M'Coy, and *Trematodiscus*, Meek and Worthen, and the Triassic genus *Pleuironautilus*, Mojs. These he regards as distinct genera, and supposes that the two former were in all probability derived from *Gyroceras*, at about the beginning of the Carboniferous epoch. The subfamily *Nautilinæ* is represented in the Alpine Trias by 26 species, of which, according to Mojsisovics, 19 belong to the genus *Nautilus*, and 7 to *Clydonautilus*. Hyatt¹ has, however, placed two of the former, viz. *N. Carolinum* and *N. Tintoretti*, in his genus *Cenoceras*. Zittel² assigns only subgeneric value to the various divisions of the genus *Nautilus*; while Fischer³, though he enumerates Meek's subdivisions, apparently attaches no importance to them; and Blake⁴ selects only one of them—*Discites*—as a subgenus of *Nautilus*.

Table B is designed as a convenient reference to the stratigraphical divisions adopted in the text. It is based, with some modifications, upon the table furnished by Mr. J. E. Marr in his "Classification of the Cambrian and Silurian Rocks" (1883). The subdivisions of the British rocks are those employed by Mr. H. B. Woodward in his 'Geology of England and Wales' (2nd ed., 1887). Dr. Schmidt's paper "On the Silurian (and Cambrian) Strata of the Baltic Provinces of Russia, as compared with those of Scandinavia and the British Isles,"⁵ has also been consulted in compiling the table.

Many attempts have been made, with more or less success, to correlate the minor divisions of the North-American Palæozoic rocks with those of Europe. Professor Lapworth⁶ has recently contributed towards this object by working out the graptolitic zones of the Lower Palæozoic rocks of the river St. Lawrence at and below Quebec, and has shown the relations between those rocks and the rocks of the same age in Great Britain, Continental Europe, New York State, and Canada, by means of their graptolitic fauna.

¹ Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 300.

² 'Handb. der Palæontologie,' 1884, p. 379.

³ 'Manuel de Conchyliologie,' fasc. iv. 1882, p. 414.

⁴ 'British Foss. Ceph.' 1882, pt. i. p. 62.

⁵ Quart. Journ. Geol. Soc. 1882, vol. xxxviii. p. 514.

⁶ Trans. Roy. Soc. Canada, Sect. iv. 1886, p. 182 (Table A).

Before concluding, I desire to express my obligations to those who have aided me in the prosecution of my work.

To Dr. Gustav Lindström I am particularly indebted for much friendly advice, as well as for valuable information bearing upon questions concerning the nomenclature of certain Swedish fossils, which questions could only be decided by one thoroughly conversant with the history of the palæontological Collections in the Royal Museum of Stockholm, which Dr. Lindström has under his charge.

To Professor Alpheus Hyatt, of Boston, U.S., I owe many thanks for his kindness and liberality in supplying me with a nearly complete set of his writings on fossil Cephalopods, of which I have made abundant use.

I am much beholden also to Mr. C. E. Beecher, of Albany, New York, who, when he was in London, kindly looked over several of the proofs of the Catalogue, and gave me the benefit of his critical knowledge of the North-American species of the Nautiloidea.

To Professor McKenny Hughes and Messrs. Marr and Roberts I tender my best thanks for their courtesy in affording me every facility for the study of some of the types of British Cephalopods contained in the Woodwardian Museum, Cambridge: and I gratefully acknowledge similar favours received from Messrs. Newton and Sharman, of the Museum of Practical Geology, Jermyn Street.

I gladly seize this opportunity also of expressing my obligations to Dr. Woodward for the valuable and opportune counsel he has been ever ready to extend to me.

My cordial thanks are likewise due to Mr. B. B. Woodward and to Mr. G. C. Crick. To Mr. Woodward for the help he has given me in the bibliography of the Cephalopoda, and to Mr. Crick for having looked through all the proofs, and for many helpful suggestions, which have contributed in no small degree to the progress of the work.

ARTHUR H. FOORD.

London,
28th December, 1888.

A.—TABLE OF THE NAUTILOIDEA.

Family ORTHOCERATIDÆ¹, M'Coy, 1844.
 ORTHOCERAS, Breyn, 1732.

Family ENDOCERATIDÆ, Hyatt, 1883.
 ENDOCERAS, Hall, 1847.
 PLOCERAS, Salter, 1859.

Family ACTINOCERATIDÆ, Saemann, 1854.
 ACTINOCERAS, Bronn, 1837.
 DISCOSORUS, Hall, 1852.
 HURONIA, Stokes, 1824.
 SACTOCERAS, Hyatt, 1883.

Family GOMPHOCERATIDÆ, Pictet, 1854.
 GOMPHOCERAS, J. de Carle Sowerby, 1839.
 TETRAMEROCERAS, Hyatt, 1883.
 HEXAMEROCERAS, Hyatt, 1883.
 *MESOCERAS, Barrande, 1877.
 *TRIMEROCERAS, Hyatt, 1883.
 *PENTAMEROCERAS, Hyatt, 1883.
 *SEPTAMEROCERAS, Hyatt, 1883.

Family ASCOCERATIDÆ, Barrande, 1867.
 ASCOCERAS, Barrande, 1847.
 GLOSSOCERAS, Barrande, 1867.

Family POTERIOCERATIDÆ, Foord, 1888.
 POTERIOCERAS, M'Coy, 1844.
 *EREMOCERAS, Hyatt, 1883.
 *CLINOCERAS, Maske, 1876.

¹ These Families do not always include the genera originally embraced in them, many of the latter having been rearranged in accordance with more recent systems of classification.

* Genera not represented in the collection, but noticed or described in the text, are distinguished by an asterisk.

Family CYRTOCERATIDÆ, Chapman, 1857.

CYRTOCERAS, Goldfuss, 1832.

s. g. MELOCERAS, Hyatt, 1883.

s. g. OOCERAS, Hyatt, 1883.

Family LITUITIDÆ, Noetling, 1883.

LITUITES, Breyn, 1732.

s. g. OPHIDIOCERAS, Barrande, 1867.

*ANCISTROCERAS, Boll, 1857.

Family TROCHOCERATIDÆ, Zittel, 1884.

TROCHOCERAS, Barrande, 1847.

*ADELPHOCERAS, Barrande, 1874.

Family NAUTILIDÆ, Owen, 1836.

TROCHOLITES, Conrad, 1838.

GYROCERAS, de Koninck, 1844.

s. g. TRIGONOCERAS, M'Coy, 1844.

HERCOCERAS, Barrande, 1865.

URANOCERAS, Hyatt, 1883.

BARRANDEOCERAS, Hyatt, 1883.

DISCITES, M'Coy, 1844.

s. g. PHACOCERAS, Hyatt, 1883.

TREMATODISCUS, Meek & Worthen, 1861.

TEMNOCHEILUS, M'Coy, 1844.

VESTINAUTILUS, Ryckholt, 1852, emend. Hyatt, 1883.

ASYMPTOCERAS, Ryckholt, 1852, emend. Hyatt, 1883.

EPHIPPIOCERAS, Hyatt, 1883.

PLEURONAUTILUS, Mojsisovics, 1882.

NAUTILUS, Breyn, 1732.

HERCOGLOSSA, Conrad, 1866.

ATURIA, Bronn, 1838.

Family BACTRITIDÆ, Hyatt, 1883.

BACTRITES, G. Sandberger, 1841.

The family or families to which
 these genera should be referred } GONIOCERAS, Hall, 1847.
 not yet satisfactorily determined. } JOVELLANIA¹ (Bayle), Foord, 1888.

¹ After Jovellanos, a famous Spanish statesman and poet (1744-1811), born at Gijon in Asturias.

B.—TABLE OF THE CLASSIFICATION OF THE LOWER

		BRITAIN.	SCANDINAVIA.
SILURIAN SYSTEM.	Ludlow Series.	{ Ledbury Shales. Downton Sandstone. } (Passage Beds.) Upper Ludlow Beds. Aymestry Limestone. Lower Ludlow Beds.	Sandstones of Ramsosa and Kaerrstorp.
	Wenlock Series.	{ Wenlock Limestone. Wenlock Shale. Woolhope Beds.	Gothland Sandstone. Cardiola Beds, Leptæna Lime- Cyrtograptus Shales. [stone.
	May Hill Series.	{ Tarannon Shales. Upper Llandovery. Lower Llandovery.	Rastrites Shales. Brachiopod Beds (Upper).
ORDOVICIAN SYSTEM.	Bala Series.	{ Hirnant Limestone and Ashgill Shales. Caradoc Beds and Coniston Limestone. Llandeilo Flags.	Brachiopod Beds (Lower). Trinucleus Shales. Chasmops Limestone. Middle Graptolite Shales.
	Llanvirn Series.	{ Upper.— <i>Didymograptus</i> -Shales. Lower.—Flags and Slates with <i>Placoparia</i> , &c.	Murchisoni-Shales of Scania.
	Arenig Series.	{ Upper.—Garth Grit. Lower.—Garth Slates.	Orthoceras-Limestone (in part). Orthoceras-Limestone (in part). Phyllograptus-Shales.
CAMBRIAN SYSTEM.	Tremadoc Series.	{ Upper.—With <i>Asaphellus Homfrayi</i> , &c. Lower.— <i>Dictyonema</i> -Beds.	Ceratopyge Beds.
	Lingula Flag Series.	{ Dolgelly Beds. Ffestiniog Beds. ¹ Maentwrog Beds.	Olenus-Schists.
	Menevian Series.	{ Upper.—Sandstones and Shales, with <i>Orthis Hicksii</i> , &c. Middle.—Black Flags, with <i>Paradoxides Davidis</i> , &c. Lower.—Grey Flags, with <i>Paradoxides Hicksii</i> , &c.	Paradoxides-Schists.
	Harlech and Longmynd Series.	{ Longmynd Beds. Caerfai and Solva Beds. Llanberis Grits and Slates. Harlech Grits.	Eophyton and Fucoïd Sand- [stones.

¹ Dr. Schmidt (Quart. Journ. Geol. Soc. vol. xxxviii. 1882, p. 528) says that this stage is doubtless a representative of the typical Wenlock Limestone of England, and of the Niagara Limestone of North America.

² Of this zone Dr. Schmidt (*loc. cit.* p. 523) observes that the general character of its fauna is comparable with that of the Bala group of England, and the Trenton of North America.

³ Professor Lapworth has recently recorded (Geol. Mag. n. s. decade iii. 1888, vol. v. p. 484) the discovery of the "Olenellus Fauna" of Scandinavia, Esthonia, and Lapland in the Lower

PALÆOZOIC ROCKS OF EUROPE AND NORTH AMERICA.

RUSSIA.	BOHEMIA.	FRANCE (NORMANDY).	N. AMERICA.
K. Upper Oesel Beds.	H. G. F.		Lower Helderberg. Salina.
I. Lower Oesel Beds ¹ .	E 2. Part of E 1.	Calcaires ampé- liteux de Feu- guerolles et Saint-Sauveur.	Niagara.
H. ? Pentamerus-Esthonus Zone.			
G ₃ . { Raiküll Schist. G ₂ . { Borealis-Limestone. G ₁ . { Joerden Schist.	Part of E 1.		Clinton. Medina. Oneida.
F ₂ . { Borkholm Schist. F ₁ . { Lykholm Schist.	D 5.	Schistes ampé- liteux.	Hudson River or Lor- [raine.
E. Wesenberg Schist ² .	D 4.	Grès de May.	
D. Jewe Schist.	D 3.	Schistes à Caly- mènes. Minerais de fer.	Utica. Trenton.
C ₃ ? { Itfer Schist. C ₂ ? { Kuckers Schist. C ₁ ? { Echinosphærites-Limestone.	D 2.		
B ₃ in part ?	D 1 γ.		Birdseye and Black River.
B ₃ in part—Vaginatens- or Ortho- ceras-Limestone. B ₂ . Glauconite Sandstone.	Volcanic Beds.	Grès à bilobites.	Chazy.
B ₁ . Glauconite Sandstone.	D 1 β.		Calceiferous.
A? { Dictyonema-Schists. Ungulite Grit. Blue Clay.	D 1 α.		Potsdam.
	C.		Braintree and St. John.
	B in part.		Ocoee ? ⁴

Cambrian of Britain, in the Shropshire area. It there consists of "two main members, viz. the basal Quartzite of Lawrence Hill and Caer Caradoc, and an overlying green sandstone, the Comley Sandstone (Hollybush Sandstone of Dr. Callaway)," the latter being correlated with the Ffestiniog Beds of N. Wales.

⁴ The Ocoee conglomerate and slates of East Tennessee are "doubtfully included" by C. D. Walcott in the lowest Cambrian of North America. (International Congress of Geologists, 1888: Report of the American Sub-Committee on the Lower Palæozoic, p. B 29.)



SYSTEMATIC INDEX

OF THE

FAMILIES, GENERA, AND SUBGENERA.

[Those Genera marked with an asterisk are not in the Collection, but they have been specially mentioned or else described in the text.]

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CORRIGENDA ET ADDENDA.

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- Page 7, line 6 from top, for **Orthoceras politum**, McCoy, read **Orthoceras lancea**, Barrande.
- „ 13, line 14 from top, for **Orthoceras gracile**, Portlock, read **Orthoceras Lapworthi**, Foord, the former specific name being preoccupied by Blumenbach (see p. 81).
- „ 62, last line, for horizontally read longitudinally.
- „ 78, line 19 from top, for the type-specimen read two specimens, and line 11 from bottom, for this name read the name *O. vertebrale*.
- „ 80, line 8 from top, for **Orthoceras longicameratum** read **Orthoceras Nassoviense**, the former specific name being preoccupied by Hall (Pal. New York, 1859, vol. iii.).
- „ 82, in the fourth column, for Cydrinen read Cyprinen.
- „ 93, line 2 from top, for Switzerland read Hartz.
- „ 96, line 4 from top, for **Orthoceras Bavaricum**, Foord, read **Orthoceras Muensterianum**, d'Orbigny (see Prodr. de Paléont. vol. i. p. 55).
- „ 111, line 15 from bottom, for p. 52 read p. 62.
- „ 115, delete lines 1 and 2 from top, and at line 2 from bottom for Tournai read Visé.
- „ 117, line 6 from top, delete from A specimen to end of paragraph.
- „ 174, line 5 from top, for **Actinoceras capitolum** read **Jovellania capitolina**.
- „ 214, line 7 from bottom, delete the word Remarks.

3

CATALOGUE
OF
FOSSIL CEPHALOPODA.

Phylum **MOLLUSCA.**

Class CEPHALOPODA.

Order TETRABRANCHIATA.

Suborder *NAUTILOIDEA.*

(Suture-line simple, more rarely undulating or denticulate. Siphuncle variable in position. Septa concave towards the aperture. Necks of septa usually short (*Ellipchoanoida*, Hyatt), more rarely long (*Holochoanoida*¹, Hyatt). Initial chamber conical, with cicatrix.)

Family **ORTHOCERATIDÆ.**

Genus **ORTHOCERAS**, Breyn².

(*Molossus*, *Achelois*, Montf. 1808.)

Gen. Char. Shell straight or slightly curved, elongate-conical, circular or subelliptical in cross-section. Septa concave, usually horizontal, sometimes a little oblique; widely separated as a rule. Siphuncle usually slender, cylindrical, central, subcentral, or eccentric. Body-chamber large, of variable length. Aperture simple.

¹ Embracing *Endoceras*, *Piloceras*, and some other aberrant genera.

² Dissert. Phys. de Polythalamiiis, 1732, Cap. vi. p. 28.

CAMBRIAN SPECIES.

Orthoceras sericeum, Salter.

1866. *Orthoceras sericeum*, Salter, Mem. Geol. Surv. vol. iii. p. 356, pl. x. ff. 4, 5.
 1873. *Orthoceras sericeum*, Salter, Camb. & Sil. Foss. p. 18.
 1873. ? *Orthoceras*, sp., Hicks, Quart. Journ. Geol. Soc. vol. xxix. p. 51, pl. iii. f. 27.
 1882. *Orthoceras sericeum*, Blake, British Foss. Ceph. pt. i. p. 138, pl. xiii. ff. 1, 2.

Sp. Char. Owing to slaty cleavage the characters of this species are very obscure, all the specimens observed having suffered distortion and compression in a high degree.

The rate of tapering is slow, apparently about 1 in 12, but according to Professor Blake ranging in different specimens between 1 in 8 and 1 in 31. Nothing can be said with certainty about the body-chamber. The septa are oblique, remarkably numerous, and exhibit a slight curvature; the angle of their obliquity in the best preserved specimen is nearly 45° . About 18 septa are contained in the space of 1 inch.

Salter (*loc. cit.*) states that the siphuncle is "very large, and a good deal eccentric, but not quite lateral." Blake, on the other hand, finds it in some examples to be "central and moderate in size, always supposing that the festoon in the septa indicates it."

Horizon. Tremadoc.

Locality. Portmadoc, Caernarvonshire.

Represented by two specimens, No. C 611, presented by H. Hicks, Esq., M.D., F.R.S.

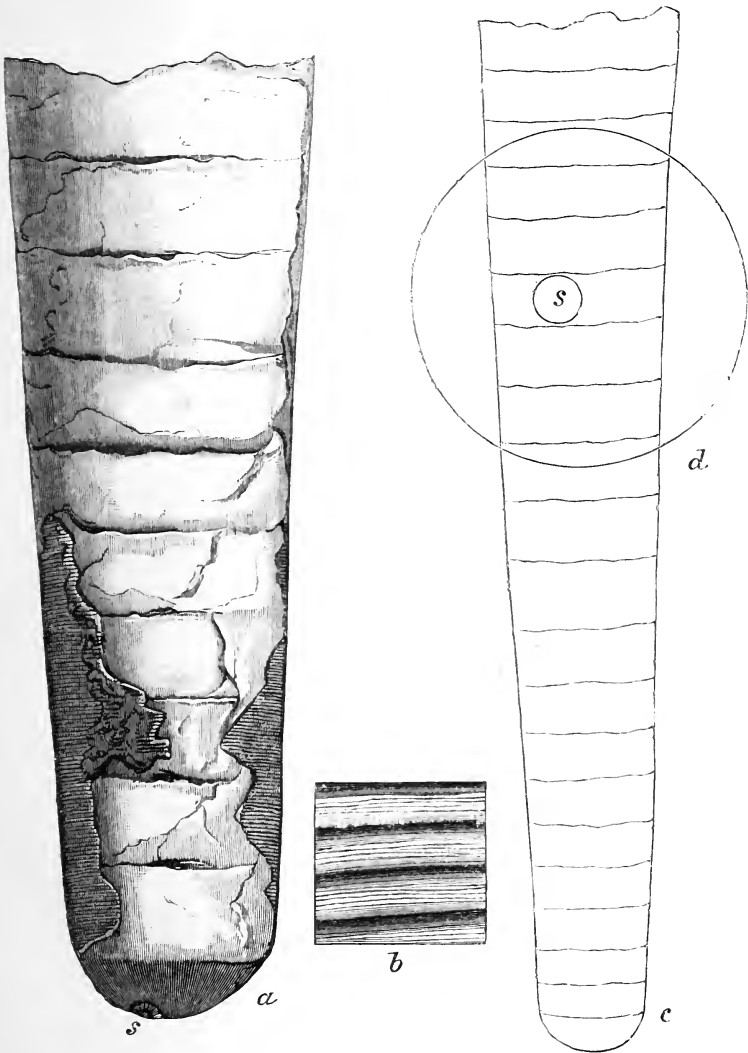
ORDOVICIAN SPECIES.

Orthoceras Kinnekullense, Foord.

1887. *Orthoceras Kinnekullense*, Foord, Ann. & Mag. Nat. Hist. ser. 5, vol. xx. p. 401, f. 2.

Sp. Char. Shell elongate, tapering at the rate of 1 in 9. Circular in cross-section. The septa direct, distant about $\frac{1}{3}$ the diameter, strongly arched, their convexity about $\frac{2}{3}$ that of their diameter. Siphuncle a little eccentric, about three lines in diameter where the shell has a diameter of twenty-one lines. Test ornamented with regular, direct, flattened, transverse riblets, divided by narrow interspaces. Body-chamber unknown.

Fig. 1.



Orthoceras Kinnekullense.—*a*, fragment of the septate part of the shell (about one half of it), with some of the test remaining: natural size (*s*, siphuncle); *b*, portion of the test, greatly enlarged; *c*, outline of the entire specimen reduced one half; *d*, outline of section, restored from another specimen, showing siphuncle at *s*.

Remarks. The most characteristic feature in the present species is the sculpture of the test, which is beautifully preserved on most of the specimens that have come before me. The figure (1 b) will enable the reader to realize the sculpture of the shell much better than a verbal description can do. It is necessary, however, to state that the riblets vary in width, so that in some places nearly five of them are contained in the space of 1 line, while in others, especially at the larger extremity of the shell, only about $2\frac{1}{2}$ are required to fill that space. Ordinarily about 4 to $4\frac{1}{2}$ are contained in 1 line. These measurements include the interspaces.

The dimensions of the largest specimen in the National Collection are as follows:—length 11 inches, greatest diameter 2 inches, least diameter 1 inch. Septa about $\frac{1}{2}$ inch apart, but becoming a little closer near the smaller extremity of the shell.

The very characteristic ornamentation of this species separates it from all other Ordovician species known to me.

Horizon. *Orthoceras*-Limestone¹ (= Arenig).

Localities. Kinnekulle Hill (Westrogothia), and Oeland, Sweden.

Represented by a few good specimens: No. C 1951 presented by J. E. Lee, Esq., F.S.A., F.G.S.; No. C 2029 by A. H. Foord, F.G.S.

***Orthoceras Revalense*, Foord.**

1887. *Orthoceras Revalense*, Foord, Ann. & Mag. Nat. Hist, ser. 5, vol. xx. p. 402, f. 3.

Sp. Char. Shell straight. Section elliptical, the ratio of the diameters being as 24 : 19. Very uniformly tapering at the rate of 1 in 6. Septa direct, undulating; distant about $\frac{1}{3}$ the diameter. Siphuncle eccentric, cylindrical, its diameter about $\frac{1}{8}$ the longer diameter of the shell. Body-chamber and test unknown.

Remarks. The distinguishing feature of this species is its relatively high rate of tapering.

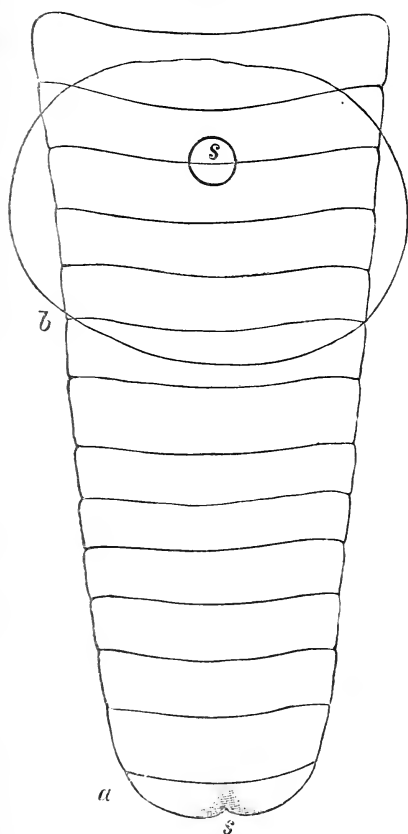
Horizon. *Orthoceras*-Limestone (= Arenig-Llanvirn).

Locality. Reval (Esthonia), Russia.

One specimen, presented by E. Hubbard, Esq.

¹ See a valuable paper by Prof. F. Schmidt, of St. Petersburg, "On the Silurian (and Cambrian) Strata of the Baltic Provinces of Russia, as compared with those of Scandinavia and the British Isles," in Quart. Journ. Geol. Soc. vol. xxxviii. p. 514 (1882). Also J. E. Marr, on the "Classification of the Cambrian and Silurian Rocks," pp. 74 & 82 (1883).

Fig. 2.



Orthoceras Revalense.—*a*, part of a specimen, the whole of which measures $7\frac{1}{2}$ inches (*s*, siphuncle); *b*, section, showing siphuncle at *s*. Natural size.

***Orthoceras regulare*, Schlotheim.**

1732. *Orthoceratites siphunculo axem transeunte* &c., Breyn, Diss. Phys. de Polythalamiis, p. 31, tab. iii. ff. 1–4.

1775. *Orthoceratites*, Knorr & Walch, Recueil des Monumens des Catastrophes, tom. iii. p. 141, Suppl. iv. c. f. 2, p. 142, Suppl. iv. d. f. 5.

1813. *Orthoceratites Oelandicus*, Schlotheim, in Leonhard's Taschenb. für Mineralogie, Abth. i. p. 34.

1820. *Orthoceratites regularis*, Schlotheim, Die Petrefactenkunde, p. 54.

? 1837. *Orthoceratites regularis*, Bronn, Lethæa Geognostica, zweite Auflage, Band i. p. 100, tab. i. ff. 10, *a*, *b* (excl. *c*).

- ? 1840. *Orthoceratites regularis*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 95, Taf. xvii. ff. 3, 4.
 1853. *Orthoceras regulare*, Geinitz, Die Verstein. der Grauwackenform. in Sachsen, Heft ii. p. 27, Taf. i. f. 12.
 1857. *Orthoceras regulare*, Boll, Beitrag zur Kenntniss der Silur. Ceph. in Archiv für die Naturkunde von Mecklenburg, p. 14, Taf. iii. ff. 7, a, b, c.
 1860. *Orthoceras regulare*, Eichwald, Lethæa Rossica, Seconde Section, vol. i. p. 1198.
 1861. *Orthoceras regulare*?, Ferd. Roemer, Die fossile Fauna der sil. Diluvial-Geschiebe von Sadewitz, p. 57, Taf. vii. ff. 5, a, b.
 1869. *Orthoceras regulare*, Karsten, Die Verstein. des Uebergangsgewirges in den Geröllen der Herzogthümer Schleswig und Holstein, p. 46, tab. xv. ff. 8, a-e.
 ? 1869. *Orthoceras regulare*, Heidenhain, Ueber Graptolithen führende Diluvial-Geschiebe der norddeutschen Ebene, p. 21.
 ? 1878. *Orthoceras commutatum* (pars), Kayser, Abhandl. zur geol. Specialkarte von Preussen, p. 69, Taf. xi. ff. 4, 4 a.
 ? 1878. *Orthoceras regulare*, Haupt, Die Fauna des Graptolithens Gesteines, p. 51.
 ? 1880. *Orthoceras regulare*, Angelin-Lindström, Fragm. Silurica, p. 4, tab. iv. ff. 4, 5.
 1880. *Orthoceras regulare*, Dewitz, Beiträge zur Kenntniss der in den Ostpreussischen Silurgeschieben vorkommenden Ceph. in Schrift. d. phys.-ökon. Gesellsch. zu Königsberg, Abth. ii. p. 165, ff. 2, 3.
 1880. *Orthoceras regulare*, Kjerulf, Die Geol. des südlichen und mittleren Norwegen (deutsche Ausgabe von A. Gurlt), p. 68.
 [Not *Orthoceratites regularis*, Hisinger, Leth. Suec. p. 29, tab. ix. f. 3. *Orthoceratites regularis*, Quenstedt, 1846, Petref. Deutschl. Bd. i. Abth. i. p. 43, tab. i. f. 1. *Orthoceras regulare*, G. & F. Sandb. Die Verstein. des rhein. Schicht. in Nassau, p. 173, Taf. xx. ff. 2, 2 a, bis 2 l.]

Sp. Char. The species has a central siphuncle and somewhat remote, strongly convex septa. In a specimen having a maximum diameter of 1 inch, they are about $\frac{1}{2}$ an inch apart. The rate of tapering is slow, about 1 in 17. The surface of the test is transversely striated.

Remarks. Schlotheim's description is very brief and insufficient; it runs thus:—" *O. regulare* is distinguished chiefly by its perfectly round, very slender, nearly central siphuncle. The septa are slightly curved and not very close together. It appears to attain a considerable length and thickness." Schlotheim's reference to Breyn's excellent figures has enabled authors to recognize the species, though it is evident from the synonymy that several forms have been erroneously included under this name. Most of the examples known are imperfect.

Horizon. *Orthoceras*-Limestone (= Arenig).

Locality. Prussia ?

[Also a specimen from Norway, presented by Dr. Kjerulf, from the Oskarskal Group, 4 (= Bala ?).]

Fairly well represented in the Collection.

***Orthoceras politum*, M'Coy.**

1851. *Orthoceras politum*, M'Coy, Ann. & Mag. Nat. Hist. ser. 2, vol. vii. p. 45.

1851. *Orthoceras politum*, Salter, in Murchison, Quart. Journ. Geol. Soc. vol. vii. p. 137, pl. x. ff. 5, 6.

1852. *Orthoceras politum*, M'Coy, British Pal. Foss. fasc. ii. p. 316, pl. i. l. f. 30.

1865. *Orthoceras politum*, Haswell, Silurian Formations of the Pentland Hills, pl. i. f. 1.

1870. *Orthoceras lancea*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 640, pl. cclxxix. f. 10, pl. ccccx. ff. 1-14, ? pl. ccccx. f. 8.

1870. *Orthoceras lancea*?, Barrande, Distrib. des Ceph. dans les Contrées Siluriennes, p. 50 (Extrait du Syst. Sil. de la Bohême, vol. ii. 4me sér.).

1870. *Orthoceras lentum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 641, pl. ccccx. ff. 3-8, pl. ccccxii. ff. 24, 25.

? 1870. *Orthoceras potens*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 540, pl. cccx. ff. 5, 6, pl. cclxxxv., pl. cclxxxvi. ff. 1-6, pl. cclxxxviii. ff. 4-6, pl. cccxiv. ff. 1-3.

1873. *Orthoceras politum*, Salter, Cat. Camb. & Silurian Foss. p. 70.

1876. *Orthoceras lancea*?, Tromelin & Lebesconte, Assoc. Franç. pour l'avancement des Sciences, 4me Sess. (Nantes), p. 621, and Tabl. D. no. 29.

1878. *Orthoceras*, sp., Bayle, Explication de la Carte Géol. de la France, tom. iv. Atlas, prem. part. pl. xxxiv. ff. 3, 4.

1882. *Orthoceras politum*, Blake, British Foss. Ceph. pt. i. p. 141, pl. ix. ff. 1, 2, 8.

[*Not Orthoceras politum*, Klipstein, 1843, Beitr. z. Kenntn. der östlichen Alpen, p. 144, pl. ix. f. 6.]

Sp. Char. Section circular. Rate of increase slow, not exceeding 1 in 11. Septa direct, but sometimes slightly oblique; distant from $\frac{1}{2}$ to $\frac{1}{3}$ the diameter, with a convexity of $\frac{1}{3}$ to $\frac{1}{4}$ the diameter. Siphuncle from $\frac{1}{7}$ to $\frac{1}{6}$ of the whole diameter, central in the young shell, but becoming eccentric with growth. Surface with fine transverse striæ of growth. The type (in the Woodwardian Museum, Cambridge) is the longest example known. The species occurs also in the Silurian.

Remarks. *O. politum* differs from *O. vagans* in the regularity of its septa, the eccentricity of its siphuncle, and its less rapid increase.

From *O. distans* it is distinguished by its closer septa and more slender proportions.

Horizon. Llandeilo Flags and Middle Bala.

Localities. D'Aran-y-Gesil slate-quarry, near Machynlleth, Merionethshire (Llandeilo); Piedmont Glen, Knockgeirn, Ayrshire (Middle Bala).

Represented by very fine specimens, two of them figured by Salter, *loc. cit.*

Orthoceras Pomerense?, Portlock.

1843. *Orthoceras Pomerense*, Portlock, Rep. on the Geol. of Londonderry, p. 370, pl. xxvi. f. 4.

1843. *Orthoceras irregulare*, Portlock, *loc. cit.* p. 375. (*Not of Münster.*)

1843. *Orthoceras complanatoseptum*, Portl. *loc. cit.* p. 374, pl. xxviii. B, f. 1.

1843. *Orthoceras tumidum*, Portlock, *loc. cit.* p. 373, pl. xxviii. ff. 5, 6.

? 1843. *Orthoceras regulare*, Portlock, *loc. cit.* p. 377, pl. xxvii. f. 4.

1882. *Orthoceras Pomerense*, Blake, Brit. Foss. Ceph. p. 123, pl. xi. f. 1.

Sp. Char. Section probably elliptical. The rate of increase "probably between 1 in 14 and 1 in 17, allowing for the flattening. The body-chamber has in one example a length of $7\frac{1}{2}$ inches, which is about twice the length of the basal diameter, if that were unaltered" (*Blake*). Siphuncle slightly eccentric. Septa direct, distant about $\frac{1}{6}$ the diameter. Surface with irregular transverse lines of growth, some of which are stronger than others.

Remarks. I have referred a crushed fragment to this species as interpreted by Professor Blake (*loc. cit.*).

Horizon. Lower Llandeilo.

Locality. Round Hill, Stiper Stones, Shropshire.

Represented by one imperfect example.

Orthoceras fractum, Barrande.

1870. *Orthoceras fractum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 129, pl. ccccxv. ff. 16-20, pl. cccclxviii. ff. 6-9.

1875. *Orthoceras fractum*, Tromelin & Lebescontes, Notes sur quelques fossiles des grès siluriens d'Ille-et-Vilaine, p. 4.

1876. *Orthoceras fractum*, Tromelin & Lebescontes, Assoc. Franç. pour l'avancement des Sciences, 4me Sess. (Nantes), p. 643, Tabl. C. no. 10.

1877. *Orthoceras fractum*, Tromelin, Bull. de la Soc. Linn. de Normandie, 3me sér. vol. i. p. 27.

Sp. Char. This species is found only in fragments, indicating a straight and elongated shell. The rate of tapering is about 1 in 9.

The cross-section of the shell is elliptical. The length of the body-chamber is about $\frac{1}{3}$ that of the entire shell. The difference between the septa varies considerably in different specimens, being from $\frac{1}{4}$ to $\frac{1}{3}$ the diameter, roughly speaking. The convexity of the septa is equivalent to about $\frac{1}{3}$ the diameter. The siphuncle is small, cylindrical, and measures about $\frac{1}{10}$ the diameter of the shell.

Remarks. The matrix in which this species occurs is a sandstone, and the shell is always completely dissolved away, so that the specimens consist of casts in sandstone. The species has been found in a like condition in the sandstones of May, in Normandy, whence it was obtained by M. Eudes Deslongchamps, and submitted by him to M. Barrande, who recognized it as identical with his species from Mt. Drabow, in Bohemia.

Horizon. Étage D, bande d 2 (= Llanvirn Series?).

Locality. Mt. Drabow, Bohemia.

Fairly well represented.

Orthoceras decrescens, Billings.

1857. *Orthoceras decrescens*, Billings, Geol. Surv. of Canada, Rep. of Progress for the years 1853-56, p. 337.

1863. *Orthoceras decrescens*, Bill. Geol. of Canada, App. p. 950.

1869. *Orthoceras decrescens*, Safford, Geol. of Tennessee, p. 289.

Sp. Char. "Shell annulated, with subacutely rounded and slightly undulating ridges, which are two lines distant at a diameter of fourteen lines, somewhat more approximate towards the apex; intervening spaces regularly concave and half a line in depth. Section circular, tapering at the rate of two lines to the inch; siphuncle small, eccentric, about one sixth of the diameter from the centre; septa concave, slightly oblique, their ventral margins nearest the aperture, distant two lines at a diameter of eleven lines. Differs from all other described annulated species of the Silurian [Ordovician] limestone of America in its more rapid rate of tapering."

I have given Billings's description in full, because it includes some specific features which are not observable in the British-Museum example.

I may add that the surface of the test is covered with fine transverse striæ.

Horizon. Black River (= Llandeilo Limestones?).

Locality. St. Joseph Island, Lake Huron, Canada.

Represented by one example.

Orthoceras arcuoliratum, Hall.

1847. *Orthoceras arcuoliratum*, Hall, Pal. of New York, vol. i. p. 198, pl. xlii. ff. 7, a, b, c.
 ? 1852. *Orthoceras (Cycloceras) arcuoliratum*, M'Coy, British Pal. Foss. fasc. ii. p. 319.
 ? 1859. *Orthoceras arcuoliratum*, Salter, Quart. Journ. Geol. Soc. vol. xv. p. 375.
 1863. *Orthoceras arcuoliratum*, Billings, Geol. of Canada, Appendix, p. 949.
 ? 1873. *Orthoceras arcuoliratum*, Salter, Cat. of Cambr. and Sil. Foss. p. 71.
 ? 1882. *Orthoceras arcuoliratum* (?), Blake, British Foss. Ceph. pt. i. p. 84, pl. iii. f. 14.

Sp. Char. "Slender, very gradually tapering to an acute point; surface marked by strong and extremely arched or undulating annulations, and, obscurely, by fine longitudinal striæ; annulations about equalling the spaces between them; outer chamber and aperture unknown; section circular; siphuncle central.

"The distinguishing features of this species are its slender form and extremely arched annulations, which, in half the circumference, ascend twice the width of the space between each annulation." (*Hall.*)

Remarks. Three small, chalcedonized fragments from the Durness Limestone are referred to this species. They exhibit the strongly arched annulations characteristic of *Orthoc. arcuoliratum*.

Horizon. Durness Limestone (= Calciferous (?) of North America).

Localities. *British.* Durness, Sutherlandshire.—*Foreign.* Allumette Island, River Ottawa, Canada.

Fairly well represented in the Collection.

Orthoceras, sp.

Two imperfect fragments, consisting of two or three septa, may be referred provisionally to the same form as that mentioned by Brögger ('Die silurischen Etagen 2 und 3,' Kristiania, 1882, p. 24), as "*Orthoceras* nah bei *O. regulare*, Schloth."

The siphuncle is small and slightly eccentric. The septa are 6 or 7 lines distant in a diameter of $2\frac{1}{4}$ inches. The test is not preserved.

Horizon. Oskarskal Group, 4 (= Bala?).

Locality. Birkö, Norway.

Orthoceras junceum, Hall.

1847. *Orthoceras junceum*, Hall, Pal. of New York, vol. i. p. 204, pl. xlvii. ff. 3, a-f.

1852. *Orthoceras junceum*?, Shumard, in D. D. Owen's Geol. Surv. of Wisconsin, Iowa, and Minnesota, p. 626.

1863. *Orthoceras junceum*, Billings, Geol. of Canada, Appendix, p. 949.

Sp. Char. "Slender, terete-cylindrical, tapering very gradually; septa thin, distant from $\frac{1}{4}$ to $\frac{1}{3}$ the diameter; outer chamber deep; siphuncle small, central: section circular; surface finely striated transversely." * * * (*Hall.*)

Remarks. Besides a well-authenticated example of *O. junceum* from the Trenton limestone of Watertown, New York, I have referred also to this species a group of specimens in the Collection from the Cincinnati Group of Dubuque Co., Iowa. The matrix in which they are imbedded is a sandstone, and the fossils are marvelously well preserved in it, the nacreous layer as well as the outer shell still adhering to them. The slowly tapering, slender, cylindrical form, and the surface-markings (fine transverse striæ) and small, nearly central siphuncle are all in agreement with the characters of Hall's species.

Dr. Shumard states (*loc. cit.*) that the fossil referred by him to *O. junceum* is larger than Hall's f. 3, pl. xlvi., and this is the case also with the specimens above described.

Horizon. Trenton Formation and Cincinnati Group (= Lower and Middle Bala?).

Localities. Watertown, New York State; Dubuque Co., Iowa. Fairly well represented.

Orthoceras multicameratum, Emmons.

1842. *Orthoceratites multicameratus*, Emmons, Geol. of New York, pt. 2, p. 382, f. 93.

1847. *Orthoceratites multicameratum*, Hall, Geol. of New York, vol. i. p. 45, pl. xi. ff. 1, a, b, c.

1863. *Orthoceras multicameratum*, Billings, Geol. of Canada, p. 194.

1869. *Orthoceras multicameratum*?, Safford, Geol. of Tennessee, p. 289.

1875. *Orthoceras multicameratum*, Nicholson, Pal. of Ontario, p. 36, f. 12, a.

Sp. Char. "Extremely elongated, slender, very gradually tapering to an acute point; surface apparently smooth, or girt with slight undulations; septa thin, gently arched, distant from a $\frac{1}{4}$ to $\frac{1}{1\frac{1}{2}}$ the diameter; siphuncle a cylindrical ventral tube; outer chamber very deep." (*Hall.*)

This species resembles the *O. tenuiseptum* of the Chazy Limestone (Arenig?) in the closeness of its septa, but in the latter these are still closer. Of *O. tenuiseptum*, however, only fragments have been found, and all its characters are not known.

Horizon. Black River Formation (= Llandeilo Limestones ?); Cincinnati Group (= Bala ?)

Localities. Grenville, on the River Ottawa; Montreal; and "near Quebec": Canada. Cincinnati and Waynesville, Ohio; Nicholasville, Kentucky.

Fairly well represented.

Orthoceras sodale, Barrande.

1870. *Orthoceras sodale*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 453, pl. ccccxvii. ff. 9-21.

? 1882. *Orthoceras expansum*, Blake, British Foss. Ceph. pt. i. p. 118, pl. vi. f. 15.

Sp. Char. Shell much elongated; very slowly increasing at the rate of about 1 in 18. The section is circular when the specimens have not been compressed. Body-chamber imperfect in all the examples met with. That which is preserved of it measures five times the diameter of its base. Septa distant, varying from $\frac{2}{3}$ the shell-diameter in young individuals to $\frac{1}{3}$ in adults. The siphuncle is small and central, and probably cylindrical. Surface-ornamentation consisting of fine, slightly undulating riblets.

Remarks. Professor Blake's species agrees with Barrande's in all respects except in the rate of increase, which is stated to be rapid in *O. expansum*. But considering that the outline of the individual figured by Blake is partly concealed by a covering of matrix, the latter character may have been inadvertently exaggerated. It is worthy of note that the original label attached to one of the specimens in the National Collection is "*Orth. centrale?* His.," this being the species which Blake finds his *O. expansum* "nearly corresponds to."

Horizon. Étage D, bande d 5 (= Middle Bala ?).

Locality. Leiskow, Bohemia.

Fairly well represented.

Orthoceras carinatum?, Münster.

1840. *Orthoceratites carinatus*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 100, Taf. xix. ff. 8, a, b, c.

1868. *Orthoceras teres*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 416, pl. ccxcviii. ff. 1-5, pl. ccxcix. ff. 17-24.

Sp. Char. "Apex (*Spitz*) conical, narrow, somewhat compressed, hence elliptical in cross-section; upon the back is a raised keel, upon which the transverse wavy acute striæ of the outer thick shell run, the intermediate shell smooth; a very small central siphuncle, the narrow septa transversely undulated." (*Münster*.)

Remarks. The rate of tapering is slow, about 1 in 15. I can find

nothing to separate Barrande's from Münster's species, and I have therefore united them under the first name applied to this form.

The specimen in the Collection is badly preserved, and partly buried in the matrix, but it retains a portion of the test, showing the very characteristic wavy riblets of this species.

It occurs in Bohemia in Étages D, E, and F, that is, both in the Second and Third Faunas. If I have rightly interpreted the Ordovician example in the National Collection, this species occurs in beds in Britain (Middle Bala) which have been correlated by Mr. Marr with bande *d* 5 of Barrande.

Horizon. Middle Bala.

Locality. Ardwell, Ayrshire.

Represented by one example.

Orthoceras gracile, Portlock.

1843. *Orthoceras gracile*, Portlock, Rep. on the Geol. of Londonderry, p. 366, pl. xxv. f. 2.
1843. *Orthoceras tubicinella*, Portlock, Rep. on the Geol. of Londonderry, p. 367, pl. xxv. ff. 3, 4. (*Not* of Sowerby.)
1843. *Orthoceras calamiteum*, Portlock, Rep. on the Geol. of Londonderry, p. 365, pl. xxv. ff. 1, *a*, *b*. (*Not* of Münster.)
1851. *Orthoceras calamiteum*, Salter, in Murchison's "Silurian Rocks of Scotland," Quart. Journ. Geol. Soc. vol. vii. p. 173.
1851. *Orthoceras annellatum*, M'Coy, in Sedgwick's "Geological Structure and Relations of the Frontier Chain of Scotland," British Assoc. Rep. p. 103. (*Not* *O. anellum* of Hall.)
1852. *Orthoceras bilineatum*, M'Coy, British Pal. Foss. fasc. ii. p. 319.
1854. *Orthoceras bilineatum*, Salter, in Murchison's 'Siluria,' ed. i. p. 197, Foss. Gr. 26. f. 2.
1882. *Orthoceras gracile*, Blake, British Foss. Ceph. pt. i. p. 85, pl. iii. ff. 5, 5 *a*, 9 *a-c*.

Sp. Char. Section circular; rate of increase about 1 in 9, decreasing with age to almost zero. The ornaments consist of transverse undulations of very variable character, being sometimes wider than the interspaces, as in Portlock's type, sometimes narrower, but tending to become less acute and conspicuous with age; they occupy $\frac{1}{3}$ to $\frac{1}{5}$ of the diameter. The minor ornaments consist of a cancellation over the surface. The septa are parallel to the ribs, and occupy the re-entering angle between them, and are therefore distant $\frac{1}{3}$ the diameter. (*Blake.*) Siphuncle unknown.

Remarks. The great variability of this species, as remarked by Professor Blake, must be regarded as one of its characters.

Horizon. Middle Bala.

Locality. Ardwell, Ayrshire.

Represented by one fairly good specimen.

Orthoceras lamellosum, Hall.

1846. *Orthoceras lamellosum*, Hall, Pal. of New York, vol. i. p. 312, pl. lxxxvi. ff. 2, a-e.

1875. *Orthoceras lamellosum*, Nicholson, Pal. of Ontario, p. 36, f. 12, b.

Sp. Char. Slender, very gradually tapering to an acute point; septa distant about $\frac{1}{3}$ the diameter; siphuncle slightly eccentric; surface apparently lamellose or subimbricate.

Remarks. Professor Hall states that "this species is of frequent occurrence in the calcareous portions of the Hudson River Group."

Horizon. Hudson River Formation (= Bala Limestone Group?).

Locality. Western Ontario, Canada.

Represented by two fairly good specimens.

Orthoceras Duseri, Hall & Whitfield.

1875. *Orthoceras Duseri*, Hall & Whitfield, Geol. Surv. of Ohio, vol. ii. pt. 2, Palæont. p. 97, pl. iii. ff. 2-4.

? 1881. *Orthoceras Fosteri*, Miller, Journ. Cincinnati Soc. Nat. Hist. vol. iv. No. 4, p. 319, pl. viii. ff. 7, 7a.

1886. *Orthoceras Duseri*, J. F. James, Journ. Cincinnati Soc. Nat. Hist. vol. viii. No. 4, p. 241.

Sp. Char. Section circular or elliptical, (? by pressure) enlarging rather rapidly at the rate of about 1 in 6. Septa closely approximate, but increasing gradually in distance with the growth of the shell, so that they are about 1 line apart where the shell has a diameter of 5 lines, and about $1\frac{1}{2}$ line where the diameter has increased to 10 lines, and so on. "Siphuncle eccentric, situated a little nearer to the centre than to the margin; very small where it passes through the septa, but expanding within the chambers to about four times its diameter at the other point, and forming a flattened bead-like body within each chamber. Surface of the shell apparently smooth except that the edges of the septa are raised above the general level, in the form of narrow rings." (*H. & W.*)

Remarks. Messrs. Hall and Whitfield describe the surface of the shell in *O. Duseri* as having a finely reticulate or net-like character, "dividing the surface into small rhombic figures of microscopic dimensions," &c. I think these appearances are due to an encrusting Monticuliporoid Coral, of which I find traces adhering to the specimen in the National Collection.

Horizon. Cincinnati Group (= Lower and Middle Bala?).

Locality. Cincinnati, Ohio.

Represented by one imperfect example.

Orthoceras Halli ?, S. A. Miller.

1875. *Orthoceras Halli*, S. A. Miller, Cincinnati Quart. Journ. Sci. vol. ii. No. 2, p. 128, f. 14.

Sp. Char. Section elliptical, rate of increase about 1 in 13. Septa numerous, about 3 lines apart. Siphuncle eccentric, somewhat inflated between the chambers. "Body-chamber about $\frac{1}{3}$ the length of the shell." (*Miller.*) Surface of the test unknown.

Horizon. Cincinnati Group (=Lower and Middle Bala?).

Localities. Cincinnati, Ohio; Danville, Kentucky.

Fairly well represented.

Orthoceras Dyeri ?, S. A. Miller.

1875. *Orthoceras Dyeri*, S. A. Miller, Cincinnati Quart. Journ. Sci. vol. ii. No. 2, p. 125, f. 11.

1880. *Orthoceras Dyeri*, S. A. Miller, Journ. Cincinnati Soc. Nat. Hist. vol. iii. No. 3, p. 236, pl. vii. f. 7.

1886. *Orthoceras Dyeri*, J. F. James, Journ. Cincinnati Soc. Nat. Hist. vol. viii. No. 4, p. 238.

Sp. Char. Section elliptical, somewhat rapidly tapering. Septa from 3 to 4 lines distant at a diameter of about $1\frac{1}{2}$ inch. Siphuncle large, subcentral, somewhat inflated between the septa. Body-chamber and surface characters unknown.

Horizon. Cincinnati Group (=Lower and Middle Bala?).

Locality. Cincinnati, Ohio.

One specimen only in the Collection.

Orthoceras Mohri ?, S. A. Miller.

1875. *Orthoceras Mohri*, S. A. Miller, Cincinnati Quart. Journ. Sci. vol. ii. No. 2, p. 124, f. 10.

1886. *Orthoceras Mohri*, J. F. James, Journ. Cincinnati Soc. Nat. Hist. vol. viii. No. 4, p. 238.

Sp. Char. Section circular. The rate of tapering somewhat rapid, about 1 in 6. Septa numerous, rather strongly arched. Siphuncle central, inflated between the septa. "Outer [Body] chamber more than $\frac{1}{4}$ the length of the shell" (*Miller.*) Surface smooth.

Horizon. Cincinnati Group (=Lower and Middle Bala?).

Locality. Versailles, Indiana.

Fairly well represented.

Orthoceras transversum ?, S. A. Miller.

1875. *Orthoceras transversum*, S. A. Miller, Cincinnati Quart. Journ. Sci. vol. ii. No. 2, p. 129, f. 15.

1886. *Orthoceras transversum*, J. F. James, Journ. Cincinnati Soc. Nat. Hist. vol. viii. No. 4, p. 239.

Sp. Char. Section elliptical, tapering at the rate of about 1 in 6. Septa numerous and rather strongly arched. Siphuncle eccentric. Surface of the shell ornamented with fine transverse striæ.

Horizon. Cincinnati Group (= Lower and Middle Bala?).

Locality. Cincinnati; Ohio.

Fairly well represented.

Orthoceras laqueatum ?, Hall.

1847. *Orthoceras laqueatum*, Hall, Pal. of New York, vol. i. p. 206, pl. iii. f. 12, pl. lvi. ff. 2, a, b, c.

1852. *Orthoceras laqueatum*, Owen, Geol. Surv. of Wisconsin, Iowa, and Minnesota, p. 626.

1863. *Orthoceras laqueatum*, Billings, Geol. of Canada, Appendix, p. 950, referring only to pl. iii. f. 12, Pal. of New York (*loc. cit.*).

Sp. Char. Section circular or subelliptical; rate of increase slow, about 1 in 12. "Surface marked by sharp, elevated, longitudinal ridges, alternating with finer intermediate ones" (*Hall*). Siphuncle subcentral.

Remarks. The imperfect condition of preservation of the specimens renders their identification with Hall's species rather doubtful. They show, however, traces of what would appear to have been longitudinal ridges, such as are figured by Hall (*loc. cit.* pl. lvi. f. 2 a).

Horizon. Trenton Formation (= Bala Limestone Group).

Locality. Montmorenci Falls, near Quebec, Canada.

Fairly well represented.

Orthoceras velatum, Blake.

1865. *Orthoceras velatum*, Salter, MS., Cat. Foss. Mus. Practical Geology.

1882. *Orthoceras velatum*, Blake, British Foss. Ceph. pt. i. p. 87, pl. iii. ff. 12, 12 a.

Sp. Char. Section, though generally compressed, nearly circular in two or three instances, or at least equiaxial. Rate of increase in smaller examples about 1 in 9, but decreases at the larger diameters. The larger ornaments are gently undulating ribs, somewhat oblique, and distant $\frac{1}{3}$ the diameter; these are covered by fine longitudinal and transverse riblets, each 18 per line, dividing the

surface into square cancellations. The septa have a convexity of $\frac{1}{4}$ the diameter, and appear to cut the ribs on the upward slope: The siphuncle is central and small. (*Blake.*)

Remarks. "The statement that *O. ibex* occurs in the Lower Silurian is doubtless founded on examples of this species (M'Coy, British Pal. Foss. p. 319). The ribs, however, have not the separateness of those of *O. tenuiannulatum*, which is the species meant; and though in some the transverse lines are scarcely discernible, in other associated examples they are equal to the longitudinal, which is only the case in the young of M'Coy's species. Moreover, the separation of the septa by two rings is a feature which unites the Cumbrian examples to those from Ireland. *O. discretum*, Barrande, from Étage F, is very closely allied, but the ribs are much more pronounced and separate, and the cancellation is never equal in the two directions, while the rate of increase is less." (*Blake.*)

Horizon. Upper Bala.

Locality. Cynwyd, Merionethshire.

Two specimens presented by J. E. Lee, Esq., F.G.S.

Orthoceras striatissimum, Salter.

1865. *Orthoceras striatissimum*, Salter, in Paleont. of Niti in the Northern Himalaya, by Salter and Blanford, p. 15, pl. ii. f. 4.

Sp. Char. "Broad-oval in section, very slowly tapering, without rings or any inequalities except very fine transverse striæ. These striæ are oblique from back to front, with a slight double wave on the side, so that the curve is downward from the back to the middle of the side, and thence gently upward again before curving downward over the front. The striæ are fine and elevated threads; in some specimens every seventh or eighth is more prominent than the rest; in other specimens the prominent ones are less frequent. Siphuncle?"

"In the oblique fine striæ and slowly tapering form, this resembles a great many Silurian species. *O. tenuicinctum* [*elongatocinctum*], Portlock, a Lower Silurian species from Ireland, is especially like ours. Even the wave of the striations (not correctly represented in our figure) is but a little more decided than is usual in the smoother species. The septa are not plainly seen, unless they are indicated by the stronger rings; but this is somewhat uncertain."

Horizon. Lower Silurian (Ordovician?).

Locality. Chorhoti Pass (17,000 feet), Himalaya Mountains.

Represented by one of the examples figured by Salter.

SILURIAN SPECIES.

Orthoceras primævum, Forbes.

1845. *Creseis primæva*, Forbes, Quart. Journ. Geol. Soc. vol. i. p. 146.
1846. *Creseis primæva*, Sharpe, Quart. Journ. Geol. Soc. vol. ii. pl. xiii. f. 2.
1846. *Creseis ventricosa*, Sharpe, *loc. cit.* pl. xiii. f. 3.
1852. *Orthoceras primævum*, M'Coy, British Pal. Foss. fasc. ii. p. 316.
1852. *Orthoceras primævum*, Salter, in M'Coy's British Pal. Foss., Appendix A, p. viii.
1852. *Orthoceras ventricosum*, M'Coy, British Pal. Foss. fasc. ii. p. 318.
1852. *Orthoceras ventricosum*, Salter, in M'Coy's British Pal. Foss., Appendix A, p. vii.
- † 1852. *Orthoceras torquatum*, Salter, in M'Coy's British Pal. Foss., Appendix A, p. vii.
1857. *Orthoceras primævum*, Salter, in Murchison's 'Siluria,' Foss. Gr. 62. f. 4.
1873. *Orthoceras primævum*, Salter, Cat. Camb. and Silurian Foss. pp. 97, 159.
1873. *Orthoceras ventricosum*, Salter, Cat. Camb. and Silurian Foss. pp. 98, 159.
- † 1873. *Orthoceras torquatum*, Salt. Cat. Camb. and Sil. Foss. p. 187.
1882. *Orthoceras primævum*, Blake, British Foss. Ceph. pt. i. p. 148, pl. xiii. f. 4.

Sp. Char. The rate of increase is difficult of determination owing to the compression of the specimens; it varies from 1 in 5 to 1 in 9 (*O. ventricosum*), but becomes in the other form (*O. primævum*) reduced to 1 in 18. The septa (about which there appears to be some doubt) are stated by Professor Blake to be distant $\frac{1}{2}$ to $\frac{2}{3}$ the diameter, with a slight obliquity. The same author remarks that "the body-chamber was probably very long." Siphuncle minute and central. Surface with transverse striæ, too obscure to be characterized.

Remarks. These are very obscure fossils. None of the specimens known as *O. ventricosum* are to be found in the National Collection, and I have derived my information regarding this form from Professor Blake's description of the species.

Horizon. Wenlock Shales.

Locality. Nantglyn, Denbighshire.

This species is fairly well represented.

Orthoceras Marloense, Phillips.

1848. *Orthoceras Marloense*, Phillips, Mem. Geol. Surv. vol. ii. pt. i. p. 353, pl. iii. f. 1.

1882. *Orthoceras imbricatum*, Blake, British Foss. Ceph. pt. i. p. 153, pl. xiv. ff. 1, 1a, 3, 3a, ? 4, 4a, 5, 6.

Sp. Char. Section probably elliptical. Rate of increase varying from 1 in 9 to 1 in 15. Septa moderately convex, rather numerous, about 3 lines apart in a diameter of 22 lines; somewhat oblique and undulating. The length of the body-chamber is $2\frac{1}{2}$ times its basal diameter. Siphuncle subcentral. Surface marked only by transverse lines of growth.

Remarks. Phillips's type is slightly curved, but Professor Blake, who appears to have seen it, says that its curvature "is due solely to the dislocation of the upper part, the lower two-thirds having absolutely straight sides."

My reasons for reinstating Phillips's species are given at length under the description of *Actinoceras* ("Orthoceras") *imbricatum*, which is retained for Hisinger's species.

Horizon. Upper Ludlow.

Localities. Ludlow, Shropshire; Kendal, Westmoreland.—A specimen from Llandegfydd, North (?) Wales, presented by J. E. Lee, Esq., F.S.A., F.G.S.

Represented by several good specimens, one of them figured by Blake (*loc. cit.*).

Orthoceras perversum, Blake.

? 1839. *Orthoceras imbricatum*, Sowerby, in Murchison's Sil. Syst. p. 620, pl. ix. f. 2.

? 1852. *Orthoceras imbricatum*, M'Coy, Brit. Pal. Foss. fasc. ii. p. 315.

? 1873. *Orthoceras imbricatum*, Salter, Cat. Cambr. and Sil. Foss. p. 187.

1882. *Orthoceras perversum*, Blake, British Foss. Ceph. pt. i. p. 155, pl. xvi. ff. 1, 2.

Sp. Char. Section elliptical. Rate of increase from 1 in 21 in the septate portion to 1 in 36 in the body-chamber. The length of the latter is more than $2\frac{1}{2}$ times its basal diameter. Septa approximate; distant $\frac{1}{2}$ the shell diameter; irregularly undulating. Siphuncle moderate in size, eccentric and unsymmetrical in its situation. Surface with lines of growth only.

Horizon. Wenlock Limestone and Upper Ludlow.

Localities. Dudley, Worcestershire; Kendal, Westmoreland.

Fairly well represented.

Orthoceras Ludense, Sowerby.

1839. *Orthoceras Ludense*, Sowerby, in Murchison's Sil. Syst. p. 619, pl. ix. ff. 1a, 1b.
1852. *Orthoceras Ludense*, M'Coy, British Pal. Foss. fasc. ii. p. 315.
1854. *Orthoceras Ludense*, Salter, in Murchison's 'Siluria,' Foss. Gr. 44. f. 2.
1857. *Orthoceras columnare*, Boll, Archiv für die Naturkunde von Mecklenburg, p. 16, Taf. i. ff. 3a, 3b.
1866. *Orthoceras temperans*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 658, pl. ccxxx. ff. 7-9, pl. cccxxvii. ff. 1, 2, pl. cccclxxxii., pl. ccccli. ff. 1-3.
1870. *Orthoceras Dahlli*, Barrande, loc. cit. pl. ccccxl. ff. 7-10.
1870. *Orthoceras columnare*, Barrande, loc. cit. p. 697, pl. cccclxlii. ff. 1, 2.
1873. *Orthoceras Ludense*, Salter, Cat. Cambr. and Sil. Foss. p. 158.
1880. *Orthoceras columnare*, Angelin and Lindström, Fragmenta Silurica, p. 7, tab. v. ff. 1, 2, 5, 6.
1882. *Orthoceras Ludense*, Blake, British Foss. Ceph. pt. i. p. 156, pl. x. ff. 1, 3, 4, 5, 7.
- [Not 1841. *Orthoceras Ludense*, Phillips, Pal. Foss. of Cornwall, Devon, and West Somerset, p. 110, pl. xlii. f. 206, a, b, c.—1867. *Orthoceras columnare*, Hall, 20th Reg. Rep. p. 351, pl. xix. (x.) ff. 4, 5, 6, 8.]

Sp. Char. Section circular. Rate of increase 1 in 12. Septa direct, or slightly undulating in some specimens (for these last Professor Blake proposes the varietal name *undulata*), distant $\frac{2}{7}$ the diameter. Body-chamber of considerable length; one measured by Professor Blake reaching $7\frac{1}{2}$ inches in length. Siphuncle a little eccentric, and placed $\frac{7}{16}$ along the diameter. Surface marked only by obscure lines of growth.

Remarks. This species attains a great length; the longest in the National Collection measures $15\frac{1}{2}$ inches; and Blake estimates that some individuals may have reached $4\frac{1}{2}$ feet. It is a widely distributed species, as a glance at the synonymy will show.

Horizon. Lower (?) and Upper Ludlow.

Localities. British: Ludlow, Shropshire; Herefordshire.—
Foreign: Island of Gothland, Sweden.

Represented by very fine specimens, two of them figured by Blake (*loc. cit.*).

Orthoceras distans, Sowerby.

1839. *Orthoceras distans*, Sowerby, in Murchison's Sil. Syst. p. 619, pl. viii. f. 17.
1866. *Orthoceras migrans*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 643, pl. ccxii. ff. 1-4, pl. ccxxii. ff. 1, 2, pl. cccix. ff. 1-4, pl. cccxlvi., pl. cccclxxvii.

1878. *Orthoceras* *cnf. migrans*, Kayser, Die Fauna der ältesten Devon-Ablagerungen des Harzes, in the Abhandl. zur geol. Specialkarte von Preussen, Band ii. Heft i. p. 71, Taf x. ff. 6, 6a.

1882. *Orthoceras distans*, Blake, British Foss. Ceph. pt. i. p. 158, pl. xv. ff. 1, 2.

Sp. Char. Section circular or subelliptical. Rate of tapering 1 in 8. Septa direct; their distance exceeding $\frac{1}{2}$ the diameter of the shell. The length of the body-chamber in a small flattened example measured $3\frac{1}{2}$ times its basal diameter. Siphuncle eccentric, somewhat inflated between the septa. Surface smooth, or with obscure striæ of growth.

Remarks. Blake's figure of this species has a higher rate of tapering than any of Barrande's, and the septa are more strongly arched in the figures of the latter author.

Kayser's fossil is thus described:—"A large, thick form, very slowly increasing in breadth, with circular cross section. Septa strongly convex, chambers about twice as broad as high, siphuncle very eccentric. Test unknown."

Horizon. Calcaires ampéliteux (=Third Fauna of Barrande).—Étage E of Barrande (=Salopian?).

Localities. Feuguerolles (Calvados), France; Germany; (?Bohemia).

Fairly well represented in the Collection.

Orthoceras politum, M'Coy.

(*Ante*, p. 7.)

Remarks. This species is recorded by Barrande in his 'Distribution des Céphalopodes,' 1870, p. 50, under the name of *Orthoceras lancea*?

Horizon. Calcaires ampéliteux (=Third Fauna of Barrande).

Locality. Feuguerolles (Calvados), France.

Orthoceras Arion, Barrande.

1866. *Orthoceras Arion*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 619, pl. cxxxi. f. 24, pl. cccxlvii. ff. 1-4, pl. ccccviii. ff. 9-14.

1870. *Orthoceras Arion*?, Barrande, Distrib. des Céph. dans les Contrées Siluriennes, p. 50 (Extrait du Syst. Sil. de la Bohême, vol. ii. 4me sér.).

1876. *Orthoceras Arion*, Tromelin and Lebesconte, Assoc. Franç. pour l'avancement des Sciences, 4me Sess. (Nantes), Tableau B.

1878. *Orthoceras* sp., Bayle, Explication de la Carte Géol. de la France, tom. iv., Atlas, première partie, pl. xxxiv. ff. 7, 8.

Sp. Char. Section circular. Rate of increase 1 in 6. Septa

approximate; a little more than 3 lines distant at a diameter of 1 inch. Body-chamber unknown. Siphuncle central. Surface of test quite smooth, or with very faint horizontal lines.

Remarks. Reference is made in the synonymy of this and of other species occurring in the same beds to the figures given by M. E. Bayle, in the Atlas to the 'Carte Géologique de la France.'

In order to ascertain if any explanation of this Atlas of Plates was likely to be published I wrote to M. Douvillé, Engineer-in-Chief of Mines, of the "École des Mines," Paris, and he very courteously replied to me to the following effect: that the text which should accompany the Atlas had not been begun, and that it was not probable that it ever would be completed and published.

Nevertheless I thought it might be useful to refer to such of M. Bayle's figures as appeared to represent species from the same locality contained in the National Collection.

Horizon. Calcaires ampéliteux (=Third Fauna of Barrande).

Locality. Saint-Sauveur-le-Vicomte (Manche), France.

Well represented in the Collection.

Orthoceras hastile, Barrande.

1868. *Orthoceras hastile*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 636, pl. cccxxxii. ff. 1-3, pl. ccccxliv. ff. 8-10.

1870. *Orthoceras hastile*, Barrande, Distrib. des Céph. dans les Contrées Siluriennes, p. 50 (Extrait du Syst. Sil. de la Bohême, vol. ii. 4me sér.).

1876. *Orthoceras hastile*, Tromelin and Lebesconte, Assoc. Franç. pour l'avancement des Sciences, 4me Sess. (Nantes), p. 621, and Tableau D. no. 28.

Sp. Char. Section circular. Rate of increase almost imperceptible. Barrande gives the apical angle as varying between 1° and 2°, and concludes that the shell must have attained a great length. Very little is known about the septa, but one seen below the body-chamber, in a specimen figured by Barrande, has a height which represents about $\frac{5}{6}$ the diameter. The body-chamber is imperfectly known. The siphuncle is central, and was probably cylindrical. Surface of the test with obscure lines of growth.

Horizon. Calcaires ampéliteux (=Third Fauna of Barrande).

Locality. Saint-Sauveur-le-Vicomte (Manche), France.

Represented by a large fragment.

Orthoceras Vibrayei, Barrande.

1866. *Orthoceras Vibrayei*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 562, pl. ccx. ff. 1-3, pl. ccxiv. ff. 1-3, pl. cclxxxiii. ff. 1-4, pl. ccccl. ff. 4, 5.

1870. *Orthoceras Vibrayeï*, Barrande, Distrib. des Céph. dans les Contrées Siluriennes, p. 50 (Extr. du Syst. Sil. de la Bohême, vol. ii. 4me sér.).

Sp. Char. Section circular. Rate of tapering about 1 in 14. Septa distant rather less than $\frac{1}{4}$ the diameter. Body-chamber unknown. Siphuncle nearly central. Test almost smooth.

Remarks. The Collection contains only a fragment of the septate portion of the shell showing the nearly central siphuncle.

Horizon. Calcaires ampéliteux (= Third Fauna of Barrande).

Locality. Normandy, France.

Orthoceras tritonum, Barrande.

1868. *Orthoceras Tritonum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 661, pl. ccxlv. ff. 13-22, pl. ccxlvii. ff. 19-21.

Sp. Char. Section elliptical. Rate of increase very slow, about 1 in 16. Septa very numerous, undulating, about $\frac{1}{4}$ the diameter. Body-chamber varying in length from twice to three times the basal diameter, but it is sometimes reduced to less than $1\frac{1}{2}$ times that diameter. Siphuncle a little eccentric. Surface smooth, or showing only some feeble lines of growth.

Horizon. Étage E, bande e 2 (= Salopian).

Localities. Wiskočilka, Kosorž, Bohemia.

Well represented in the Collection.

Orthoceras truncatum, Barrande.

1860. *Orthoceras truncatum*, Barrande, Bull. Soc. Géol. France, tom. xvii. 2^e sér. p. 573, pl. ix. ff. 1-20.

1868. *Orthoceras truncatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 556, pl. ccxli. (excl. ff. 3-7), pl. ccxliii. (excl. f. 14).

1882. *Orthoceras truncatum*, Blake, British Foss. Ceph. pt. i. p. 151, pl. xiv. ff. 8, 8 a.

Sp. Char. Section elliptical, the diameters in the ratio of 5 : 4; individual variations excepted. The rate of increase is very slow, the body-chamber decreasing in size towards the aperture, which is oblique and undulating. The septa are nearly direct, and distant about $\frac{1}{3}$ the diameter; they are very strongly convex. The successive chambers drop off, the truncated extremity thus caused being protected by a calcareous deposit. The siphuncle is small and a little eccentric, as a rule, though in some examples it appears to be central. The test is almost smooth, but is marked with feeble striæ, which have a tendency to direct imbrication.

Remarks. The truncation of the septa in certain species of fossil Cephalopods has been made the subject of exhaustive study by M. Barrande, by whom the phenomenon was first discovered in 1855¹ in *Ascoceras*, and subsequently in a communication made by him to the Geological Society of France², elaborately illustrated and described by means of the present species.

Finding that the extremity of the shell in all individuals of *O. truncatum*, both old and young, had been covered by a new test, M. Barrande came to the conclusion that the septa must have been successively thrown off by the animal, and the broken end repaired regularly and periodically by a fresh shelly deposit.

To explain this reparation of the truncated septa, M. Barrande assumed that the animal possessed long palmated brachial appendages, more or less analogous to those of *Argonauta*, and capable of reaching the basal portion of the shell, and endowed with a power of secretion of the same nature as that of the mantle, but more potent, reproducing exactly the external layer of the test.

On examining the terminal septum in *O. truncatum* we find that it is covered with calcareous deposits which consist of several layers, easily separable by percussion, the whole forming a sort of conical cap (*calotte conique*) to the shell, corresponding nearly to the shape of the septum it covers. The layers of the first deposit (*dépôt conique*) exhibit a groove or depression, more or less deep, proceeding from the periphery towards the siphuncle, and constituting a median line, following the greatest diameter of the septum, and dividing it into two equal and symmetrical parts.

The surface of each of the layers shows a series of irregular longitudinal striæ converging towards the siphuncle, which latter is sometimes central, sometimes a little eccentric.

Upon these layers a thin one is deposited, distinguished by the regular, longitudinal, fine, and close-set striæ with which it is covered. These striæ converge towards the siphuncle like those of the first deposit, but they are more regularly disposed. The outermost layer is very thin, and instead of the striæ taking a longitudinal direction, they are transverse or concentric. Their course is interrupted by a bending inwards towards the siphuncle, along a median line, corresponding in position with that of the groove found upon the first deposit (*dépôt conique*). This bending inwards of the striæ, which may be called a sinus, has its convexity turned

¹ Leonhard and Bronn's 'Neues Jahrbuch für Min.,' Jahrg. 1855, Heft iii, p. 280.

² *Loc. cit.*

towards the summit of the cone occupied by the aperture of the siphuncle. The striæ do not quite reach the siphuncle, a smooth area of very limited extent surrounding the latter.

There yet remains another feature to be described in the terminal cap (*calotte terminale*) of the shell. M. Barrande found a few specimens showing spaces partly filled up between the concentric striæ, and these presented a punctate appearance. When the spaces were completely filled, a smooth surface was produced, harmonizing with the rest of the shell. The smoothness begins to be apparent in the space surrounding the siphuncle, and gradually spreads up to the base of the terminal cap (*calotte terminale*), that is, up to the first suture. The truncation and subsequent reparation of specimens in this condition would be quite unsuspected.

It is obvious that all the cases of truncation of the septa in the fossil Cephalopoda cannot be proved to have been produced by natural causes, because we have no means of distinguishing between the effects of normal truncation and those of accidental fractures, unless the truncated extremity be repaired, as in the species before us, by means of a shelly secretion.

The forms in which periodical truncation of the shell has been satisfactorily made out are *Orthoceras*, *Gomphoceras*, *Ascoceras*, and *Glossoceras*.

Detached specimens of the terminal cap of *O. truncatum* are by no means uncommon in the beds containing that species in Bohemia. One of these fragments, figured by Barrande (*loc. cit.* pl. cccxli. ff. 15, 16), measures three inches in its longer diameter, and exhibits upon its surface the concentric striæ above described¹.

Orthoceras truncatum makes its first appearance in the Bohemian beds in "Bande d 5" (=Middle Bala), where it is rare, but in bandes e 1 and e 2 it is very abundant.

To this species I have assigned two very interesting specimens from the Wenlock of Dudley. These consist each of two or three septa showing the conical terminal cap with its characteristic ornaments admirably preserved.

Horizon. Étage E, bande e 2 (=Salopian). Calcaires amplicaux (=Third Fauna of Barrande). Wenlock.

¹ For a very full account of all the phenomena connected with the truncation of the septa of *O. truncatum* and other species see Syst. Sil. de la Bohême, 1877, vol. ii. Texte iv. chap. viii. p. 291—"Troncature normale ou périodique de la coquille dans certains Céphalopodes paléozoïques"—upon which the foregoing observations are based.

Localities. British: Dudley, Worcestershire.—*Foreign:* Hinter Kopanina, Kosořz, Lochkow, Butowitz, Bohemia; Feuguerolles (Calvados), France.

The Collection contains a fine series of specimens of this species.

Orthoceras valens, Barrande.

1868. *Orthoceras valens*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 559, pl. cccxxvii. ff. 16-18, pl. cccxxxv. ff. 1-17, ? pl. ccxxxix. f. 24, pl. cccci. ff. 1-3, pl. ccccliv. ff. 13-15, and pl. ccccxii. f. 33.

Sp. Char. Section circular. Rate of increase 1 in 7. The septa vary greatly in their distance apart; sometimes they are $\frac{1}{3}$, sometimes even $\frac{1}{2}$ the diameter. The length of the body-chamber varies between twice and four times its basal diameter; compared with the total length of the shell, it comprises sometimes $\frac{1}{4}$, sometimes $\frac{2}{5}$. The siphuncle is central. The surface of the test appears, at first sight, to be quite smooth, but in a favourable light faint transverse lines are visible, but they possess no distinctive feature, and must be regarded merely as lines of growth. On one specimen in the Collection very fine, close-set longitudinal lines can be made out with a lens; these last are not mentioned by Barrande, and they may be only an individual peculiarity.

Horizon. Étage E, bande e 2 (=Salopian).

Locality. Butowitz, Bohemia.

Well represented in the Collection.

Orthoceras decipiens, Barrande.

1868. *Orthoceras decipiens*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 629, pl. ccxvii. ff. 14-17, pl. ccxxiii. ff. 16, 17, pl. cccxviii. ff. 7-9, pl. ccxxiv. ff. 11-14, pl. cccl. ff. 1-8.

Sp. Char. Shell sometimes a little curved. Section circular. Rate of increase 1 in 10. Septa increasing gradually in their distance apart, ranging between $\frac{1}{5}$ and $\frac{1}{4}$ the diameter. The body-chamber varies considerably in length, from a minimum length of $2\frac{1}{2}$ times the diameter of its base to a maximum of $3\frac{1}{4}$ times the same; the mean length appears to be about $\frac{1}{5}$ of the total length of the shell. The siphuncle is eccentric, and lies about $\frac{2}{3}$ along the diameter. The surface of the test appears to be perfectly smooth.

Horizon. Étage E, bande e 2 (=Salopian).

Locality. Dlauha Hora, Bohemia.

Well represented in the Collection.

Orthoceras culter, Barrande.

1868. *Orthoceras culter*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 626, pl. ccxxxix. ff. 9-11, pl. cccxlvii. ff. 5-22, pl. cccclii. ff. 7, 8.

Sp. Char. Section oval. Rate of increase variable, from 1 in 20 to 1 in 27. Septa distant about $\frac{1}{5}$ the diameter; undulating. Body-chamber greatly developed; very variable in length, from twice up to six times the diameter of the base. Surface smooth.

Horizon. Étage E, bande e 2 (=Salopian).

Locality. Hinter Kopanina, Bohemia.

Well represented in the Collection.

Orthoceras disjunctum, Barrande.

1868. *Orthoceras disjunctum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 631, pl. cccxl. ff. 8-12.

Sp. Char. Shell always very short. Section circular. Rate of tapering about 1 in 7. Septa few in number, generally 2 or 3 only are found. Body-chamber in length about twice the diameter of its base, but sometimes a little less. Siphuncle very slightly eccentric. Surface of test smooth, or with faint lines of growth.

Remarks. In all his specimens, numbering about 30, M. Barrande could find but very few with more than two or three air-chambers; hence he concludes that, like *O. truncatum*, this species cast off its septa; moreover, some of the specimens exhibited the terminal cap.

Horizon. Étage E, bande e 1 (=Salopian).

Locality. Butowitz, Bohemia.

Fairly well represented.

Orthoceras novellum, Barrande.

1870. *Orthoceras novellum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 648, pl. ccxviii. ff. 15-18, pl. cccxcvi. ff. 16-20.

Sp. Char. Section circular. Rate of tapering 1 in 4. Septa slightly oblique, about $\frac{1}{4}$ the diameter. The length of the body-chamber is equal to about three times the diameter of its base. Siphuncle central. Surface smooth.

Horizon. Étage E, bande e 2 (=Salopian).

Locality. Dlauha Hora, Bohemia.

Fairly well represented.

Orthoceras Michelini, Barrande.

1870. *Orthoceras Michelini*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 642, pl. ccxxi. ff. 12-19, pl. cccclxxxi. ff. 3-16, pl. ccccliii. ff. 20-23, ? pl. cccclxvii. ff. 12, 13.

Sp. Char. Section circular. Rate of increase very slow, sometimes scarcely perceptible. Septa direct, their distance slightly exceeding the shell-diameter. Length of the body-chamber from 10 to 16 times the diameter of the base, so that the body of the mollusk was probably nearly the longest known in this genus. Siphuncle subcentral, with cylindrical elements, very slightly constricted at the necks of the septa. Surface smooth.

Horizon. Étage E, bande e 2 (=Salopian).

Locality. Dworetz, Karlstein, Bohemia.

Fairly well represented.

Orthoceras Hagenowi, Boll.

1857. *Orthoceras Hagenowii*, Boll, Beitrag zur Kenntniss der Silur. Ceph., in Archiv für die Naturkunde von Mecklenburg, p. 22, Taf. vi. ff. 19, a-c.

1869. *Orthoceras Hagenowii*, Karsten, Die Verstein. des Uebergangsgebirges in den Geröllen der Herzogthümer Schleswig und Holstein, p. 50, tab. xviii. ff. 3, a-c.

1869. *Orthoceras Hagenowi*, Heidenhain, Ueber Graptolithen führende Diluvial-Geschiebe der norddeutschen Ebene, p. 21.

1878. *Orthoceras Hagenowi*, Haupt, Fauna des Grapt. Gest. p. 53.

1880. *Orthoceras Hagenowi*, Angelin and Lindström, Fragmenta Silurica, p. 7, tab. v. ff. 14-17, tab. ix. f. 7.

Sp. Char. Section circular. Rate of increase in the septate part of the shell 1 in 6. Septa undulating, distant about $\frac{1}{3}$ the diameter of the shell. Body-chamber unknown. Siphuncle eccentric, situated between the centre and the margin. Surface smooth.

Horizon. Upper Ludlow¹.

Locality. Island of Gothland, Sweden.

Represented by a single fragment.

Orthoceras (?), sp. 2.

1852. *Orthoceras*, sp. 2, Salter, in Sutherland's 'Voyage in Search of Sir John Franklin,' Appendix, p. cxxiii.

¹ The Silurian Rocks of the island of Gothland have been hitherto regarded (mainly on the authority of Sir R. I. Murchison) as equivalent to the Wenlock Limestone of this country. But the investigations of Roemer and Helmersen show that other divisions are present, and I am informed by Dr. Lindström that the Gothland strata, whence the rich Cephalopodous Fauna of that island is derived, "must in age correspond nearly with the Upper Ludlow."

For a detailed account of the stratigraphy of the island of Gothland see Dr. Lindström's valuable memoir, "On the Silurian Gastropoda and Pteropoda of Gothland," Kongl. Svenska Vetenskaps-Akad. Handlingar, Bandet xix. Häfte 6, p. 5 (1884).

The Collection contains the specimens described by Salter:—
 “Long and very slowly tapering. The septa . . . frequently more than two lines apart, and very convex. The siphon is frequently out of the middle, and is small where it joins the septum, but is swelled into a bead-like shape between them.”

Horizon. Silurian (Division unknown).

Locality. Griffith's Island, Arctic America.

Orthoceras Belgicum, Malaise.

1873. *Orthoceras Belgicum*, Malaise, Terrain Silurien du centre de la Belgique, p. 88, pl. iii. ff. 1, 2.

Sp. Char. Shell straight. Section elliptical. Rate of tapering very slow. Septa unknown. Siphuncle a little eccentric. Surface ornamentation consisting only of lines of growth.

Remarks. M. Malaise observes that he possesses numerous casts of this form, which are crushed and flattened, and without any trace of the test, the septa, or the siphuncle. The largest attain a length of about one foot. All these fragments, he adds, are in a bad state of preservation, and it is impossible to correlate them with any other species with any degree of certainty. He therefore bestows a specific name upon them, because of their number, and of the similarity of the characters uniting them.

Horizon. Silurian (exact Division unknown).

Locality. Grand-Manil, Belgium.

Represented by a single specimen.

Orthoceras ascendens, Blake.

1882. *Orthoceras ascendens*, Blake, Brit. Foss. Ceph. p. 132, pl. xii. f. 7.

Sp. Char. Section circular. Rate of increase 1 in 15. Septa unknown. Siphuncle apparently central. Surface ornaments consisting of “sharp, upward imbrications which cross the shell directly, without any undulation; they are distant about $\frac{1}{4}$ of a line, or $\frac{1}{4}$ the shell diameter.”

Horizon. Lower Ludlow?

Locality. England?

Represented by a single example.

Orthoceras subundulatum?, Portlock.

1843. *Orthoceras subundulatum*, Portlock, Rep. on the Geol. of Londonderry, p. 373, pl. xxviii. f. 2.

1843. *Orthoceras incertum*, Portlock, *loc. cit.* p. 347, pl. xxviii. f. 7.

1845. *Creseis Sedgwickii*, Forbes, Quart. Journ. Geol. Soc. vol. i. p. 146, f. 2.

1852. *Orthoceras subundulatum*, M'Coy, British Pal. Foss. p. 317.
 1854. *Orthoceras subundulatum*, Salter, in Murchison's 'Siluria,' p. 231,
 Foss. Gr. 44. f. 3.
 ? 1863. *Orthoceras subundulatum*, Haswell, 'Silurian Formation of the
 Pentland Hills,' pl. i. ff. 10, 14.
 1882. *Orthoceras subundulatum*, Blake, British Foss. Ceph. pt. i.
 p. 133, pl. xi. ff. 8-10.

Sp. Char. Section circular. Rate of increase 1 in 12. Septa from $\frac{2}{5}$ to $\frac{1}{2}$ the diameter; direct. Body-chamber known only by incomplete fragments. Siphuncle subcentral. Surface ornaments consisting of upward imbrications having an undulating course; from 3 to 4 of them occupy the space of 1 line.

Remarks. This species is very widely distributed in Britain both in time and in space, if the forms recorded from various localities and formations be correctly ascribed to it.

Horizon. Wenlock Shales; Upper Ludlow.

Localities. Nantglyn, Denbighshire; Ludlow, Shropshire.

Represented by one example.

Orthoceras fretum ?, Blake.

1882. *Orthoceras fretum*, Blake, British Foss. Ceph. pt. i. p. 135,
 pl. xiv. ff. 7, 7a, 7b.

Sp. Char. Section nearly circular. Rate of increase 1 in 10. Body-chamber short, its length is about $1\frac{1}{3}$ times its basal diameter, with a constriction below the aperture. Septa distant less than $\frac{1}{8}$ the diameter, with a convexity of more than $\frac{1}{5}$; they are slightly oblique. Siphuncle eccentric, situated $\frac{2}{7}$ across the longer diameter. Surface of test with very close upward imbrications, 20 in the space of 1 line.

Remarks. A fragment which does not show the body-chamber is referred to this species with considerable doubt.

The septa are closer than in *O. Marloense*, agreeing in this respect with *O. fretum*; the rate of tapering of the present form is also in accordance with the latter species. The surface markings are not preserved.

Horizon. Upper Ludlow.

Locality. Ludlow, Shropshire.

Orthoceras Mocktreense, Sowerby.

1839. *Orthoceras Mocktreense*, Sowerby, in Murchison's 'Silurian System,' p. 616, pl. 6. f. 11.

1848. *Orthoceras Mocktreense*, Salter, in Phillips' Mem. on the Malvern Hills; Mem. Geol. Surv. vol. ii. pt. i., Palæont. Append. p. 353.
1852. *Orthoceras Mocktreense*, M'Coy, British Pal. Foss. fasc. ii. p. 315.
1873. *Orthoceras (Actinoceras) Mocktreense*, Salter, Cat. Camb. and Sil. Foss. p. 158.
1882. *Orthoceras Mocktreense*, Blake, British Foss. Ceph. pt. i. p. 137, pl. xv. ff. 6, 6 a; also pl. x. ff. 2, 6, and pl. xi. f. 3.

Sp. Char. Section circular. Rate of increase 1 in 10 to 1 in 13. Septa direct, though a little undulating, distant $\frac{1}{3}$ to $\frac{2}{5}$ the diameter. Body-chamber unknown. Siphuncle eccentric, inflated into a bead-like form between the septa. Surface with well-marked upward imbrications.

Remarks. A large crushed and distorted specimen in the National Collection attains a length of 13 inches.

Horizon. Upper Ludlow.

Localities. Ludlow, Shropshire; Benson Knot¹, Kendal, Westmoreland; Llangynllo, Radnorshire.

Represented by several very fine examples, the largest being 13 inches in length and 3 inches in its greatest diameter.

Orthoceras carinatus, Münster.

(*Ante*, p. 12.)

[Not 1856. *Bactrites carinatus*, G. & F. Sandberger, Die Verstein. Nassau, Abth. i. p. 129, pl. xvii. ff. 3, a-n.]

Sp. Char. Section elliptical, the ratio of the two diameters being as 8 : 7. Rate of tapering very slow, scarcely exceeding 1 in 30. Septa distant from $\frac{1}{3}$ the diameter in the younger shells to $\frac{1}{4}$ in the adult. The length of the body-chamber is about 4 times the diameter of its base, and about $\frac{1}{2}$ the total length of the shell. The siphuncle is central. The surface is ornamented with very distinct undulating transverse striæ, which have a downward imbrication, and conform to the outline of the aperture of the shell.

Remarks. The "raised keel" (erhabene Leiste) described by Münster as characterizing this species is met with in many others besides. It is doubtless one of the so-called "normal lines" described by the Brothers Sandberger (*loc. cit.*), which, when very prominent, have sometimes been mistaken for the siphuncle.

¹ A hill 1035 feet in height.

In Münster's species, as we have seen, the siphuncle is central, not marginal, and therefore I cannot understand why the Messrs. Sandberger should have identified their form, in which the siphuncle is as close to the margin as it could possibly be, with this one.

Horizon. Étage E, bande e 2 (=Salopian).

Locality. Butowitz, Bohemia.

Fairly well represented.

Orthoceras timidum, Barrande.

1868. *Orthoceras timidum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 388, pl. ccxvii. ff. 6, 7, pl. cccxv. ff. 20-32, pl. cccxxvii. ff. 19, 20, pl. cccxxiv. ff. 30-32.

Sp. Char. Section circular, or very slightly flattened. Rate of increase about 1 in 7. Septa augmenting gradually in their distance apart till about $\frac{1}{7}$ of the diameter is attained; their convexity equals $\frac{1}{4}$ the diameter. The length of the body-chamber averages 3 times the diameter of its base. The siphuncle is central. The surface is ornamented with very distinct transverse undulating striæ, having an upward imbrication.

This is one of the most widely diffused species of the Bohemian basin. A form resembling *O. timidum* was collected by M. de Verneuil in the black limestones of Ogasa, Province of Gerona, Spain. The species is cited also by L. Mallada¹.

Horizon. Étage E, bande e 2 (=Salopian).

Locality. Wiskočilka, Bohemia.

Well represented in the Collection.

Orthoceras placidum, Barrande.

1868. *Orthoceras placidum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 410, pl. ccxcviii. ff. 18-35, pl. ccclxvii. ff. 19-21.

Sp. Char. Section elliptical, the ratio of the two diameters being as 15:13. Rate of increase about 1 in 16. Septa oblique and undulating, increasing in their distance apart to about $\frac{1}{4}$ of the diameter of the shell. The length of the body-chamber equals 4 or 5 times the diameter of its base, and represents about $\frac{1}{4}$ the entire length of the shell. The aperture has an obliquity of nearly 35°. The siphuncle is nearly always central. The surface

¹ "Fosiles de España," Bol. Com. del Mapa geol. de España, 1875, tom. ii. p. 25.

is ornamented with very distinct transverse striæ, which have a downward imbrication. They are from $\frac{1}{2}$ to $\frac{1}{3}$ of a line distant from each other, and quite perceptible to the naked eye. Between the principal striæ one or two are intercalated which do not extend to the dorsal side of the shell. Besides these transverse striæ, well-preserved specimens show a series of faint longitudinal ones, about $\frac{1}{2}$ line apart.

Remarks. A form similar to this one, associated with *O. Bohemicum*, Barrande, was found by M. de Verneuil in the black limestones on the southern flanks of the eastern Pyrenees, at Ogasa, Province of Gerona, Spain. L. Mallada also mentions this species¹.

Horizon. Étage E, bande e 2 (=Salopian).

Localities. Lochkow, Kosorž, Bohemia.

Well represented in the Collection.

Orthoceras transiens, Barrande.

1866. *Orthoceras transiens*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 88, pl. ccxviii. ff. 8-11, pl. ccxxiv. ff. 17-23, pl. ccxcii., pl. ccxciii. ff. 9-12, pl. cccci. ff. 12-15, pl. ccccxlii. ff. 13-15.

Sp. Char. Section circular. Rate of increase of the shell very high, about 1 in 4, or with an apical angle, measured in the septate portion, of from 13° to 18° . Septa increasing gradually in their distance apart, till this reaches more than $\frac{1}{3}$ the diameter. Body-chamber greatly developed, its length representing from $2\frac{1}{2}$ to 3 times the diameter of its base. Siphuncle central. The ornamentation of the surface presents important differences according to the age of the individual. At the commencement the shell is nearly smooth; above this there appear strong and isolated transverse striæ with direct imbrication, becoming relatively close-set as the shell increases in size. Striæ of this description occupy the greater part of the length of the shell, grouping themselves at frequent intervals into faint rings or undulations, which are, however, quite visible to the naked eye. Towards the aperture, and especially above the constriction, the undulations become obsolete, and nothing remains but distinct, generally very prominent transverse striæ.

Remarks. Owing to the high apical angle of this species M. Barrande places it in his 'Orthocères brévicônes.'

Horizon. Étage E, bande e 1, ? Zone 4, Colonus Beds (=Salopian).

Locality. Butowitz, Bohemia.

Well represented in the Collection.

¹ *Loc. cit.*

Orthoceras severum ?, Barrande.

1866. *Orthoceras severum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 384, pl. ccxix. ff. 1-4, 7-8; ? pl. ccxxi. ff. 4, 5; pl. ccxxv. ff. 14-17; ? pl. ccxxix., pl. cclxxx. ff. 15-17; pl. cccii. ff. 1-5; pl. cccii. ff. 1-7; pl. cccx. ff. 12-15; pl. ccccliii. ff. 7, 8.
1876. *Orthoceras severum*?, Tromelin and Lebesconte, Assoc. Franç. pour l'avancement des Sciences, 4me Sess. (Nantes), p. 621, and Tabl. D. No. 32.

Sp. Char. Section circular. Rate of increase about 1 in 10. Septa distant about $\frac{3}{8}$ the diameter. Body-chamber known only by incomplete and isolated fragments, whose specific identity is not established beyond a doubt. Siphuncle a little eccentric. Surface with subregular imbricating (?) striæ, which are visible, as a rule, without the aid of a lens. The so-called organic deposit of Barrande is well developed in the chambers.

Horizon. Calcaires ampéliteux (= Third Fauna of Barrande).

Locality. Feuguerolles (Calvados), France.

Two imperfect specimens.

Orthoceras bifrons, Barrande, var. **geminorum**, Barr.

1870. *Orthoceras bifrons*, Barrande, var. *geminorum*, Barr. Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 398, pl. cclxvii. ff. 12, 13, 15.

Sp. Char. Shell very slender. Section somewhat elliptical. Rate of increase very gradual, scarcely perceptible in some examples, about 1 in 13 in others. Septa very variable in their distance apart, even in the same individual, generally about $\frac{1}{4}$ the diameter, which is also the amount of their convexity. The body-chamber is not well developed. Its length is about 4 times the diameter of the base, or about $\frac{1}{6}$ the total length of the shell. Siphuncle very slightly eccentric.

The surface ornamentation, instead of being composed of continuous striæ, as in *O. bifrons*, has alternately long and short striæ. The long ones are paired, and they nearly encircle the shell, disappearing or becoming very feeble upon the dorsal surface.

Between these principal striæ there occur two or three secondary ones, which are strongly marked upon the ventral side, but become obsolete towards the middle of the lateral surface. Faint longitudinal lines may also be seen, especially in that part of the shell which is not reached by the transverse striæ. M. Barrande appears to have overlooked these. The striæ above described have a downward imbrication. There are about six of them per line.

Horizon. Étage E, bande e 2 (=Salopian).

Localities. Butowitz, Dlauha Hora, Bohemia.

Well represented in the Collection.

Orthoceras Minos?, Barrande.

1868. *Orthoceras Minos*, Barrande, Syst. Sil. de la Bohême, vol. ii.

Texte iii. 1874 (janvier), p. 524, pl. cccxxx. ff. 1-4.

Sp. Char. Section elliptical. Rate of tapering about 1 in 10. Septa approximate; about 3 lines distant in a diameter of 18 lines. Body-chamber unknown. Siphuncle central; the form of its elements unknown. Surface of the test consisting of striæ having an obliquity of 25° to the long axis of the shell.

Horizon. Calcaires ampéliteux (=Third Fauna of Barrande).

Locality. Feuguerolles (Calvados), France.

One very imperfect specimen.

Orthoceras socium, Barrande.

1866. *Orthoceras socium*, Barrande, Syst. Sil. de la Bohême, vol. ii.

Texte iii. 1874 (janvier), p. 449, pl. ccxiii. ff. 7-9, pl. ccxxii.

ff. 23, 24, pl. ccxxvii. f. 4, pl. cccvii. ff. 9-12, pl. cccix. ff. 5-7.

Sp. Char. Section circular. Rate of increase about 1 in 15. Septa from $\frac{1}{3}$ to $\frac{2}{5}$ the diameter distant from each other. Body-chamber only known by fragments belonging to its base. Siphuncle very slightly eccentric. Surface ornaments consisting of very fine and close-set striæ, which have a direct imbrication.

This species resembles in its general aspect *O. pelagium* and *O. rivale*; but it is distinguished from the former by its circular section and more regularly arranged striæ, and from the latter by the much closer disposition of its striæ and by its more nearly central siphuncle.

Horizon. Étage E, bande e 2 (=Salopian).

Locality. Dlauha Hora, Bohémia.

Well represented in the Collection.

Orthoceras asparagus, Barrande.

1868. *Orthoceras asparagus*, Barrande, Syst. Sil. de la Bohême, vol. ii.

Texte iii. 1874 (janvier), p. 428, pl. cccxvii. ff. 1-5.

Sp. Char. Section slightly elliptical. Rate of increase extremely slow, not exceeding 1 in 28. Septa widely separated, the maximum distance between them being about $\frac{5}{6}$ the diameter. The body-chamber is unknown. The siphuncle is eccentric, but in-

cludes within one of its borders the axis of the shell. The surface is ornamented with very fine transverse striæ, which appear to have a direct imbrication. They are separated by very slight horizontal depressions.

Horizon. Étage E, bande *e* 2 (=Salopian).

Locality. Lochkow, Bohemia.

Represented by two fairly good specimens.

Orthoceras pastinacea, Barrande.

1868. *Orthoceras pastinacea*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 98, pl. cclxviii. ff. 4-8, pl. cccxxx. ff. 8-10.

Sp. Char. Shell always a little curved. Section circular, when not abnormally compressed. Rate of increase about 1 in 4. Body-chamber highly developed, occupying nearly half the length of the shell, its length being about 3 times the diameter of its base. Owing to the rapid increase in the diameter of the shell, the body-chamber has a volume more than double that of the septate portion. The septa have an obliquity of about 5° , corresponding with that of the aperture; they are distant from about $\frac{1}{4}$ to $\frac{1}{3}$ the diameter, according to the growth of the shell. The siphuncle is central. The test is almost always wanting, having been dissolved away; but some fragments show subregular transverse striæ, having a direct imbrication.

Horizon. Étage G, bande *g* 3 (=Downtonian).

Locality. Hlubočep, Bohemia.

Well represented in the Collection.

Orthoceras rivale, Barrande.

1866. *Orthoceras rivale*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 383, pl. ccix. ff. 1-7, pl. ccxvi. ff. 4-10, pl. cclxxiv. ff. 1-7, pl. cclxxxvii. ff. 1-3, pl. cccvi. ff. 1-4.

Sp. Char. Section circular. Rate of increase about 1 in 11. Septa distant about $\frac{2}{5}$ the diameter. The organic deposit is well developed. Body-chamber unknown. Siphuncle very eccentric, the edge of the siphuncle touching the centre. Surface ornamented with subregular striæ, the surface between which appears to be quite smooth.

Horizon. Étage E, bande *e* 2 (=Salopian).

Localities. Lochkow, Dlauha Hora, Bohemia; Feuguerolles (Calvados), France.

Orthoceras pelagium, Barrande.

1870. *Orthoceras pelagium*, Barrande, Syst. Sil. de la Bohême, vol. ii.

Texte iii. 1874 (janvier), p. 444, pl. cccxxi, pl. cccxxv. ff. 13-15;

id. Suppl. Sér. tardive, avril 1877, p. 217, pl. dxxi. ff. 1-3.

1876. *Orthoceras pelagium*, Tromelin & Lebesconte, Assoc. Franç. pour l'avancement des Sciences, 4me Sess. (Nantes), Tabl. B.

Sp. Char. Section elliptical, the ratio of the two diameters being as 12 : 11. Rate of increase about 1 in 11. Septa distant a little more than $\frac{1}{3}$ the diameter. Length of body-chamber a little less than 3 times the greater diameter of its base. Siphuncle very slightly eccentric. Surface-ornaments consisting of striæ having an obliquity of about 15°; they have a direct imbrication, not very distinctly marked.

Horizon. Étage E, bande e 2 (=Salopian).

Localities. Dlauha Hora, Karlstein, Bohemia.

Several good examples in the Collection.

Orthoceras duplicans?, Barrande.

1868. *Orthoceras duplicans*, Barrande, Syst. Sil. de la Bohême, vol. ii.

Texte iii. 1874 (janvier), p. 431, pl. cccv. ff. 22-27.

1878. Cnf. *Orthoceras commutatum*, Giebel, Kayser, in Geol. Specialkarte von Preussen; Die Fauna der ältesten Devon.

Sp. Char. Section circular. Rate of increase 1 in 7. Septa distant about $\frac{1}{3}$ the diameter. Length of body-chamber about 3 times the diameter of its base. Siphuncle central. Surface-ornaments consisting of fine horizontal imbricating striæ, which vary in their distance and strength in the same individual.

Remarks. Some imperfect specimens, with fragments of the test adhering to some of them, are assigned, with a degree of hesitation, to the present species.

Horizon. Étage E (=Salopian).

Locality. Bohemia.

Orthoceras Murchisoni, Barrande.

1868. *Orthoceras Murchisoni*, Barrande, Syst. Sil. de la Bohême, vol. ii.

Texte iii. 1874 (janvier), p. 528, pl. ccliv. ff. 4-6, pl. ccciii. ff.

11, 12, pl. cccx. ff. 1-3, pl. cccxvi. ff. 1-3, pl. cccxx. ff. 5-10,

pl. cccxxi. ff. 1-12, pl. cccxxxi. ff. 1-3, pl. ccccviii. ff. 1-8, pl.

cccxliv. ff. 12, 13, pl. cccclv. ff. 1-3.

Sp. Char. Section elliptical. Rate of tapering very variable, from 1 in 15 to 1 in 5. Septa distant about $\frac{1}{7}$ the diameter, with an obliquity of about 35°. Body-chamber with a length of nearly 3 times the diameter of its base. Siphuncle nearly central at first, but assuming gradually an eccentric position, until it is situated midway between the axis and the circumference. Surface with oblique lamellose striæ.

Horizon. Étage E, bande e 2 (= Salopian).

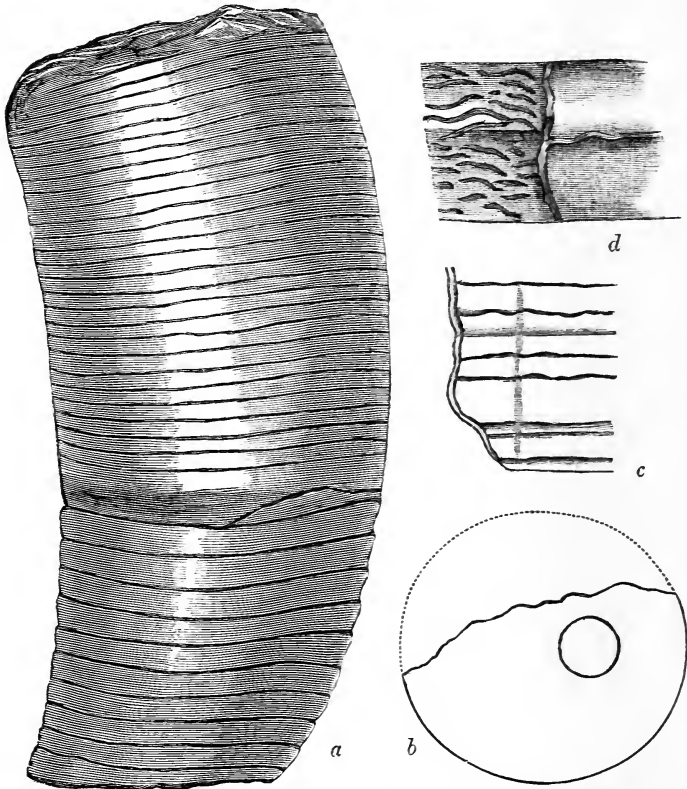
Locality. Wiskočilka, Bohemia.

Well represented in the Collection.

***Orthoceras arcticum*, sp. nov.**

1878. *Cyrtoceras*, sp., Etheridge¹, Quart. Journ. Geol. Soc. vol. xxxiv. p. 608.

Fig. 3.



Orthoceras arcticum, sp. nov.—*a*, figure of the type specimen, with the septate portion slightly restored, one half the natural size; *b*, section showing siphuncle, one half the natural size; *c*, fragment of the test, natural size; *d*, markings on the internal cast of the shell, probably produced by the mantle of the animal, enlarged to about twice the natural size.—N.B. The striae on the upper part of fig. 3 *a* (the body-chamber) are made a little too thick.

¹ "Palæontology of the Coasts of the Arctic Lands visited by the late British Expedition ('Alert' and 'Discovery'), under Captain Sir George Nares, R.N., K.C.B., F.R.S."

Sp. Char. Shell slightly curved. Section elliptical, the ratio of the two diameters being as 41:38. The rate of increase is about 1 in 12. The dimensions of the fragment are the following:—Total length about 8 inches, of which $\frac{1}{2}$ is taken up by the body-chamber. The greatest diameter of the latter is 41 lines; of the septate part of the shell 35 lines. The length of the body-chamber cannot be precisely determined, but the part preserved exceeds the basal diameter by about $\frac{1}{3}$; it decreases slightly in diameter towards the aperture, where there may have been a constriction. The septa are somewhat undulating and distant about $\frac{1}{3}$ the longer diameter, with a convexity of nearly $\frac{1}{5}$ that diameter. The siphuncle is large and cylindrical, with little or no inflation between the septa; its diameter is 7 lines, or $\frac{2}{11}$ that of the longer diameter of the shell. It is eccentric in position, and is situated about $\frac{2}{3}$ across the longer diameter, measuring from its centre to the margin of the shell. The surface is ornamented with very strong transverse striæ, having an upward imbrication, and these are crossed longitudinally, apparently at rare intervals, by faint ridges, which appear also upon the cast. The striæ (fig. 3, *c*) are generally from 2 to $2\frac{1}{2}$ lines distant from each other, but occasionally the interval separating them is not more than $1\frac{1}{2}$ line; they are distinctly marked upon the cast of the body-chamber (fig. 3, *a*), which is also covered with fine, wavy, irregular, impressed lines (fig. 3, *d*), produced probably by the mantle of the animal. These markings are observable in many other genera of fossil Cephalopods, such as *Cyrtoceras*, *Trochoceras*, *Goniatites*, &c.

Remarks. This fine shell was at first taken for a *Cyrtoceras*, on account of its curvature, but the position of the siphuncle, lower rate of tapering, and distance of the septa, distinguish it completely from that genus.

With reference to the horizon of the rocks whence this species was obtained, the following remarks in Mr. Etheridge's paper are worthy of note:—" . . . few as are the Lower Silurian fossils brought home, they are enough to show the succession to be much the same as in British North America and the British Islands; and the Upper Silurian [Silurian] fossils of Dobbin Bay, Cape Hilgard, Cape Louis Napoleon, Offley Islands, &c., confirm this unmistakably. Moreover, we are enabled to correlate these Upper Silurian fossils with the Wenlock group of Britain; but, nevertheless, they have a facies allying them to the American types rather than to our own."

I regret that the space at my command has not permitted me to

give a full-sized figure of this interesting specimen. I may mention that it was collected in 1876 by Dr. R. W. Coppinger, who accompanied Lieut. Fulford in his exploration of Petermann Fjord (Kennedy Channel), at the mouth of which Offley Island is situated.

I have not been able to find any species resembling this closely enough to suggest affinity with it.

Horizon. Silurian (Niagara Formation).

Locality. Offley Island, Kennedy Channel, Arctic America (lat. 81° 16'). Transferred from the Museum of Practical Geology.

Orthoceras bullatum, Sowerby.

1839. *Orthoceras bullatum*, Sowerby, in Murchison's 'Sil. Syst.' p. 612, pl. v. f. 29.

1839. *Orthoceras striatum*, Sowerby, *id.* in description of plates, p. 612.

1847. *Orthoceratites substriatus*, D'Orbigny, Prodrôme de Paléont. vol. i. p. 54.

1852. *Orthoceras bullatum*, McCoy, British Pal. Foss. fasc. ii. p. 313.

1867. *Orthoceras bullatum*, Dixon, Trans. Woolhope Nat. Field Club, Fossil Sketches, No. 1. f. 1.

1873. *Orthoceras bullatum*?, Malaise, Terrain Silurien du Centre de la Belgique, p. 89, pl. iii. f. 3.

1882. *Orthoceras bullatum*, Blake, British Foss. Ceph. pt. i. p. 129, pl. xii. ff. 4, 5.

[Not *Orthoceras striatum*, Sowerby, Min. Con. vol. i. p. 127, pl. lviii.]

Sp. Char. Section circular, in uncompressed examples. Rate of increase 1 in 6, decreasing to almost zero in the body-chamber. Septa more or less undulating; distant from $\frac{1}{8}$ to $\frac{1}{5}$ the diameter. Body-chamber not more than twice its basal diameter in length, with a slight contraction below the aperture. Siphuncle central; elements bulbous or head-like. Surface covered with fine, longitudinal riblets, varying in their aspect according to the preservation of the fossil.

Horizon. Wenlock Shales; Lower Ludlow; Upper Ludlow.

Localities. Dudley, Worcestershire; Ludlow, Shropshire; Presteign and Stapleton, Radnorshire; Hutton-i'-th'-Hay, Benson Knot, End Moor, near Milnthorpe, and Kendal, Westmoreland; Aymestry, Herefordshire; Usk, Monmouthshire; Llanfrechva, North(?) Wales.

Represented by a large series of specimens.

Orthoceras Griffithi ?, Haughton

1858. *Orthoceras Griffithi*, Haughton, in Captain McClintock's Reminiscences of Arctic Ice-Travel in Search of Sir John Franklin, Journ. Royal Dublin Soc. vol. i. p. 239, pl. v. f. 1.

Sp. Char. Section circular, very slowly tapering. Septa distant about $\frac{1}{2}$ the diameter. Length of the body-chamber apparently about 3 times the basal diameter. Siphuncle very eccentric, about $\frac{2}{3}$ along the diameter. Surface marked with fine, close-set, thread-like lines or riblets, about 12 in the space of 1 line.

Remarks. The position of the siphuncle in this species is described by Professor Haughton as central, but as the specimen figured by him is a longitudinal section, he may have been misled upon this point. In other respects the specimens in the National Collection agree perfectly with *O. Griffithi*.

"This fossil was found in great abundance at Griffith's Island, where Captain Austin's squadron wintered. It differs from all the *Orthocerata* described by Mr. Salter in Sutherland's Voyage¹, and I have named it after Mr. Griffith, the founder of Irish geology" (*Haughton*).

The geological horizon of the rocks of Griffith's Island, whence the present species was obtained, appears to have been well established, the fossils being "of a decidedly Upper Silurian type."

Horizon. Silurian (Wenlock?).

Locality. Griffith's Island, Barrow Strait, Arctic America.

Two somewhat imperfect specimens.

Orthoceras faustulum, Barrande.

1870. *Orthoceras faustulum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 504, pl. cccix. ff. 11-13.

1878. *Orthoceras* sp., Bayle, Explication de la Carte Géol. de la France, tom. iv. Atlas, première partie, pl. xxxiv. ff. 1, 2.

Sp. Char. Section somewhat oval. Rate of increase 1 in 6. Septa close together, distant about $\frac{1}{10}$ the diameter. Body-chamber unknown. Siphuncle very slightly eccentric, so that the central axis of the shell is touched by its border. Surface ornamentation consists of very fine and regular transverse striæ with an obliquity of about 15°.

Horizon. Calcaires ampéliteux (= Third Fauna of Barrande).

Locality. Feuguerolles (Calvados), France.

Represented by two fine specimens.

¹ Journal of a Voyage in the years 1850-1851, in search of the missing crews of H.M. ships 'Erebus' and 'Terror.' By Peter C. Sutherland, M.D.

Orthoceras styloideum, Barrande.

1866. *Orthoceras styloideum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 553, pl. cccxxxix. ff. 5-8, pl. cccclxv. ff. 1-8, 10, 11.

1873. *Orthoceras styloideum*, Barrande, Distrib. des Céph. dans les Contrées Siluriennes, p. 50 (Extrait du Syst. Sil. de la Bohême, vol. ii. 4me sér.).

1876. *Orthoceras styloideum*, Tromelin & Lebesconte, Assoc. Franç. pour l'avancement des Sciences, 4me Sess. (Nantes), p. 601.

Sp. Char. Shell very slender. Section generally a little elliptical. Rate of increase 1 in 24. Septa distant about $\frac{1}{3}$ the diameter. Body-chamber a little variable in its relative length, the extreme limits being $4\frac{1}{2}$ times and 7 times the basal diameter. The aperture has an obliquity of about 10° from the horizontal. The siphuncle is eccentric, and is placed about $\frac{4}{5}$ across the longer diameter. Surface markings consisting of faintly impressed, very fine striæ. The test is rarely preserved, as it is nearly always torn away in separating the specimens from the matrix.

Remarks. M. de Verneuil cites this species from St. Bât (Hautes-Pyrénées), whence it was brought to him by M. Leymérie, with other characteristic Upper Silurian fossils.

M. Barrande believes that this species, like *O. truncatum*, &c., shed or truncated its shell, and he supports his opinion upon the following considerations. He says: "The constant absence of the initial part of the shell, in more than a thousand individuals of this species that we have collected, leads us to conclude that they have undergone regular and normal truncation. This supposition of natural truncation in *Orth. styloideum* seems confirmed by this fact, that the septa of our specimens are constantly destroyed, save in very exceptional cases. These exceptions relate almost solely to the terminal septum of the great [body] chamber, that is to say, to that one which remains in contact with the source of life and of preservation, up to the death of the mollusk." M. Barrande further observes that he has not recognized in any case in this species the reparation of the truncated extremity.

Horizon. Étage E, bande e 1 (=Salopian); Calcaires ampéliteux (=Third Fauna of Barrande).

Localities. Butowitz, Bohemia; Feuguerolles (Calvados), France.

Orthoceras aperiens, Barrande.

1868. *Orthoceras aperiens*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 475, pl. cccxliv. ff. 12-23.

Sp. Char. Section somewhat variable in outline. Sometimes

nearly circular, but most frequently elliptical, with the diameters in the ratio of 11:9. Rate of increase rapid, about 1 in 5. Septa rather distant, reaching a maximum distance of $\frac{1}{2}$ the diameter. Body-chamber variable in length in different individuals, from twice to three times the diameter of the base. Siphuncle slightly eccentric, about $\frac{2}{3}$ across the longer diameter. Surface with slightly oblique transverse striæ, rather wide apart.

Remarks. In a note at the head of the description of this species given by M. Barrande (*loc. cit.*), that author observes that he had already communicated specimens of this *Orthoceras*, under the name of *O. hians*, and such was the name borne by the specimens in the National Collection. It appears, however, that this name was preoccupied by Dr. R. Richter de Saalfeld, in 1866, for a Devonian species, and therefore a new one was chosen.

Horizon. Étage E, bande e 1 (=Valentian, or Salopian?).

Locality. Butowitz, Bohemia.

Fairly well represented in the Collection.

Orthoceras mutabile, Barrande.

1870. *Orthoceras mutabile*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. (janvier), p. 278, pl. cccclxxviii. ff. 4-12.

Sp. Char. Section circular. Rate of increase 1 in 11. Septa very wide apart, exceeding $\frac{2}{3}$ of the diameter of the shell in their separation from each other. Body-chamber of very great length. In a specimen figured by M. Barrande, which is incomplete towards the aperture, it equals in length more than 11 times the diameter of its base. The siphuncle is central. Surface ornamented with very fine transverse striæ, placed at regular distances apart; these are crossed by faint longitudinal striæ, which can with difficulty be seen, except when the light is upon them.

Horizon. Étage E? (=Salopian).

Locality. Bohemia.

Only one imperfect specimen.

Orthoceras acuarium?, Münster.

1840. *Orthoceratites acuaris*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 95, Taf. xvii. ff. 5, a-d.

? 1855. *Orthoceras acuarium*, G. & F. Sandberger, Die Verstein. Nassau, Abth. i. p. 175, Taf. xx. f. 8.

1870. *Orthoceras acuarium?*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 474, pl. ccccvii. ff. 30, 31.

1876. *Orthoceras acuarium*, Tromelin & Lebesconte, Assoc. Franç. pour l'avancement des Sciences, 4me Sess. (Nantes), Tabl. B. No. 32.

Sp. Char. Section circular. Rate of increase 1 in 11. Septa regular and horizontal; their distance varies with the diameter, which it is sometimes equal to, and sometimes exceeds. The body-chamber is quite unknown. The siphuncle is central. The surface is ornamented with very fine transverse striæ.

Remarks. Barrande applies the name *O. acuarium* with doubt to some fragments resembling Count Münster's species, which was itself founded upon incomplete specimens; hence the uncertainty that prevails regarding this form.

Horizon. Étage E (=Salopian).

Locality. Lochkow, Bohemia.

Fairly well represented in the Collection.

Orthoceras senile, Barrande.

1866. *Orthoceras senile*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 589, pl. ccxxiii. ff. 11-15, pl. cccxxxiv. ff. 1, 2, & 7-15.

Sp. Char. Section circular; the occurrence of one or two individuals in which it is elliptical being deemed by M. Barrande to be accidental. Rate of increase about 1 in 7. Septa averaging about $\frac{1}{5}$ the diameter in their distance from each other. Length of the body-chamber varying between $1\frac{1}{2}$ and $2\frac{1}{2}$ times the diameter of its base; that is, equalling nearly $\frac{1}{5}$ the total length of the shell. Siphuncle eccentric, placed about midway between the centre and the circumference. Surface with very distinct, irregular, transverse riblets, covered with very fine, longitudinal striæ, which can only be distinguished with the aid of a lens; these pass over the riblets.

Horizon. Étage E, bande e 2 (=Salopian).

Localities. Kosořz, Wiskočilka, Bohemia.

Fairly well represented.

Var. **Hoernesii**, Barrande.

1866. *Orthoceras Hoernesii*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 507, pl. ccxxiii. ff. 4-6, pl. cccxxxiii. ff. 1-16.

Remarks. This form does not differ from *O. senile*, except in the absence of the fine longitudinal striæ, and I have therefore reduced it to varietal rank, as I do not consider such a character of sufficient importance for specific distinction.

Horizon. Étage E, bande e 2 (=Salopian).

Localities. Lochkow, Kosořz, Bohemia.

Well represented in the Collection.

Orthoceras capax, Barrande.

1868. *Orthoceras capax*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 485, pl. cccxxii. ff. 10-14, pl. cccxxix. ff. 15-22, pl. cccxxvi. ff. 8-10.

Sp. Char. Section circular. Rate of tapering from 1 in 4 to 1 in 5. The distance between the septa increases gradually until it attains half the diameter of the shell. The body-chamber attains a length of at least from $2\frac{1}{2}$ to 3 times the diameter of the base. The siphuncle is central or very nearly so. The surface is ornamented with horizontal, somewhat prominent riblets, about 4 per line.

Horizon. Étage E, bande e 2 (=Salopian).

Localities. Lochkow, Kosoř, Bohemia.

Well represented in the Collection.

Orthoceras Neptunicum, Barrande.

1868. *Orthoceras Neptunicum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 247, pl. cccxii. ff. 25, 26. pl. cclxxii., pl. cclxxiii., pl. cclxxiv., pl. ccc. ff. 27-30, pl. ccccliii. ff. 1-4, pl. cccclii. ff. 3-5.

Sp. Char. Section most frequently circular, but in some specimens it is decidedly elliptical. Rate of tapering about 1 in 9. The distance between the septa increases gradually to a maximum of $\frac{1}{7}$ the diameter, so that they are rather close together upon the whole. The length of the body-chamber equals about twice the diameter of its base. The siphuncle is at first central, but it gradually becomes eccentric as it approaches the last few septa, where it is situated about midway between the centre and the periphery. The surface ornamentation is somewhat complicated. It consists principally of a series of longitudinal riblets, variable in size, and so close-set as to require 6 or 7 of them to fill the space of one line; these are covered by a series of extremely fine transverse lines, which fill the concavities between the riblets, and pass over the latter. In addition to these ornaments the young shells are furnished with tolerably prominent undulations.

Horizon. Étage E, bande e 2 (=Salopian).

Locality. Dlauha Hora, Bohemia.

Several fine examples in the Collection.

Orthoceras araneosum, Barrande.

1868. *Orthoceras araneosum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 283, pl. cccxxvii., pl. cccxxviii., pl. cccxxxix., pl. cccxl.

? 1872. *Endoceras proteiforme*, Nicholson, Geol. Mag. new series, vol. ix. p. 102, f. 1, a, b.

? 1882. *Orthoceras araneosum*, Blake, British Foss. Ceph. pt. i. p. 124, pl. xvii. ff. 2, 2 a.

Sp. Char. The shell has often a slight curvature. Section for the most part circular, but in some examples it is more or less elliptical. The rate of increase is about 1 in 7, but including the body-chamber it increases to 1 in 4. The septa are about $\frac{1}{3}$ the diameter distant from each other. The length of the body-chamber is about $2\frac{1}{2}$ times the diameter of its base; it is rarely preserved owing to the tenuity of the test. The siphuncle is more or less eccentric, sometimes as much as $\frac{2}{3}$ across the diameter, but generally very near the centre. The ornaments of the test are very variable, and consist of strong thread-like striæ or riblets, very close together and forming a network; sometimes the longitudinal, sometimes the transverse lines predominate. There are also transverse folds of growth (bourrelets), and sometimes prominent irregular longitudinal folds.

Remarks. M. Barrande observes that this species is one of the most remarkable in the Bohemian Basin, for the number of specimens, the preservation of the test in a great many of them, and above all for the different appearances, not only of the ornaments of the surface but also of several other parts of the shell. This species, with its numerous variations of form, has never been found above Étage E.

Horizon. Étage E, bande e (=Salopian).

Locality. Hinter-Kopanina, Lochkow, Bohemia.

Very well represented in the Collection.

Orthoceras victima, Barrande.

1870. *Orthoceras victima*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 286, pl. cclx. ff. 25-35.

Sp. Char. Shell straight. Section circular. Rate of increase about 1 in 7. Body-chamber relatively well developed, but the exact proportion between its length and the diameter of its base cannot well be ascertained, as the test covers the latter. Septa horizontal, regularly increasing in their distance apart, which amounts to about $\frac{2}{3}$ the diameter. Siphuncle a little eccentric. The surface of the test is beautifully cancellated with thread-like transverse lines crossed at right angles by finer lines, so as to divide the whole surface into minute squares of net-like appearance. This sculpture can only be distinguished with a lens.

Horizon. Étage F, bande f 2 (=Downtonian).

Locality. Konieprus, Bohemia.

Well represented in the Collection.

Orthoceras extenuatum ?, Barrande.

1870. *Orthoceras extenuatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 502, pl. cccxci. ff. 1-4, 9-14, 18-21, pl. cccxcii. ff. 12-14, ? pl. cccxciii. f. 9, pl. ccccv. ff. 4-7.

Sp. Char. Section circular. Rate of increase very slow, about 1 in 17. Septa regular and horizontal; distant about $\frac{1}{3}$ the diameter. Length of the body-chamber about 4 times the diameter of its base. Siphuncle subcentral. Surface ornamented by very fine, subregular, oblique raised striæ, of which there are about 6 in a line.

Remarks. The specimen in the National Collection which may represent this species consists of a fragment, probably belonging to the body-chamber, as it exhibits no trace either of septa or siphuncle. The surface of the test is, however, well preserved in some places, and presents the same characters as the species to which I have, with some doubt, referred it. The transverse lines in the specimen before me are, if anything, closer than in Barrande's species, but beyond that I can find no difference between the two forms.

Horizon. Stage 7, "Upper Orthoceras-Limestone" (=Salopian?).

Locality. Malmö, Sweden.

One very imperfect example.

Orthoceras amœnum, Barrande.

1866. *Orthoceras amœnum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 306, pl. cccxiv. ff. 5-7, pl. cccxv. ff. 16-33, pl. cccc. ff. 14-16, pl. ccccv. ff. 8-10.

Sp. Char. Section circular. Rate of increase 1 in 7. Septa distant about $\frac{1}{5}$ the diameter; regular and horizontal. Body-chamber well-developed and occupying nearly $\frac{1}{2}$ the length of the shell; its length equalling from 4 to 6 times the diameter of its base. The siphuncle is subcentral. The surface of the test is ornamented with very faint annulations, of which there are about two per line.

Horizon. Étage E, bande e 1 (=Salopian).

Locality. Butowitz, Bohemia.

Well represented in the Collection.

Orthoceras inchoatum, Barrande.

1866. *Orthoceras inchoatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 328, pl. ccix. ff. 8-12, ? pl. cccxxxix. f. 27, pl. cccclviii., pl. cccclxix.

Sp. Char. Section invariably circular. Rate of increase about 1 in 10. The body-chamber, judging by fragments in different

examples, has a length representing at least from 4 to 5 times the diameter of its base. The distance of the septa is about $\frac{1}{3}$ the diameter. The siphuncle is cylindrical and a little eccentric, but with some part of it always touching the central axis. The surface ornamentation commences in the young shell with very distinct annulations, but these disappear in the adult, and irregular rugosities take their place, the whole of the test being covered with irregular, rough, raised lines.

Remarks. The most striking feature in this species is the diversity of the surface ornamentation in different parts of the same shell. The species attains a considerable size, specimens having been collected exceeding three feet in length.

O. inchoatum differs from *O. subannulare*, *O. Duponti*, and others of its congeners, by the irregularity of its ornamentation in the adult state.

Horizon. Étage E, bande e 2 (=Salopian).

Locality. Hinter-Kopanina, Bohemia.

Fairly well represented in the Collection.

Orthoceras Nicholianum, Blake.

1882. *Orthoceras Nicholianum*, Blake, British Foss. Ceph. pt. i. p. 88, pl. iii. ff. 7, 7 a, 8, 15.

Sp. Char. Section unascertainable, owing to compression. Rate of increase slow, but its amount unknown. Septa estimated, by the remains of the beaded siphuncular elements, to be distant about $\frac{2}{3}$ of a line. Body-chamber unknown. Siphuncle apparently central. Surface ornaments consisting of "transverse, sharp, scarcely separate ribs, with an obliquity of about 5° and about $\frac{1}{6}$ the diameter apart. These are crossed by sharp, separate, longitudinal lines, which pass over the ribs and slightly knot them at the crossing. They are irregularly placed and not all of the same size; on the whole they are about three or four times as numerous as the ribs. Besides these, there are extremely fine transverse lines five times as close as the longitudinal, and scarcely parallel to the ribs."

Remarks. The specific name *Nicholianum* was adopted by Professor Blake from the type specimen in the Museum at Cardiff.

Horizon. Wenlock Shales (Salopian).

Locality. ? Dudley, Worcestershire.

Well represented in the Collection.

Orthoceras tenuiannulatum, M'Coy.

1851. *Cycloceras tenuiannulatum*, M'Coy, Ann. & Mag. Nat. Hist. ser. 2, vol. vii. p. 45.
 1852. *Cycloceras tenuiannulatum*, M'Coy, British Pal. Foss. fasc. ii. p. 320, pl. 1 L. f. 31.
 1852. *Cycloceras ibex*, M'Coy, *ibid.* p. 319 (pars).
 1852. *Orthoceras ibex*, Salter, *ibid.* Appendix A, p. vii. (Not of Sowerby.)
 1854. *Orthoceras vertebrale*, Morris, Cat. British Foss. p. 312. (Not of Hall.)
 1865. *Orthoceras tenuiannulatum*, Haswell, On the Silurian Formation of the Pentland Hills, p. 25, pl. i. f. 3.
 1873. *Orthoceras tenuiannulatum*, Salter, Cat. Cambr. and Sil. Foss. p. 173.
 1873. *Orthoceras ibex*, Salter, *ibid.* p. 186.
 1882. *Orthoceras tenuiannulatum*, Blake, British Foss. Ceph. pt. i. p. 93, pl. v. ff. 9, 9 a.

Sp. Char. Section not known, owing to compression. Rate of increase variable, about 1 in 14. Septa, siphuncle, and body-chamber unknown. Surface ornaments consisting of very clearly separated rounded ribs, the interspaces wider than the latter. The ribs are slightly oblique, and are distant $\frac{1}{3}$ to $\frac{1}{4}$ the (flattened) diameter. Fine longitudinal lines, about 20 in the space of 1 line, cross the ribs, and a few transverse lines are seen on the summits of the ribs. The longitudinal and transverse lines in small (young?) individuals sometimes become closely cancellated.

Horizon. Wenlock Shales (Salopian).

Localities. Dudley, Worcestershire; Byton Cross, Herefordshire; near Presteign, Radnorshire.

Fairly well represented in the Collection.

Orthoceras Duponti, Barrande.

1868. *Orthoceras Duponti*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte, iii. 1874 (janvier), p. 324, pl. cexii. ff. 5-13, ? pl. cexiv. ff. 9, 10, pl. cclxxxv., pl. ccxxiv. ff. 7-10, pl. ccxciv. ff. 1-4.
 1873. *Orthoceras subannulare*, Salter, Cat. Cambr. and Sil. Foss. p. 98.
 1882. *Orthoceras Duponti*, Blake, British Foss. Ceph. pt. i. p. 92, pl. v. ff. 1, 1 a, 2, 2 a.

Sp. Char. Shell always straight. Section circular. Rate of increase 1 in 10. Septa direct, very variable in their distance; from $\frac{2}{3}$ to $\frac{1}{3}$ the diameter. Body-chamber four times the length of its basal diameter. Siphuncle eccentric; about $\frac{2}{3}$ across the diameter; its elements slightly inflated. Ornaments changing with growth. In the apical portion of the shell there are annulations, slightly oblique and close-set, occupying a space greater than the spaces separating them. At a certain period in the growth of the

shell the annulations disappear rapidly and completely. The larger ornaments are covered with transverse parallel riblets, and these also tend gradually to become obsolete towards the aperture.

Horizon. Wenlock Limestone.

Locality. Dudley, Worcestershire.

Well represented in the Collection.

Orthoceras Maclareni, Salter.

1839. *Orthoceras*, Maclareni, 'A Sketch of the Geology of Fife and the Lothians,' p. 203.

1854. *Orthoceras Maclareni*, Salter, in Murchison's 'Siluria,' Foss. Group 25.

1861. *Orthoceras Maclareni*, Salter, Mem. Geol. Surv. of Scotland, Sheet 32, p. 143.

1865. *Orthoceras Maclareni*, Haswell, 'On the Silurian Formation of the Pentland Hills,' p. 23, pl. i. f. 2.

1873. *Orthoceras Maclareni*, Salter, Cat. Camb. and Sil. Foss. p. 186.

1882. *Orthoceras Maclareni*, Blake, British Foss. Ceph. pt. i. p. 105, pl. vi. ff. 7-10.

Sp. Char. Shell straight. Section elliptical; but the specimens are all compressed. Septa direct, with a convexity of $\frac{1}{3}$ the long diameter; they are distant $\frac{2}{7}$ the diameter. Siphuncle central; surface ornamented with "strong, sharp ridges, imbricating upwards;" their distance is variable, from $\frac{1}{9}$ to $\frac{1}{16}$ the diameter, or even less; they have an irregular imbrication.

Remarks. The species most nearly allied to this is *O. Duponti*; but that has ornaments which, though irregular, may be described as true ribs, whereas in the present species they are rather irregular transverse folds.

Horizon. Ludlow (exact division unknown).

Locality. Usk, Monmouthshire.

Fairly well represented in the Collection by specimens presented by J. E. Lee, Esq., F.S.A., F.G.S.

Orthoceras tracheale, Sowerby.

1839. *Orthoceras tracheale*, Sowerby, in Murchison's Sil. Syst. p. 604, pl. iii. f. 9 b.

1852. *Orthoceras tracheale*, M'Coy, British Pal. Foss. fasc. ii. p. 321.

1854. *Orthoceras tracheale*, Salter, in Murchison's 'Siluria,' pl. xxxiv. f. 6.

1882. *Orthoceras tracheale*, Blake, Brit. Foss. Ceph. pt. i. p. 97, pl. v. f. 6.

[? 1848. *Orthoceras perelegans*, Salter, Mem. Geol. Surv. vol. ii. pt. i. pl. xiii. ff. 2, 3 (not f. 4).]

Sp. Char. The section in well-preserved examples is circular,

and the rate of increase is 1 in 12. There is no curvature whatever. The ornaments are acute ribs, though rather rounded in the casts; they are scarcely separate, are quite direct, and distant $\frac{1}{3}$ to $\frac{2}{7}$ the diameter. When well preserved, there are sharp riblets parallel to the ribs, somewhat imbricating downwards. The septa are parallel to the ribs, and lie in the interspaces; their convexity is very small, indeed they are remarkably flat. The siphuncle is small, and nearly central. (*Blake.*)

Remarks. This species closely resembles *O. ibex*, but it differs therefrom in the directness of its annulations.

Horizon. Upper Ludlow (Downtonian).

Locality. "Brook Farm Lane." (No further particulars about the locality of this fossil are obtainable. It was very probably collected in the neighbourhood of Ludlow, Shropshire.)

Represented by one specimen presented by J. E. Lee, Esq., F.S.A., F.G.S.

Orthoceras ibex, Sowerby.

1839. *Orthoceras ibex*, Sowerby, in Murchison's Sil. Syst. p. 613, pl. v. f. 30.

1839. *Orthoceras articulatum*, Sowerby, *ibid.* f. 31.

1868. *Orthoceras ibex*, Dixon, Trans. Woolhope Naturalists' Field Club, Fossil Sketches, No. 1, f. 2.

1882. *Orthoceras ibex*, Blake, British Foss. Ceph. pt. i. p. 95, pl. v. ff. 3, 3 a, 4, 5, 8.

[Not 1839. *Lituities ibex*, Sowerby, in Murchison's Sil. Syst. p. 622, pl. xi. f. 6.—1852. *Orthoceras (Cycloceras) ibex*, M'Coy, British Pal. Foss. p. 319.—1852. *Orthoceras ibex*, Salter, *ibid.* Appendix A, p. vii.—1852. *Hortolus ibex*, M'Coy, British Pal. Foss. p. 324.—1873. *Orthoceras ibex*, Salter, Cat. Camb. and Sil. Foss. p. 71.]

Sp. Char. Section circular. The rate of increase is slow, but it cannot be accurately ascertained owing to the frequently compressed condition of the specimens. Septa not seen in the type, nor in any of the specimens in the National Collection. The body-chamber attains in some individuals a length equalling five times its basal diameter. The siphuncle is apparently a little eccentric. The surface is ornamented with rounded or subangular annulations, generally with a little obliquity, amounting in some specimens to 10° . The distance of the ribs or annulations varies from $\frac{1}{3}$ to $\frac{2}{9}$ the longer diameter. The surface, when well preserved, is seen to be covered with numerous transverse lines, parallel to the annulations. The latter entirely disappear towards the aperture.

Horizon. Wenlock Shales, Upper Ludlow (Salopian and Downtonian).

Localities. Benson Knot, Kendal, Westmoreland; Byton Cross,

Herefordshire; Llangollen, Denbighshire; Usk, Panteague, Monmouthshire; Llandegfydd, North(?) Wales. Specimens from the two last-named localities were presented by J. E. Lee, Esq., F.S.A., F.G.S.

Represented in the Collection by numerous examples.

Orthoceras Grayi, Blake.

1882. *Orthoceras Grayi*, Blake, Brit. Foss. Ceph. pt. i. p. 102, pl. xiii. f. 6.

Sp. Char. Section elliptical, the diameters in the ratio of 5 to 4. Rate of increase of the long diameter 1 in 5 in the type specimen. The septa are 2° or 3° oblique, and about $\frac{1}{5}$ the long diameter apart. The siphuncle appears to be central. The ornaments consist of subacute, subseparate ribs $\frac{2}{9}$ the long diameter apart. The body-chamber is unknown.

Remarks. This species is distinguished from *O. ibex* by its rate of increase and larger size, and from *O. annulatum* by the same characters and also by the absence of fimbriation in the transverse riblets.

Horizon. Wenlock Limestone (Salopian).

Locality. Dudley, Worcestershire.

Represented by the type, described by Prof. Blake.

Orthoceras dimidiatum, Sowerby.

1839. *Orthoceras dimidiatum*, Sowerby, in Murchison's Sil. Syst. p. 620, pl. viii. f. 18.

1849. *Orthoceras subdimidiatum*, D'Orbigny, Prodr. de Pal. vol. i. p. 28.

1852. *Orthoceras dimidiatum*, M'Coy, British Pal. Foss. fasc. ii. p. 314.

1852. *Orthoceras dimidiatum*, Salter, id. Appendix A, p. vii.

1873. *Orthoceras dimidiatum*, Salter, Cat. Cambr. and Sil. Foss. p. 98.

1882. *Orthoceras dimidiatum*, Blake, Brit. Foss. Ceph. pt. i. p. 103, pl. vi. ff. 11, 12.

[Not 1840. *Orthoceratites dimidiatus*, Münster, Beitr. zur Petrefractenkunde, Heft iii. Taf. xix. ff. 2, 5.]

Sp. Char. Section not seen. Average rate of increase 1 in 16. The septa vary in their distance from $\frac{1}{3}$ to more than $\frac{1}{2}$ the diameter. The body-chamber is several times the length of its basal diameter. The siphuncle is unknown. "The ornaments are semi-ribs, found only on the right side of the specimen; these are slightly undulating, but rather oblique, rising to the left side; and are $\frac{1}{7}$ the mean diameter apart, and consist of downward imbrications which gradually die away" (Blake). The imbrication may be either upward or downward.

Horizon. Lower Ludlow (Salopian).

Locality. Combe Wood, Presteign, Radnorshire.

Fairly well represented in the Collection.

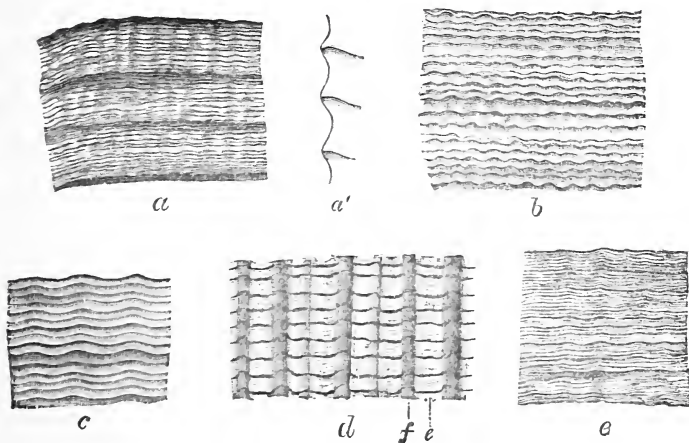
Orthoceras annulatum, Sowerby.

1816¹. *Orthocera annulata*, Sowerby, Min. Conch. vol. ii. 1818, p. 73, tab. cxxxiii.

? 1860. *Cycloceras annulatum*, Eichwald, Lethæa Rossica, vol. i. Seconde Section de l'ancienne Période, p. 1229.

1882. *Orthoceras annulatum*, Blake (pars), British Foss. Ceph. pt. i. p. 89, pl. iv. ff. 3, 4.

Fig. 4.



Surface ornamentation of *Orthoceras annulatum* and its varieties.

a, *O. annulatum*; *a'*, outline of annulations viewed in profile, to show their convexity; *b*, var. *crassum*; *c*, var. *Americanum*; *d*, var. *fimbriatum* (*e*, elevations, *f*, furrrows); *e*, var. *subtile*. All of the natural size.

Sp. Char. Shell straight. Section elliptical; the ratio of the diameters 11 to 13. Rate of increase varying from 1 in 10 to 1 in 14. The length of the body-chamber cannot be accurately determined, as the aperture is not preserved in any of the specimens examined.

In one example contained in the National Collection (figured by Blake, *loc. cit.* pl. iv. f. 2), which has been cut longitudinally, the portion of the body-chamber remaining is nearly three times the length of its basal diameter. The septa vary somewhat in their distance apart, being from $\frac{1}{6}$ to $\frac{1}{4}$ the diameter of the shell. The

¹ Date of publication of plate.

former measurement is taken from the last two septa, at the base of the chamber, where they are probably closer together than in other parts of the shell. The convexity of the septal surface is about $\frac{1}{3}$ the longer diameter of the shell, but in the type it is $\frac{1}{4}$. The siphuncle is usually central, but occasionally a little eccentric. In large examples it has a diameter of from $\frac{1}{2}$ to $\frac{1}{3}$ that of the shell; it is cylindrical in shape, and has a very slight expansion between the septa.

The ornaments consist of, first, transverse, undulating, rounded or subacute ribs, separated by concave interspaces a little wider than the ribs. In uncompressed examples the latter are distant from $\frac{1}{4}$ to $\frac{1}{5}$ the diameter. Secondly, the whole surface of the shell is covered with fimbriated riblets or lamellæ, running parallel with the ribs. The fimbriæ, when perfect, project vertically from the surface of the test; they vary greatly in number and character, but are always more crowded upon the ribs than in the interspaces. Fine parallel striæ may be seen between the fimbriæ, on well-preserved specimens. Somewhat faintly defined longitudinal elevations traverse the surface, crossing the ribs, and sometimes imparting to them an obscurely nodose character: these elevations generally correspond with the arches of the fimbriæ.

In some examples (including Sowerby's type) the ribs for a short interval (equivalent generally to the space occupied by two or three ribs) entirely disappear, and their place is filled up by the fimbriæ, very much crowded together. That these ribless intervals do not represent the true aperture is shown by the fact that they are succeeded in some examples by a ribbed surface of indefinite length.

A specimen in the Museum of Practical Geology exhibits very distinct bands of colour. This interesting phenomenon has been seen also in other species, such as *Orthoceras anguliferum*, d'Arch. & de Vern.¹ In this the colour-bands are chevron-shaped, and have a very beautiful and characteristic appearance.

Remarks. The fact of this species having been erroneously assigned by its author to the horizon of the Carboniferous Limestone (Derbyshire Peak Limestone), in the "Supplementary Index" to vol. ii. of the Min. Conch., has led many to suppose that Sowerby's type of *O. annulatum* was a Carboniferous species. But in his paper, "On the Geology of Coalbrook Dale,"² Professor Prestwich records it from the Wenlock and other Silurian rocks of

¹ Trans. Geol. Soc. 1842, vol. vi. p. 346, tab. xxvii. f. 6.

² Trans. Geol. Soc. 1850, vol. v. pt. 3, p. 422.

that district, and there can be no further doubt about its true horizon. Moreover, Sowerby himself insisted upon the identity of his type with the species collected elsewhere by Sir Roderick Murchison, and figured by him in the 'Silurian System'¹.

Horizon. Wenlock Limestone (Salopian).

Localities. Coalbrookdale, Shropshire; Walsall, Staffordshire; Gaercoed, near Usk, Monmouthshire. A specimen from the latter locality was presented by J. E. Lee, Esq., F.G.S.

A very fine series of examples represents this species and its varieties.

Var. crassum, var. nov.

1827. *Orthoceratites undulatus*, Hisinger, Vetensk. Akad. Handlingär, Sednare Hälften, p. 323, tab. vii. f. 8.
1831. *Orthoceratites undulatus*, Hisinger, Anteckn. i Physik och Geognosie, Femte Häftet, p. 112, tab. iv. f. 6.
1837. *Orthoceratites undulatus*, Hisinger, Lethæa Svecica, p. 28, tab. x. f. 2. (Not of Sowerby.)
1839. *Orthoceras annulatum*, Sowerby, in Murchison's Sil. Syst. p. 632, pl. ix. f. 5.
1852. *Orthoceras (Cycloceras) annulatum*, McCoy, British Pal. Foss. fasc. ii. p. 319.
1854. *Orthoceras annulatum*, Salter, in Murch. 'Siluria,' pl. xxvi. f. 1.
1857. *Orthoceras annulatum*, Boll, Archiv des Ver. der Freunde der Naturgesch. in Mecklenburg, xi. Jahrg. p. 25, Taf. vii. f. 23.
- ? 1858. *Orthoceras annulatum*, Schmidt, Archiv für die Naturkunde Liv-, Ehst- und Kurlands, Zweiter Band, p. 197.
1867. *Orthoceras annulatum*, Dixon, Trans. Woolhope Naturalists' Field-Club, Fossil Sketches, No. 1. f. 5.
1868. *Orthoceras annulatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 308, pl. ccxxv. f. 23, pl. ccxc., pl. ccxcii. ff. 1-4, ? 5, 6, 15-17.
- ? 1869. *Orthoceras annulatum*, Heidenhain, Ueber Grapholithen führende Diluvial-Geschiebe der norddeutschen Ebene, p. 20.
1870. *Orthoceras annulatum*, Barrande, *ibid.* pl. cccxli. ff. 2-5 (not f. 1).
1882. *Orthoceras annulatum*, Blake, British Foss. Ceph. pt. i. p. 89, pl. iv. ff. 1, 2, 5, 6-8.
- [Not 1831. *Orthoceratites annulatus*, Hisinger, Anteckn. Femte Häftet, p. 112, tab. iv. f. 5.—1836. *Orthoceras annulatum*, Phillips, Geol. Yorkshire, vol. ii. p. 239, pl. xxi. ff. 9, 10.—1837. *Orthoceratites annulatus*, Hisinger, Lethæa Svecica, p. 29, tab. ix. f. 8.]

The great majority of examples figured and described under the name *Orthoceras annulatum* differ from Sowerby's type in the character of their ornamentation to such an extent as, I think, justifies

¹ Sil. Syst. 1839, footnote, p. 632.

their separation under varietal names. In the present variety this difference consists in the very much coarser character of the fimbriæ. Generally not more than three or four of these lie in the spaces between the ribs, whereas in Sowerby's type, and in other forms that should now be associated therewith, the fimbriæ number from eight to ten in that situation. It should be remarked also that the fimbriæ are much more distinctly waved in this variety than they are in the typical form. These distinctions are exhibited in the accompanying figures (p. 53).

Horizon. Wenlock Limestone, Lower Ludlow; Aymestry Limestone, Upper Ludlow (Salopian and Downtonian).

Localities. *British.* Dudley, Malvern, Worcestershire; Ludlow, Ledbury, Shropshire.—*Foreign.* Island of Gothland, Sweden; Butowitz, Bohemia.

Var. **perundosum**, var. nov.

This variety is conspicuous for the very distinct manner in which the transverse fimbriæ are waved, the annulations also partaking of the same character. The only variety of *Orth. annulatum* in which the annulations themselves are wavy is that one I have called *Americanum*; but it differs from the present form in the much less pronounced character of its annulations, and also in the generally coarser nature of its ornamentation. In *perundosum* there are 10 or 12 fimbriæ in the space between two annulations, or about 16 if we add those upon one of the annulations. A specimen of the apical portion of this variety measures $5\frac{1}{2}$ inches in length, and its greatest diameter half an inch. The sculpture upon it is not very well preserved. This is best seen upon a fragment $1\frac{1}{4}$ inch in length and 1 inch in its larger diameter.

I am not acquainted with any published figures of this variety.

Horizon. Wenlock Shales (Salopian).

Locality. Gaercoed, near Usk, Monmouthshire.

Var. **Americanum**, var. nov.

1852. *Orthoceras annulatum*?, Hall, Pal. New York, vol. ii. p. 96, pl. xxix. f. 3.

1852. *Orthoceras undulatum*, Hall, *ibid.* p. 293, pl. lxiv., pl. lxv. f. 3.

? 1860. *Orthoceras annulatum*, Roemer, Sil. Fauna des Westlichen Tennessee, p. 78, Taf. v. f. 18, a, b.

1861. *Orthoceras nodocostatum*, M'Chesney, New Palæozoic Fossils, p. 94, pl. ix. f. 5 (*vide* J. Hall).

1863. *Orthoceras undulatum*, Billings, in Logan's Geol. of Canada, p. 325.

1866. *Orthoceras nodocostatum*, M^cChesney, Trans. Chicago Acad. Nat. Sci. vol. i. p. 53, pl. ix. f. 5 (*vide* J. Hall).
1867. *Orthoceras annulatum*, Hall, 20th Reg. Rep. p. 351, pl. xx. ff. 4-6.
1868. *Orthoceras annulatum*?, Worthen, Geol. Surv. of Illinois, vol. iii. p. 117.
1870. *Orthoceras annulatum*, Hall, 20th Reg. Rep., revised edition, p. 411, pl. xxiv. ff. 2-4.
1875. *Orthoceras annulatum*, Hall & Whitfield, in Newberry's Geol. Surv. of Ohio, vol. ii. pt. ii. p. 147, pl. ix. f. 1.
1882. *Orthoceras annulatum*, Whitfield, in Chamberlin's Geol. Surv. of Wisconsin, vol. iv. pt. iii. p. 298, pl. xix. f. 1.
1884. *Orthoceras annulatum*, Whiteaves, Palæozoic Fossils, vol. iii. pt. i. p. 33.

I think that there exist sufficiently well-marked characters in the American form of *O. annulatum* to make it desirable to separate it from the European one, and, accordingly, I propose the above designation for it.

The characters by which the variety *Americanum* is distinguished from its European allies reside in the surface ornaments. These consist of transverse elevations, partaking more of the nature of undulations than of ribs, and becoming in some places indistinct, or even obliterated. The undulations are generally wider than the spaces separating them, being at a distance of about $\frac{1}{6}$ the diameter. The fimbriæ are coarse, as in the variety *crassum*, but with their arches or festoons much wider apart. Three or four only occupy the spaces between the undulations. The longitudinal elevations are sometimes so strong as to cause a nodose appearance; but this is not always the case, as I have a specimen before me in which they are very obscure. The rate of tapering in a somewhat flattened example from Canada, measured along its broader diameter, is 1 in 17.

Horizon. Niagara Group (Wenlock).

Localities. Canada; Lockport, New York State; Ripley County, Indiana. The specimen from Canada was presented by the late Dr. J. J. Bigsby, F.R.S.

Var. **fimbriatum**, Salter.

1839. *Orthoceras fimbriatum*, Sowerby, in Murchison's Sil. Syst. p. 632, pl. xiii. f. 20.
1854. *Orthoceras annulatum*, var. *fimbriatum*, Salter, in Murchison's 'Siluria,' p. 232, pl. xxvi. f. 2.
1868. *Orthoceras annulatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. p. 308, pl. cxcxi. ff. 7, 8, 10-14, pl. ccccxli. f. 1.

1873. *Orthoceras annulatum*, var. *fimbriatum*, Salter, Cat. Cambr. and Sil. Foss. p. 158.

1882. *Orthoceras fimbriatum*, Blake, British Foss. Ceph. pt. i. p. 115, pl. viii. ff. 1, 3 (not f. 2).

This variety is distinguished from the species by superficial characters. Whereas in the latter the transverse ribs predominate, in the variety the longitudinal elevations come into prominence, though I have not seen any specimens in which the transverse annulations are wholly suppressed. The arches or festoons of the fimbriæ lie, as a rule, if not invariably, in the shallow furrows between the longitudinal flattish elevations. The fimbriæ do not differ materially in character from those of the species.

I am not prepared, without more satisfactory evidence than is at present available, to accept the conclusion come to by Messrs. Salter and Blake that *O. Brightii*¹, Sow., is identical with the present variety. None of the specimens of *O. Brightii* that I have seen, either in the National Collection or in the Museum of Practical Geology, show the slightest vestige of the test, its position being indicated only by a very thin dark line, the whole of the interior of the shell, except the siphuncle, being filled with crystalline calcite.

Horizon. Wenlock Shales, Upper Ludlow (Salopian and Down-tonian).

Localities. *British.* Dudley, Worcestershire.—*Foreign.* Wisby, Island of Gothland, Sweden.

Var. **subtile**, var. nov.

This differs from the last, to which, however, it is closely allied, in the extreme fineness of the fimbriæ. Faint annulations occur at tolerably regular intervals of about $3\frac{1}{2}$ to 4 lines. The fimbriæ are more crowded upon the annulations than they are in the interspaces, just as is the case in *O. annulatum*. Longitudinal elevations are always present as in the latter.

There is an intermediate form in which the fimbriæ are neither so coarse as in the variety *fimbriatum*, nor so fine as in the one under discussion. Its affinities seem to be, on the whole, rather with the latter: it is represented in the Collection by a specimen from the Island of Gothland, and by another from Dudley.

Horizon. Wenlock Shales, Upper Ludlow (Salopian and Down-tonian).

Localities. *British.* Dudley, Worcestershire; Herefordshire (?).—*Foreign.* Wisby, Island of Gothland, Sweden.

¹ Sowerby, in Murchison's Sil. Syst. p. 626, pl. xii. f. 21.

Orthoceras Bohemicum, Barrande.

1855. *Orthoceras Bohemicum*, Barrande, Bull. Soc. Géol. France, 2^e sér. tom. xii. p. 450.
1857. *Orthoceras Bohemicum*, Meneghini, Paléont. de l'Île de Sardaigne, p. 117, pl. C. ff. 6, 6 a, 6 a'.
1866. *Orthoceras Bohemicum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 315, pl. cxxiv. ff. 11-13, pl. cxxv. ff. 8-11, pl. cclxxxviii., pl. cclxxxix. ff. 7, 8, pl. cccx. ff. 16-19.

Sp. Char. Section circular in the majority of specimens, but in some a little elliptical. Rate of increase about 1 in 7, but very variable. Body-chamber attains a length equalling 5 or 6 times the diameter of its base. The septa are distant about $\frac{2}{3}$ the diameter, with a convexity of about $\frac{1}{3}$; they are regular and horizontal. Siphuncle central, or but very slightly eccentric. Surface with broadly rounded oblique annulations, separated by spaces as wide as they; these annulations completely disappear upon the dorsal side of the shell and upon its basal extremity (*cf. O. dimidiatum, loc. cit.* p. 52). The surface of the test is covered with fine striæ running parallel to the annulations. Sometimes feebly marked longitudinal striæ are to be seen.

Remarks. The siphuncle in the Bohemian form is somewhat smaller, relative to the shell-diameter, than it is in the Sardinian one, the ratio of the former being as 1 : 10, that of the latter as 1 : 7.

This species has a wide geographical distribution. M. de Verneuil, in a communication to the Geological Society of France (Feb. 1850), cites it from the basal deposits of the Silurian at St. Béat (Hautes-Pyrénées), giving a description of its salient characters. It has also been found in the Province of Gerona (Northern Spain¹) and in Sardinia.

Horizon. Étage E, band e 2 (=Salopian).

Localities. Hinter-Kopanina, Karlstein, Dworetz, Bohemia.

Represented by very fine specimens.

Orthoceras subannulare, Münster.

1840. *Orthoceratites subannularis*, Münster, Beitr. z. Petref. Heft iii. p. 99, Taf. xix. f. 3.
1852. *Orthoceras (Cycloceras)? subannulatum*, M'Coy, British Pal. Foss. fasc. ii. p. 320.
1866. *Orthoceras subannulare*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 343, pl. ccx. ff. 8-10, pl. ccxii. ff. 14-18, pl. ccliii. ff. 11-14, pl. cclxxxiii. (except ff. 11, 12[?]), pl. cccxxiii.

¹ Lucas Mallada, "Fósiles de España," Bol. Com. del Mapa Geol. de España, 1875, tom. ii. p. 25.

- ff. 15-19, ? pl. cccxxxvi. ff. 17-21, 30-32, ? pl. cccxcix. ff. 20-22, pl. ccccxlv. ff. 6-8, pl. ccccli. ff. 4-11, pl. cccclx. ff. 4-10.
1870. *Orthoceras subannulare*, Barrande, Distrib. des Céph. dans les Contrées Siluriennes, p. 50 (Extrait du Syst. Sil. de la Bohême, vol. iii. 4me sér. pls. cccli. à cccclx.).
1873. *Orthoceras subannulare*, Salter, Cat. Camb. and Sil. Foss. p. 159.
1876. *Orthoceras subannulare*, Tromelin & Lebesconte, Assoc. Franç. pour l'avancement des Sciences, 4me sess. (Nantes), p. 621, Tableau D, numéro 33.
1882. *Orthoceras subannulare*, Blake, British Foss. Ceph. pt. i. p. 94, pl. v. ff. 6, 6 a.

Sp. Char. Shell straight, or very slightly curved in some specimens. The section is always circular. Rate of increase about 1 in 10. Body-chamber not known in the adult, but in an immature individual it measured four times the diameter of the base, or about $\frac{1}{3}$ the total length of the shell. The septa are widely separated, having a maximum width of about $\frac{2}{3}$ that of the shell. The siphuncle is generally a little eccentric, part of it, however, always touching the central axis. The surface of the shell is variable, the ornaments consisting mainly of more or less prominent rounded sinuous annulations upon the greater part of the shell; their direction is oblique about 12° . The surface of the test is covered with very regularly disposed transverse striae, imbricating upwards; about ten of them can generally be counted from summit to summit of the annulations.

Remarks. This species was founded by Münster upon very imperfect specimens, and we must therefore turn to the large series figured by Barrande, and to the Bohemian and other examples in the National Collection, to supply the material for its more complete study.

We learn from these that the species is liable to considerable variation in its surface characters. While in some cases the undulations are well-marked, in others they almost totally disappear, though there are not wanting transitional forms connecting these two extremes.

Examples showing the absence of undulations are figured by Barrande (pl. ccccli. ff. 4, 8), and there are also specimens in the National Collection in which the undulations are extremely feeble. The typical form, as described and figured by Münster, was marked by flattish undulations, and the British examples are similarly characterized, the undulations being by no means so strong as they are in some Bohemian examples, which make an approach towards *O. dulce* in the sharpness and prominence of their rings. M'Coy gives us important testimony as regards the identity of the British species with Münster's; he says, "On comparison with authentic

specimens of Count Münster's species from his locality of Elbersreuth, I can find no difference on the most careful comparison between them and our Silurian specimens. I find that his species has the section not circular, but slightly oval as in ours, and the siphon not perfectly central. The species, as he notices, is easily distinguished from the *Orthoceras annulatum* of Sowerby by the very much flatter and more approximate rings." A slight discrepancy may be pointed out between Münster's and McCoy's descriptions of *O. subannulare*; the former states that the siphuncle is "always central, never eccentric;" while McCoy describes it in his specimens as "very slightly eccentric," which is the case also with the Bohemian examples. A specimen figured by Portlock¹ and referred by him to the present species, appears to be too imperfect for identification.

A fragment in the Collection from the "Calcaires ampéliteux" (carbonaceous limestone) of Feuguerolles (Calvados) belongs to this species. Several of Barrande's species of the Third Fauna have been recognized in these beds by MM. Tromelin and Lebesconte (*loc. cit.*), who enumerate the following in addition to *O. subannulare*, viz.:—*O. hostile*, *O. lancea*?, *O. originale*, *O. pleurotomum*, *O. severum*?

Horizon. Wenlock Shales [England]. Étage E. bande e 2 (=Salopian) [Bohemia]. Calcaires ampéliteux (=Third Fauna of Barrande) [France].

Localities. *British.* Dudley, Worcestershire.—*Foreign.* Hinter Kopanina, Dlauha Hora, Lochkow, Bohemia; Feuguerolles (Calvados), France.

Well represented in the Collection.

Orthoceras dulce, Barrande.

1868. *Orthoceras dulce*, Barrande, Syst. Sil. de la Bohême, vol. ii.

Texte iii. 1874 (janvier), p. 321, pl. cxciv. ff. 4-8 and 10-14, pl. cxcv. ff. 1-3, 6-25, 27, and 29, pl. cccclxxxviii. case v. ff. 1-3.

1877. *Orthoceras dulce*, Barrande, *ibid.* Suppl. et Sér. tardive, p. 207, pl. dxi. ff. 11-14.

Sp. Char. Shell invariably curved in some part of its length. Section always circular. Rate of increase very slow, about 1 in 16, but reduced to almost zero in the body-chamber. The extent of the latter is not exactly known, owing to the extreme fragility of the shell. The septa are distant about $\frac{1}{4}$ the diameter. The siphuncle is central. The surface is ornamented with very prominent annulations, the spaces separating them being about equal to the latter. The annulations are generally a little oblique. Furthermore, the whole of the surface of the test is covered with transverse striæ, very

¹ Report on the Geol. of Londonderry, &c. by J. E. Portlock, 1843, p. 368, pl. xxv. f. 8.

regularly disposed and close-set. Longitudinal striæ are also observable, and these when very strongly marked have led to the separation of a varietal form (*O. cælebs*) from the main group.

Remarks. This species is closely allied to *O. Hisingeri*, Boll, as pointed out by Barrande, but the latter has a more robust habit, and the ribs are sharper, more prominent, and wider apart than they are in *O. dulce*. According to M. Barrande, *O. Hisingeri* lessens in its diameter towards the aperture, which *O. dulce* does not do.

Horizon. Étage E, bande e 2 (=Salopian).

Localities. Lochkow, Dlauha Hora, Wiskočilka, Bohemia.

Well represented in the Collection.

Var. **omega**, Barrande.

1868. *Orthoceras dulce*, Barrande, var. *omega*, Barr. Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 321, pl. cxciv. ff. 1-3.

1878. *Orthoceras dulce* (?), Kayser, Abhandl. zur geologisch. Spezialkarte von Preussen, Band ii. Heft 4, p. 78, Taf. xx. ff. 17, 17 a.

This variety is remarkable for the finely crenulated character of its transverse lines. In this it resembles *O. Hisingeri*, but the striæ are much closer together and more strongly crenulated than they are in that species. In other characters there is nothing to separate this variety from *O. dulce*.

I think there can be little doubt that Kayser's form is identical with the present one. He describes it as having crowded, wavy, lamellose, transverse striæ, which he figures. His specimen is a fragment, partly buried in the matrix.

Horizon. Étage E, bande e 2 (=Salopian).

Localities. Karlstein, Dworetz, Bohemia.

Orthoceras pseudo-calamiteum, Barrande.

1852. *Orthoceratites pseudo-calamiteus*, Quenstedt, Handb. der Petrefaktenkunde, p. 342, tab. xxvi. f. 8.

1868. *Orthoceras pseudo-calamiteum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 261, pl. ccxvii. f. 8, pl. ccxxii. ff. 11, 12, pl. cclxxviii., pl. cclxxxvi. ff. 11-16, pl. cclcx. ff. 15-17.

Sp. Char. Shell straight. Section circular. Rate of increase very slow; about 1 in 24. Body-chamber imperfectly known. Distance between the septa slowly and regularly increasing to a maximum of $\frac{1}{5}$ the diameter. Siphuncle central. Ornaments of the surface consisting primarily of prominent and regularly disposed horizontal annulations, each corresponding to one of the air-chambers. The spaces separating the annulations are concave and wider than the rings. The annulations are distant about $\frac{2}{7}$ the diameter, but this distance increases in adult specimens to nearly $\frac{1}{4}$. Acute and very prominent lamellose riblets run longitudinally throughout the

whole extent of the shell, crossing the annulations and their inter-spaces, so that the whole surface has the appearance of a lattice-work. Between these riblets 1 or 2 much finer ones are occasionally developed. Lastly, fine and regularly disposed, horizontal, thread-like lines are placed in the intervals of the longitudinal riblets. The whole forms a striking and beautiful system of ornamentation, making the smallest fragments of the shell easily recognizable.

Remarks. A brief description and a good figure of this species were given by Quenstedt (*loc. cit.*), who adopted the name proposed for it by Barrande, to whom it had long been known in the environs of Prague.

Horizon. Étage F, bande f2 (= Downtonian¹)

Localities. Konieprus, Prague, Bohemia.

Well represented in the Collection.

Orthoceras pulchrum, Barrande.

1886. *Orthoceras pulchrum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 264, pl. cexxii. ff. 19, 20, pl. cclxxvii., pl. cccclvi. ff. 7-11.

Sp. Char. Shell perfectly straight. Section circular. Rate of increase very gradual, about 1 in 15. Body-chamber only imperfectly known, but evidently very long, its length in a specimen measured being equal to $6\frac{1}{2}$ times the diameter of its base. Septa slowly and regularly increasing to a distance equivalent to $\frac{1}{4}$ the diameter of the shell. Siphuncle central. Shell ornamented for the greater part of its length with transverse, sometimes a little oblique, annulations, varying in their distance apart in different individuals, but generally their distance is equal to $\frac{1}{4}$ the diameter of the shell. These are traversed longitudinally by fine, rather closely placed riblets, about 3 of which are contained in the space of 1 line. Between these there are very fine and regular transverse lines, which can only be seen with the assistance of a lens.

Remarks. This species is closely allied to two others from the same horizon in Bohemia, viz. *O. pseudo-calamiteum*, Barr., and *O. patronus*, Barr. From the first of these it differs in having a much larger siphuncle, and in the closer approximation of the longitudinal riblets. From the second it is separated by its much slower rate of tapering, larger siphuncle, and by the character of its ornamentation. In *O. patronus* the longitudinal riblets are much

¹ Mr. J. E. Marr correlates Étage F with the Downtonian Series, or passage beds between the Silurian and Devonian Systems. "The absence of Graptolites and the presence of fish bear out this view, as well as the abundance of large Pentameri and the presence of Goniatites." ("Classification of the Cambrian and Silurian Rocks," p. 98.)

wider apart, and the annulations are less salient than they are in *O. pulchrum* and they also become obsolete towards the aperture.

All these species are remarkable for the singular beauty of their ornamentation, which is, however, paralleled by that of other species in the Devonian rocks above them, to some of which they are closely related¹.

Horizon. Étage F, bande f 2 (= Downtonian).

Locality. Konieprus, Bohemia.

Represented by two examples.

Orthoceras Hisingeri, Boll.

1831. *Orthoceratites annulatus*, Hisinger, Anteckn. i Physik och Geognosie, Häftet 5, p. 112, tab. iv. f. 5.

1837. *Orthoceratites annulatus*, Hisinger, Lethæa Svecica, p. 29, tab. ix. f. 8. [Not *Orthoceras annulatum*, Sow.]

1857. *Orthoceras Hisingeri*, Boll, Archiv des Ver. der Freunde der Naturg. in Mecklenburg, Jahrg. xi. p. 18, Taf. v. f. 13.

1857. *Orthoceras Gottlandicum*, Boll, *ibid.* p. 19, Taf. v. f. 14.

1870. *Orthoceras Hisingeri*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 700, pl. ccccxli. ff. 17-19.

[Not 1851. *Orthoceras Hisingeri*, Marie Rouault, Bull. Soc. Géol. de France, sér. 2, tom. viii. p. 360.—1870. *Orthoceras Gothlandicum*?, Barrande, *loc. cit.* p. 699, pl. ccccxli. ff. 14-16 (not f. 13).]

Sp. Char. Shell straight. Section circular. Rate of increase very slow, about 1 in 23. Body-chamber very long, more than 4 times the diameter of the base. Septa at frequent intervals; distant about $\frac{2}{7}$ the diameter. Siphuncle central. Surface with very strong subangular annulations, situated midway between the septa, and divided by concave interspaces. The annulations are as strong upon the cast of the shell as they are upon the testaceous portions. The surface of the test is covered with fine, transverse crenulated striæ, about 18 or 20 of which occupy 1 line; they are more crowded upon the ribs than between them.

Remarks. The affinities subsisting between this species and *O. dulce*, Barr., have already been pointed out. It is sufficiently distinguished from *O. ibex* by the sculpture of its test.

I am indebted once more to the kindness of Dr. Lindström in supplying me with some valuable notes on the present species. In sending me a little sketch of the minute sculpture of the test of *O. Hisingeri*, he remarks that Barrande's figures (*loc. cit.* pl. ccccxli. ff. 17-19) represent a specimen "somewhat deviating from those

¹ Cf. e. g. *Orthoceras tenuilineatum*, Sandb. Verstein. Nassau, 1856, p. 168, Taf. xix. f. 7.

commonly found in Sweden." "The ribs," he continues, "are very seldom so much oblique in my numerous specimens, nor are the striæ of the shell so closely set as in his [Barrande's] specimens." Dr. Lindström adds: "*O. Gotlandicum*, Boll, is only the chambered portion of *O. Hisingeri*." (Fig. 6.)

In this opinion I fully concur with him, and I have therefore included the former species in the list of synonymy above.

Horizon. Upper Ludlow.

Locality. Island of Gothland, Sweden.

Fairly well represented in the Collection.

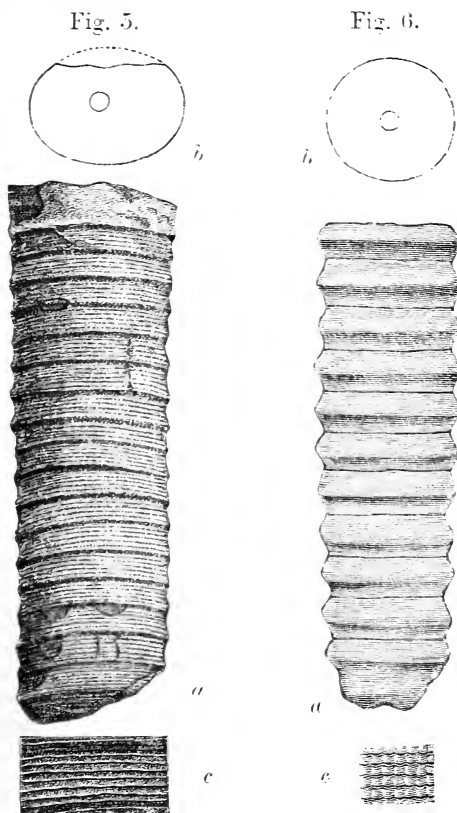


Fig. 5. *Orthoceras ornatum*.—*a*, specimen with some of the test adherent; *b*, section with siphuncle; *c*, portion of the test enlarged.

Fig. 6. *Orthoceras Hisingeri*.—*a*, cast of the septate portion of the shell; *b*, section with siphuncle; both of the natural size; *c*, portion of the test, magnified¹.

¹ From a drawing obligingly sent to me by Dr. Lindström.

Orthoceras ornatum, Boll.

1857. *Orthoceras ornatum*, Boll, Archiv für Mecklenburg, xi. Jahrg. p. 20, Taf. v. f. 16, a, b.
 1869. *Orthoceras ornatum*, Heidenhain, Ueber Graptolithen führende Diluvial-Geschiebe der norddeutschen Ebene, p. 24.
 1870. *Orthoceras tenerum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 708, pl. ccccxli. ff. 6-12.
 ? 1878. *Orthoceras* sp. [*ornatum*?, Boll], Haupt, Die Fauna des Graptolithen-Gesteines, p. 52.

Sp. Char. Section probably circular, though often appearing elliptical by compression. Rate of increase 1 in 13. Length of body-chamber not accurately known, but in a fragment it measures more than 3 times the diameter of the base. The septa are distant about $\frac{1}{6}$ the longer diameter, near the base of the body-chamber. The siphuncle appears to be eccentric. The ornaments consist of prominent, rounded, transverse undulating annulations, about 2 lines distant from each other, measured from summit to summit. Between and on these there are fine simple striæ, 4 or 5 of which lie in the spaces between the annulations, and 3 or 4 upon them; all being about equidistant. The striæ are slightly undulating, following the contour of the ribs. (Fig. 5.)

Remarks. This species differs from *O. annulatum*, Sow., and its varieties, to which it is doubtless closely allied, by the closer proximity of its annulations, the absence of longitudinal elevations, and the greater width separating the striæ, and also by the absence of crenulations in the latter.

Horizon. Upper Ludlow.

Locality. Island of Gothland, Sweden.

Well represented in the Collection by a series of specimens presented by A. H. Foord.

Orthoceras virgatum, Sowerby.

1839. *Orthoceras virgatum*, Sowerby, in Murchison's Sil. Syst. p. 620, pl. ix. f. 4.
 1852. *Orthoceras angulatum*, M'Coy, British Pal. Foss. fasc. ii. p. 313.
 1854. *Orthoceras angulatum*, Salter, in Murchison's Siluria, pl. xxviii. f. 4.
 ? 1854. *Orthoceras angulatum*, Morris, Cat. British Foss. 2nd ed. p. 309.
 1882. *Orthoceras angulatum*, Blake, British Foss. Ceph. pt. i. p. 106, pl. vii. ff. 1, 3, 3a. (Not ff. 4, 8, 9.)
 [Not 1852. *Orthoc. virgatum*?, Hall, Pal. of New York, vol. ii. p. 219, pl. lxiii. ff. 2, 3.]

Sp. Char. Section elliptical, the ratio of the two diameters in a specimen less compressed than is usually the case being as 6:8. The rate of increase cannot be accurately determined for the whole shell, but for the body-chamber it appears to be about 1 in 7. The body-chamber was apparently short, probably not exceeding twice the basal diameter, but it is not perfect enough to determine its length. The septa, at least those near the body-chamber, are approximate, being about $\frac{1}{8}$ the diameter distant from each other. The shell seems to have had a slight constriction near the aperture. The siphuncle is a little eccentric, situated about $\frac{2}{5}$ across the longer diameter, and obscurely beaded.

All the specimens known are crushed casts, so that the finer ornamentation of the test can rarely be made out. The coarser consists of longitudinal, parallel ribs separated by shallow, concave interspaces, the whole giving a fluted appearance to the casts. These ridges vary in their distance apart, but there are usually from 30 to 35 in specimens whose broadest diameter is from 1 to $1\frac{1}{4}$ inch.

The finer ornaments (which I have only seen distinctly upon a specimen in the Museum of the Geological Society of London) consist of exceedingly fine transverse arched striæ between the ribs, visible only with the aid of a lens. I have not observed any trace of smaller ridges between the large ones above described.

Remarks. Many examples of this species consist only of the body-chamber, worn down at the base in a very peculiar manner to a conical point. In some specimens the siphuncle remains, denuded of the shell, or with only traces of it crushed in the matrix.

Horizon. Wenlock Shales, Aymestry Limestone, Upper Ludlow.

Localities. Walsall, Staffordshire; Dudley, Worcestershire; Woolhope, Herefordshire; Presteign, Radnorshire; Broseley, Shropshire.

Well represented in the Collection.

Orthoceras canaliculatum, Sowerby.

1839. *Orthoceras canaliculatum*, Sowerby, in Murchison's Sil. Syst. p. 632, pl. xiii. f. 26.

1854. *Orthoceras canaliculatum*, Salter, in Murchison's Siluria, p. 232, pl. xxviii. f. 3.

1868. *Orthoceras doricum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 242, pl. cclxix.

? 1869. *Orthoceras canaliculatum*, Heidenhain, Ueber Graptolithen führende Diluvial-Geschiebe der norddeutschen Ebene, p. 22.

? 1878. *Orthoceras canaliculatum*, Haupt, Die Fauna des Graptolithen-Gesteines, p. 55.

1882. *Orthoceras angulatum*, Blake, British Foss. Ceph. pt. i. p. 106, pl. vii. ff. 4, 8, 9.

Sp. Char. Shell straight or slightly curved. Section circular. Rate of increase about 1 in 8. Body-chamber not precisely known from the British examples, but in the Bohemian ones it attains a length equivalent to about twice the diameter of its base. Septa distant about $\frac{1}{5}$ the diameter of the shell. Siphuncle central. The principal ornaments consist of a series of prominent longitudinal ribs upon the surface of the shell, which are sufficiently strong to mark the cast very distinctly. Between these, very fine riblets or raised thread-like lines are sometimes, but not always present. Between the ribs there are fine transverse arched striæ which pass over the riblets when these are present. In a Bohemian specimen having a diameter of 14 lines the ribs have a maximum distance of 2 lines, and in a British example with a diameter of 10 lines they are from $1\frac{1}{4}$ to $1\frac{1}{2}$ line apart. The finer ornaments of the test do not appear to have been preserved in any British specimens.

Horizon. Wenlock Shales. Étage E, bande e 2 (=Salopian).

Localities. *British.* Ledbury, Herefordshire.—*Foreign.* Wis-kočilka, Bohemia. A fine specimen from the Lower Ludlow, at Usk, Monmouthshire, has been presented to the Museum by J. E. Lee, Esq., F.S.A., F.G.S.

Var. **spectandum**, Blake.

1882. *Orthoceras filosum*, Sow., var. *spectandum*, Blake, British Foss. Ceph. pt. i. p. 114, pl. vii. f. 12.

The ornamentation of this variety connects it, in my judgment, rather with that group of species (of which *O. canaliculatum* is amongst the number) which centres around *O. angulatum* than with *O. filosum*. From the latter it differs in having smaller (riblets) alternating with the larger ribs, a feature which at once reminds one of *O. angulatum* and its congeners. It resembles *O. spectandum*, Barrande, in the fineness of its ribbing, and in the possession of transverse striæ, which are rarely present in *O. filosum*. On the whole, therefore, I think the place of this interesting variety is near to *O. canaliculatum*.

The specimen in the National Collection is a fragment of the test.

Horizon. Wenloek Shales.

Locality. Gaercod, Monmouthshire. Presented by J. E. Lec, Esq., F.S.A., F.G.S.

Orthoceras Bronni, Barrande.

1868. *Orthoceras Bronni*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 239, pl. celviii. ff. 1-9.

Sp. Char. Shell slightly curved in the young. Section circular. Rate of increase from about 1 in 5 to 1 in 8. Length of body-chamber about three times the diameter of its base. Septa distant about $\frac{1}{2}$ the diameter of the shell. Siphuncle eccentric, placed about midway between the centre and the margin. In the young the surface is ornamented with horizontal annulations, not very prominent, but quite distinct; these become gradually obsolete as the shell increases. The principal ornamentation of the test, however, consists in numerous longitudinal ribs, about 34 in the circumference of the shell, and about $\frac{3}{4}$ of a line distant from each other, where the shell has a diameter of 10 lines. The space which separates the longitudinal ribs is nearly double the breadth of the ribs themselves, and is rather deeply concave. The spaces are crossed by fine horizontal striæ, and these again by fine, longitudinal riblets. None of these finer ornaments are preserved in the British example, which, being a cast, retains only the longitudinal ridges and annulations.

Remarks. This species is distinguished from *O. virgatum*, Sow., by the annulations in the young shell and by the shell-sculpture.

Horizon. Wenloek Shales. Étage E, bande e 2 (=Salopian).

Localities. *British.* Dudley, Worcestershire.—*Foreign.* Kosorž, Bohemia.

Fairly well represented in the Collection.

Orthoceras angulatum, Wahlenberg.

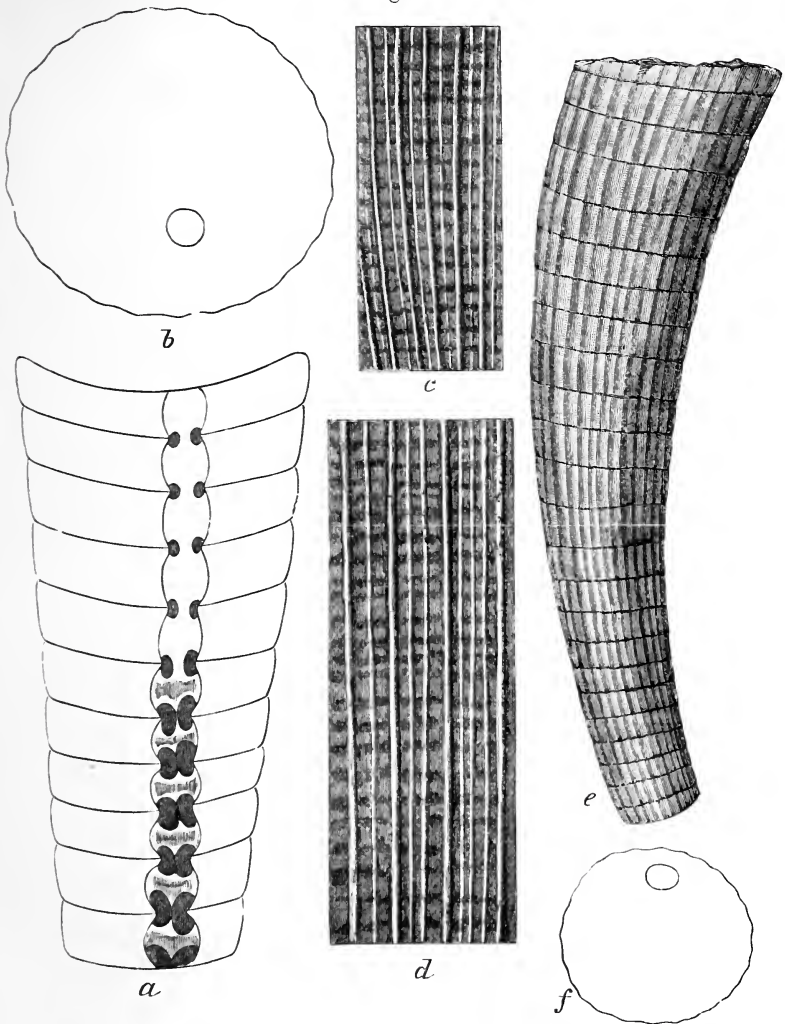
1731. Species ii. (*Sulcuti*). *Major* [and *Minor*]; *Gothlandicus, superficialis bis novies sulcata: Siphone inter centrum & peripheriam*. . . Klein, Descrip. tubulorum marinorum, p. 10, tab. v. ff. 8, 9.
1732. Species v. *Orthoceratites siphunculo inter centrum & peripheriam sito graciliori*, &c., Breynius, Dissertatio physica de Polythalamiis, p. 34, tab. vi. ff. 3-5.
1821. *Orthoceratites angulatus*, Wahlenberg, Nova Acta Reg. Soc. Scient. Upsaliensis, vol. viii. p. 90.
1831. *Orthoceratites angulatus*, Hisinger, Anteckn. i Physik och Geognosie, Häftet v. p. 112, tab. iv. f. 8.
1837. *Orthoceratites angulatus*, Hisinger, Lethæa Svecica, p. 28, tab. 10. f. 1.

1857. *Orthoceratites angulatum*, Boll, Archiv für Mecklenburg, xi. Jahrg. p. 24, Taf. vii. f. 21.
1866. *Orthoceras angulatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 692, pl. ccxxxiii. ff. 1-3.
1866. *Orthoceras Bacchus*, Barrande, ibid. p. 237, pl. ccxiii. ff. 10-13, pl. cclxx., pl. cclxxi. ff. 1-21.
1868. *Orthoceras ponderosum*, Barrande, ibid. p. 213, pl. cclxvi. ff. 1, 2, pl. cclxxi. ff. 22, 23.
- ‡ 1873. *Orthoceras angulatum*, Salter, Cat. Cambr. & Sil. Foss. p. 158.
- ‡ 1882. *Orthoceras Bacchus*, Blake, British Foss. Ceph. pt. i. p. 111, pl. ix. ff. 3-7.
- [Not 1867. *Orthoceras angulatum*, Hall, 18th Reg. Rep. p. 353, pl. xix. (x.) ff. 10, 11.—1875. *Orthoceras angulatum*, Worthen & Meek, in Worthen's Geol. Surv. of Illinois, vol. vi. pt. 2, Palæont. p. 504, pl. xxiv. ff. 8, 8a.—1882. *Orthoceras angulatum*, Blake, loc. cit. p. 106, pl. vii.]

Sp. Char. Shell slightly curved. Section circular, or very slightly elliptical. Rate of increase 1 in 5. Length of the body-chamber $2\frac{1}{2}$ times its basal diameter. Septa about $\frac{1}{5}$ the diameter of the shell. Siphuncle variable in position, generally about midway between the centre and the margin, but sometimes still nearer the centre. Surface ornamented with prominent, acute, longitudinal ribs (from 26 to 30 in a circumference) which conform to the conical growth of the shell, slowly increasing in their distance from each other as the latter expands. Between these there are from one to three prominent acute riblets or thread-like lines, running parallel to the ribs. The latter are always present in casts, but the riblets are too fine to leave any traces beneath the test. Feeble transverse annulations may be seen in well-preserved examples of the young shell, crossing the longitudinal ornaments at right angles.

Remarks. Finding the nomenclature of this species in a very unsatisfactory state, owing to the different interpretations put upon Wahlenberg's description, I communicated with Dr. Lindström, of Stockholm, with a view to ascertain whether any of Wahlenberg's original types of *O. angulatum* still existed in the Palæontological Museum of Upsala. He informs me in reply that he has lately inspected an old collection of fossils in the University of Upsala called the "Marklin Collection," a gift to the University on the part of Marklin, a contemporary of Wahlenberg. In this collection Dr. Lindström found specimens named *O. angulatum*, such as the Swedish palæontologists have been accustomed to recognize under that name, stating that, 'in his opinion, Hisinger's, as well as Marklin's interpretation of *O. angulatum*, expresses what Wahlenberg, the author of the species, implied in his description of it.

Fig. 7.



*Orthoceras angulatum*¹.—*a*, section showing siphuncle with organic deposits (dépôts organiques) at the necks of the septa, which form obstruction-rings (anneaux obstruc-teurs) in the lower half of the specimen: natural size; *b*, section showing siphuncle, natural size; *c*, surface of test, of the natural size; *d*, from a plaster cast of the surface of a larger specimen than *c*, showing a greater number of intermediate longitudinal ribs; *e*, figure of a very fine specimen, half the natural size, part of the test is preserved upon the inner curvature of the shell; *f*, section showing submarginal siphuncle, natural size (cf. position of siphuncle in fig. *b*).

¹ Figures *c* and *d* are engraved from Swedish specimens kindly supplied to the writer by Dr. Lindström, and now in the National Collection.

With this view I do not hesitate to concur, and in further support of it I may mention the following facts. I have ascertained by means of natural and artificial sections that the siphuncle in this species deviates gradually from a position close to the margin in the young shell to one nearer the centre as growth advances. These two positions of the siphuncle are shown in fig. 7, *b* and *f*. This may account for Wahlenberg's statement that his species has a central siphuncle. In the very figures, moreover, to which he refers in his description, viz. those of Klein (*loc. cit.*), the siphuncle is represented, not as central, but exactly in the position it occupies in fig. 7, *b*.

Horizon. Étage E, bande *e* 2 (= Salopian). Upper Ludlow (Sweden).

Localities. Wiskočilka, Bohemia; Island of Gothland, Sweden.

Well represented in the Collection.

Orthoceras filosum, Sowerby.

1839. *Orthoceras filosum*, Sowerby, in Murchison's Silurian System, p. 620, pl. ix. f. 3.

1852. *Orthoceras filosum*, M'Coy, British Pal. Foss. fasc. ii. p. 314.

1854. *Orthoceras filosum*, Salter, in Murchison's Siluria, p. 231, Foss. 44. f. 1.

1873. *Orthoceras filosum*, Salter, Cat. Cambr. and Sil. Foss. p. 173.

1882. *Orthoceras filosum*, Blake, British Foss. Ceph. pt. i. p. 113, pl. x. ff. 8, 9.

[Not 1880. *Orthoceras filosum*, L.-G. de Koninck, Faune du Calcaire Carbonifère de la Belgique, in Ann. du Musée Royal d'Hist. Nat. de Belgique, tome v. p. 58, pl. xxxviii. f. 7, pl. xlv. f. 1.]

Sp. Char. Shell slightly curved. Section circular, though generally compressed. Rate of increase from 1 in 5 to 1 in 12 in the body-chamber. The latter attains to a length equal to 4 times the diameter of its base. The septa are direct, and distant about $\frac{2}{7}$ the diameter at the smaller end, but become closer near the body-chamber. The siphuncle is central. The ornaments consist of longitudinal riblets upon the flat surface of the shell, so close together as to number 142 in the circumference of a small specimen and 115 in that of a large one. Their distance in the former is $\frac{1}{2}$ a line, in the latter 1 line. There are no intermediate ornaments.

Remarks. This species attains a large size. One in the British Museum is 1 foot in length, but Professor Blake records an example in the Ludlow Museum over 2 feet in length.

Horizon. Wenlock Limestone; Lower Ludlow.

Localities. Dudley, Worcestershire; Mocktree Forest, Leintwardine, Herefordshire.

Well represented in the Collection.

Orthoceras Lindströmi, Barrande.

1870. *Orthoceras Lindströmi*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 703, pl. ccccxli. ff. 20, 21.

Sp. Char. Section apparently elliptical. Rate of increase not accurately ascertainable, but it is 1 in 8 in the fragment before me. Dimensions of body-chamber unknown. Septa apparently strongly arched. Siphuncle unknown. Surface ornamented with longitudinal, irregular, close-set parallel riblets, from 1 to $\frac{1}{2}$ a line distant, with fine transverse arched striæ between them.

Remarks. This species is known only by fragments of the body-chamber, generally much crushed and distorted. The ornamentation is very similar to that of *O. spectandum*, Barrande; but the latter is a much more slender species, and has a circular section.

Horizon. Upper Ludlow.

Locality. Island of Gothland, Sweden.

The Collection contains two specimens, presented by A. H. Foord.

Orthoceras spectandum, Barrande.

1868. *Orthoceras spectandum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 223, pl. cclxvi. ff. 5-17.

Sp. Char. Shell straight, or slightly curved. Section circular. Rate of increase 1 in 7 to 1 in 6. Length of body-chamber about 3 times the diameter of its base and about $\frac{2}{3}$ the total length of the shell. Septa distant about $\frac{1}{5}$ the diameter. Siphuncle situated about midway between the centre and the margin. Ornaments consisting of parallel, longitudinal, acute riblets, irregularly disposed, sometimes as many as 4 occupying the space of 1 line, sometimes only 2. The interspaces, which are concave, are occupied by numerous minute transverse striæ.

Horizon. Étage E, bande e 2 (=Salopian).

Locality. Hinter Kopanina, Bohemia.

Fairly well represented in the Collection.

Orthoceras dorulites, Barrande.

1868. *Orthoceras dorulites*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 186, pl. cclxviii. ff. 10-17.

Sp. Char. Shell slightly arcuate at its commencement, but afterwards straight. Section circular. Rate of increase about 1 in 4. Body-chamber not completely known, owing probably to the fragile nature of the shell, but from the largest fragments it is judged to have attained a length equal to at least twice the diameter of the

base. Septa distant about $\frac{1}{5}$ the diameter. Siphuncle central at the smaller end of the shell, but sometimes a little eccentric at a later stage of the growth. Surface ornamentation consisting of narrow grooves or impressed lines running longitudinally the whole length of the shell, with narrow, slightly raised bands between them. The intervals between the grooves are a little irregular, so that the bands are of unequal breadth; as a rule about four of the latter are contained in the space of 1 line, one much narrower than the rest being occasionally intercalated. The bands are almost flat, as in *Orthoceras originale* and *O. striato-punctatum*, described below. The surface of the bands is perfectly smooth, with the exception of some very fine transverse striæ observed in one specimen. No trace of the ornaments of the test is preserved upon the internal cast of the shell.

Remarks. Barrande compares this species with *O. planicanaliculatum*, Sandb. (Verstein. Nassau, p. 161, pl. xviii. f. 4), from the Orthoceras-Schiefer (Middle Devonian). The latter, however, has wider septa and a greater space between the bands.

Horizon. Étage E, bande e 2 (=Salopian).

Locality. Wiskočilka, Bohemia.

Fairly well represented in the Collection.

Orthoceras striato-punctatum, Münster.

1840. *Orthoceratites striato-punctatus*, Münster, Beitr. z. Petrefactenkunde, Heft iii. p. 101, Taf. xx. ff. 1-3.

1852. *Orthoceratites striato-punctatus*, Quenstedt, Handb. der Petrefactenkunde, p. 342.

1868. *Orthoceras striato-punctatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874 (janvier), p. 227, pl. cclxviii. ff. 18-24, pl. ccccx. ff. 12-16, pl. ccccxlvii. ff. 14-21.

Sp. Char. Shell straight. Section circular. Rate of increase about 1 in 6. Length of body-chamber at least 4 times the diameter of its base. Distance of septa about $\frac{1}{4}$ the diameter. Siphuncle central, cylindrical, about $\frac{1}{10}$ the diameter of the shell. Surface ornaments consisting of narrow, longitudinal grooves diverging gradually from the smaller end of the shell towards the aperture. These grooves separate a series of regular, flat bands, whose maximum width is nearly 1 line; their surface is quite smooth. The grooves, on the other hand, are each of them ornamented with a series of minute, equidistant punctures, of which about five occupy the space of 1 line; they leave no trace of their existence on the cast. The bands may be easily removed from the surface, when it is found that they are doubly convex, so that in

section they have a chain-like appearance. The position of the grooves is marked upon the cast by a series of acute raised lines.

Remarks. An examination of several Bohemian examples of this species in the National Collection has satisfied me that Barrande was correct in identifying his species with Münster's.

The latter author describes the present species as follows:—"A short, conical shell, like *O. conoideus* [Münster], from which it is distinguished essentially by the pretty markings of the external shell; this is striated from the apex to the base; the striæ are near together at the apex, getting wider apart towards the base, in proportion as the shell increases in thickness. The raised striæ alternate with furrows, in which are to be found a row of elevated points. When the outer shell is flaked off a fine, raised line is exhibited upon a smooth surface, in the place of the deep punctured line."

Münster's reference to a "row of elevated points" in the grooves between the striæ may be explained by the fact that in many specimens the external layer, when torn from the shell, leaves portions of its substance in each of the punctures, so as to give them the appearance of elevated points. Barrande figures a specimen in this condition (*loc. cit.* pl. cccclvii. f. 16). Münster's figures appear to me to give an excellent representation of the characters of this species.

Professor Blake has united *O. striato-punctatum* with *O. originale*, Barr., on the ground that the punctate grooves in the former are not of sufficient importance for specific distinction. This, however, is not the only character in which the two forms differ from each other. The bands which ornament the surface of *O. originale* are striated, whereas in *O. striato-punctatum* they are smooth. I think, therefore, that the former species should be separated from the latter, at least as a *variety*, in recognition of the above characters.

Horizon. Étage E, bande e 2 (=Salopian).

Localities. Kosořz, Lochkow, Bohemia; Elbersreuth, Bavaria.

Well represented in the Collection.

Var. **originale**, Barrande.

1865. *Orthoceras dulce*, Salter, Cat. Foss. Mus. Pract. Geol. p. 75.

[*Not of Barrande.*]

1873. *Orthoceras dulce*, Salter, Cat. Camb. and Sil. Foss. p. 159. [*Not*

of Barrande.]

1868. *Orthoceras originale*, Barrande, Syst. Sil. de la Bohême, vol. ii.

Texte iii. 1874 (janvier), p. 206, pl. cclxvii.

1882. *Orthoceras originale*, Blake, British Foss. Ceph. pt. i. p. 110, pl. vii. ff. 5, 5a, 10.

Differs from the species only in the absence of punctures in the longitudinal grooves, and in having the surface of the longitudinal bands striated transversely.

Remarks. A form resembling this was found by M. de Verneuil in the black limestones of Ogasa, Province of Gerona (Spain). L. Mallada also cites it as occurring in Spain, in association with *O. placidum*, Barr., and *O. tumidum*, Barr.¹

Horizon. Étage E, bande *e* 2 (=Salopian).

Localities. *British.* Church Hill, Worcestershire (presented by J. E. Lee, Esq., F.S.A., F.G.S.).—*Foreign.* Karlstein, Kosorž, Bohemia.

Well represented in the Collection.

Orthoceras strix, Hall and Whitfield.

1875. *Orthoceras strix*, Hall and Whitfield, Geol. Surv. of Ohio, vol. ii. pt. 2, Palæont. p. 149, pl. ix. f. 3.

Sp. Char. Shell rather large. Section elliptical. Rate of increase 1 in 6. Body-chamber unknown. Septa distant about $\frac{1}{3}$ the diameter. Siphuncle slightly eccentric. Surface of cast marked with strong longitudinal ribs, with slightly concave interspaces, giving a fluted appearance to the shell. The ribs are $3\frac{1}{2}$ lines distant at a diameter of 25 lines. Four or five longitudinal riblets occupy the interspaces, but no transverse striæ have been observed.

Remarks. *O. strix* differs from *O. columnare*, Hall² (*non* Marklin), in having less numerous ribs or flutings, and in its rate of tapering, which is more rapid than any of the forms referred to that species.

From *O. Cadmus*, Billings³, it differs in its elliptical section, bolder and less numerous flutings, and also in the finer surface ornaments, which in that species consist of "fine, transverse engirdling striæ," which are more distinct than the longitudinal ones. In most of their characters, however, the two species come very near to each other.

Horizon. Niagara Formation (= Wenlock).

Locality. Wabash, Indiana.

Represented in the Collection by a fine specimen.

Orthoceras Darwini, Billings.

1862. *Orthoceras Darwini*, Billings, Palæozoic Fossils, vol. i. p. 161.

1875. *Cyrtoceras Myrice*, Hall and Whitfield, in Geol. Surv. of Ohio, vol. ii. pt. 2, p. 149, pl. viii. f. 9.

¹ Bol. Com. del Mapa Geol. de España, 1875, tom. ii. p. 25.

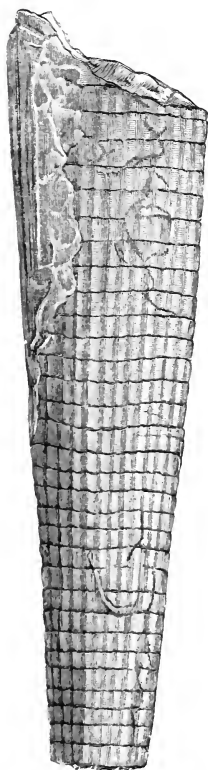
² Hall, 18th Reg. Rep. 1867, p. 351, pl. xix. ff. 4, 5, 6, 8. (The name is preoccupied, *vide* Boll, Archiv für Mecklenburg, xi. Jahrg. p. 16, Taf. i. f. 3.)

³ Sil. Foss. Anticosti, 1866, p. 83.

1878. *Orthoceras imbricatum*, Etheridge (*non* Wahlenberg), Quart. Journ. Geol. Soc. vol. xxxiv. p. 607.

1884. *Orthoceras Darwini*, Whiteaves, Palæozoic Fossils, vol. iii. pt. 1, p. 38, pl. vi. ff. 2, 2 a.—*Cyrtoceras Myrice*, Whiteaves, *loc. cit.* p. 39, pl. vi. ff. 3, 3 a.

Fig. 8.



Orthoceras Darwini.—Fragment of the septate portion of the shell, with a little of the test remaining at the upper part of the specimen. Natural size.

Sp. Char. Shell slightly curved. Section elliptical, the ratio of the two diameters as 6:7. Rate of increase, measured along the broader diameter, 1 in 6. Septa very numerous, slightly undulating, slowly increasing in distance from about $1\frac{1}{4}$ line at the narrow end to about 2 lines at the broader end of the fragment. Siphuncle central(?). Only a small fragment of the test is preserved in the specimen in the National Collection, and this shows that it was ornamented with acute longitudinal ribs, about 1 line

apart. The surface of the cast shows that these numbered about 25 in the whole circumference of the shell. None of the finer ornaments are preserved.

Remarks. I think that a comparison of the figures and description of the species enumerated above will be sufficient to prove the identity of all of them with Billings's species. The want of a figure of the latter to accompany the description probably led to its being overlooked by those who had not the opportunity of seeing the original specimen in the Museum of the Geological Survey of Canada.

Furthermore, Mr. Whiteaves observes that "the eccentricity of the siphuncle in this species [as described by Billings], the only character by which it can be distinguished from *Cyrtoceras Myrice* of Hall and Whitfield, is more apparent than real, and is probably due to distortion or to the accidental and unequal erosion of the posterior end of the specimen."

Horizon. Silurian (Niagara Formation).

Locality. Offley Island, Kennedy Channel, Arctic America (lat. 81° 16'). Represented by the type-specimen, transferred from the Museum of Practical Geology.

ADDENDA ¹.

CAMBRIAN SPECIES.

Orthoceras Olorus, Hall.

1847. *Orthoceras vertebrale*, Hall, Pal. of New York, vol. i. p. 201, pl. xliii. f. 5, a, b, c. (Changed to *Olorus*, Hall, in Miller's Cat. of Amer. Pal. Foss. 1877, p. 245.)

A very imperfect and eroded fragment has a label attached to it bearing this name in the handwriting of and initialed by J. W. Salter. It has a higher rate of tapering, and more acute and separate ribs than any examples figured by Hall; so that I think its identity with *O. Olorus* is extremely doubtful.

Horizon. Durness Limestone.

Locality. Durness, Sutherlandshire.

Represented in the Collection by a single specimen, presented by J. E. Lee, Esq., F.S.A., F.G.S.

¹ The following species were added to the Collection after the first part of the Catalogue was in type, and therefore they could not be inserted in their proper places.

ORDOVICIAN SPECIES.

Orthoceras Avelinii, Salter.

1866. *Orthoceras Avelinii*, Salter, Memoirs of the Geol. Surv. vol. iii. p. 356, pl. xi. B. f. 18.
 1872. *Orthoceras Avelinii*, Salter, in Murchison's 'Siluria,' 5th edition, p. 48, Foss. (9), f. 4.
 1875. *Orthoceras Caereesiense*, Hicks, Quart. Journ. Geol. Soc. vol. xxxi. p. 189, pl. xi. ff. 8-10.
 1882. *Orthoceras Avelinii*, Blake, British Foss. Ceph. pt. i. p. 131, pl. vi. ff. 1, 2.

Sp. Char. Shell straight. Section elliptical, the diameters being in the ratio of 8 to 7. Rate of increase 1 in 7. The ornaments in the young shell consist of "undulating rounded elevations, rising on the side of the siphuncle." The finer ornaments are upward imbrications, about 30 in the diameter of the shell, or from 4 to 8 per line, but rather irregular; they are a little oblique. The septa are parallel to them but somewhat undulating, $\frac{5}{11}$ the diameter apart, corresponding, perhaps, to the elevations. The siphuncle is $\frac{1}{3}$ across the diameter on the side to which the septa rise. (*Blake.*) Body-chamber unknown.

Remarks. *O. Caereesiense*, Hicks, is evidently only a crushed and flattened form of this species, as observed by Prof. Blake.

Horizon. Lower Llandeilo.

Locality. Cefn Gwynlle Mine, Shelve, Shropshire.

Fairly well represented in the Collection by specimens presented by J. E. Lee, Esq., F.S.A., F.G.S.

Orthoceras audax, Salter.

1866. *Orthoceras audax*, Salter, Memoirs of the Geol. Surv. vol. iii. p. 357, pl. xxiv. f. 7.
 1882. *Orthoceras audax*, Blake, British Foss. Ceph. pt. i. p. 143, pl. xii. f. 8.

Sp. Char. Shell straight. Section nearly circular, but the diameters are always unequal. Rate of increase 1 in 5 to 1 in 7. Body-chamber unknown. Septa very slightly convex, undulating to the extent of $3\frac{1}{2}^{\circ}$, being highest on the narrow side; from $\frac{1}{8}$ to $\frac{1}{9}$ the diameter apart. Siphuncle very slightly eccentric on the long axis towards that side to which the septa rise. (*Blake.*)

Remarks. Prof. Blake observes that "it seems very probable that

some of the Lower Silurian forms referred to *O. gregarium* may belong here, but it cannot be said to be proved."

Horizon. Bala series.

Locality. Cynwyd, Merionethshire.

One imperfect specimen represents this species, presented by J. E. Lee, Esq., F.S.A., F.G.S.

DEVONIAN SPECIES¹.

Orthoceras longicameratum, Foord.

1842. *Orthoceratites regularis*, var., d'Archiac & de Verneuil, Trans. Geol. Soc. 2nd ser. vol. vi. pt. ii. p. 344, pl. xxvii. f. 2.

1854. *Orthoceras gracile*, F. A. Roemer, Palaeontographica, Band iii. p. 16, tab. iii. f. 19.

1856. *Orthoceras regulare*, G. & F. Sandberger, Die Verstein. Nassau, p. 173, Taf. xx. ff. 2, 2 a-k; not f. 2 l. (Not of Schlotheim.)

[Not 1840. *Orthoceratites regularis*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 95, Taf. xvii. ff. 3, 4.]

Sp. Char. Shell straight. Much elongated. Rate of increase of two specimens measured, 1 in 36 and 1 in 41. Body-chamber (?). Septa wide apart, distant from $1\frac{1}{2}$ to 2 diameters. Siphuncle small, cylindrical, central. Test unknown.

Remarks. The specimens are all casts of the chambers (sometimes hollow) in iron-pyrites. Many of them are strangely distorted by pressure in the slaty rock in which they are embedded. In some instances the cast of each chamber has been pushed obliquely a little out of its place, so as to give to the fossil the appearance of a vertebral column of a fish. The hollow specimens frequently exhibit the siphuncle in the interior when broken open.

This species may be readily distinguished from *O. regulare*, Schloth., by the much greater distance of its septa.

Horizon. Orthoceratiten-Schiefer, Lower Devonian.

Locality. Wissenbach, near Dillenburg, Nassau.

This species is represented in the Collection by a large and fine series of specimens, presented by J. E. Lee, Esq., F.S.A., F.G.S.

¹ I have taken the excellent work of Dr. Hermann Credner (Elemente der Geologie, 6th edition, Leipzig, 1887) as my chief authority for the subdivisions of the Devonian rocks of Germany.

At p. 462 this author gives a very useful table of the "Divisions and Parallelisms of the Devonian System, in various Countries," including Germany, Belgium, Britain, and North America; with some of the characteristic fossils. A copy of this table is here given (pp. 82, 83), the fossils being omitted.

Orthoceras gracile, Blumenbach.

1803. *Orthoceratites gracilis*, Blumenbach, Specimen Archæologiæ Telluris, p. 21, tab. ii. f. 6.

? 1842. *Orthoceratites gracilis*, d'Archiac & de Verneuil, Trans. Geol. Soc. 2nd ser. vol. vi. pt. ii. p. 344, pl. xxvii. f. 4.

Sp. Char. Shell straight, very elongated. Section circular. Rate of tapering very gradual, about 1 in 24. Septa numerous, horizontal. Siphuncle small, cylindrical, nearly marginal. Test unknown.

Remarks. This species differs from *O. longicameratum* in the number of its septa, which is at least double, and in the position of its siphuncle.

The specimen figured by Blumenbach must have been partially decomposed, as it is represented with considerable spaces at the sutures, so as to expose the siphuncle to view. It was pyritized, as are all the *Orthoceratites* in the Wissenbach slates.

I am not satisfied about this being the species figured and described by MM. d'Archiac and de Verneuil. Their shell has a much more rapid rate of tapering than Blumenbach's. It is stated to be very common at Wissenbach.

Horizon. Orthoceratiten-Schiefer; Lower Devonian.

Locality. Wissenbach, near Dillenburg, Nassau.

Well represented in the Collection.

Orthoceras crassum, F. A. Roemer.

1843. *Orthoceratites crassus*, F. A. Roemer, Die Verstein. des Harzgebirges, p. 35, tab. x. f. 6.

1854. *Orthoceras crassum*, F. A. Roemer, Palæontographica, Band iii. p. 110, Taf. xi. f. 23, a-b.

1856. *Orthoceras crassum*, G. & F. Sandberger, Die Verstein. Nassau, p. 164, Taf. xix. ff. 1, 1a.

1870. *Orthoceras crassum*, Tietze, Ueber die devonischen Schichten von Ebersdorf, p. 36, Taf. i. f. 17.

1884. *Orthoceras crassum*, Kayser, Die Orthoceras-schiefer, &c., in Jahrb. d. königl. preussisch. geolog. Landesanst. u. Bergak. zu Berlin f. d. Jahr 1883, p. 15.

Sp. Char. Shell straight, very long. Section cylindrical. Rate of tapering 1 in 8. Septa distant about $\frac{1}{3}$ the diameter of the shell, very convex. Siphuncle central, rather thick. Surface ornamented with fine transverse lines.

Horizon. Spiriferen-Sandstein; Orthoceratiten-Schiefer; Lower Devonian.

DIVISIONS AND PARALLELISMS OF THE

	EIFEL (Kayser).	AACHEN DISTRICT (Kayser).	NASSAU and WESTPHALIA (Sandberger and Kayser).	NORTH- WESTERN HARTZ (F. A. Roemer and others).
UPPER DEVONIAN.	Cypridinen-Schiefer. Goniatiten-Schiefer. Cuboides-Kalk and Mergel.	Verneuili - Sandstein. Verneuili-Schiefer. Cuboides-Schichten (Verneuili-Schiefer of Ferd. Roemer).	Clymenien-Kalk of Dillenburg and Enkeberg. Cydridinen - Schiefer and Sandsteine of Nehden. Goniatiten - Kalk of Bicken, Oberscheld and Adorf (Intumescens-Stufe).	Cypridinen - Schiefer of Lautenthal. Kramenzelkalk of Schulenberg. Domanikschiefer of Altenau. Iberger Kalk.
MIDDLE DEVONIAN.	Stringocephalen-Kalk with Crinoiden-Schicht at the base. Calceola-Mergel and Kalk.	Stringocephalen-Kalk. Wanting.	Stringocephalen-Kalk of Diez, Brilon, Bensberg. Schalstein. Grauwacken-Schiefer, with inclusions from the Eifeler Kalk.	Stringocephalen-Kalk of Buntentbock and Polsterberg. Calceola-Schiefer of Auerbahn and Schalkertthal.
LOWER DEVONIAN.	Cultrijugatus-Stufe. Waxweiler Grauwacke. Vichter Schichten. Grauwacken of Stadtfeld - Daun; Hunsrück - Schiefer; Taunus-Quarzit.	Rote Schichten. Dunkle Grauwacken. Grüne Grauwacken with grünen and roten Schiefern. Grobes rotes Konglomerat.	Orthoceratiten-Schiefer of Wissenbach. Spiriferen-Sandstein = Coblenz-Schichten, Hunsrück Schiefer, Taunus-Quarzit.	Speciosus-Schichten. Spiriferen-Sandstein of Kahlenberg and of the Schalke. Bruchberg Quarzit.

DEVONIAN SYSTEM IN VARIOUS COUNTRIES.

	SOUTH BELGIUM (Dewalque and Gosselet).	BRITAIN.	NORTH AMERICA.
FAMENNEN.	Kalkstein of Etro- ungt with <i>Cly- menia</i> and <i>Sp- irifer Verneuli</i> . Psammit of Con- dros with <i>Spirifer Verneuli</i> . Cypridinen-Schiefer of Famenne.	Pilton Group (<i>Spiri- fer Verneuli</i> - Zone). Petherwin Group (<i>Clymenia</i> - Lime- stone). Intumescens Lime- stone of Torquay and Chudleigh.	Catskill Group (Old Red Sandstone with <i>Holopty- chius</i>). Chemung Group:— b. Chemung Zone. a. Portage Zone.
FRASNIEN.	Schiefer of Matagne with <i>Gon. primor- dialis</i> and <i>Cardiola retrostriata</i> . Kalk and Mergel of Frasnè with <i>Rhynch. cuboides</i> .		
EIFELIEN.	Stringocephalen- Kalk of Givet. Calceola-Schiefer of Couvin.	Plymouth Group in South Devon, with <i>Stringocephalus</i> . Ilfracombe Group in North Devon. Calceola shaly lime- stones of Ogwell House, Torquay, &c.	Hamilton Group:— c. Genesee shale. b. Hamilton shales and flags. a. Marcellus shale.
COBLZENIEN.	Cultrijugatus- Schichten. Grauwacke of Hier- ges; Konglomerat of Burnot; grauer Sandstein of Vireux; Grau- wacke of Mon- tigny; Gedinnien.	Lynton Group. Sandstein and Thon- schiefer with <i>Pleu- rodictyum</i> , <i>Homa- lonotus</i> .	Upper Helderberg Group:— c. Corniferous lime- stone. b. Schoharie grit. a. Cauda-galli grit.

OLD RED SANDSTONE—*a*, with *Dipterus*, *Coccosites*, *Cephalaspis*; *b*, with *Holoptychius*, *Pterichthys*, *Asterolepis*.

Localities. Kahlenberg, North-west Hartz; Cramberg, near Dietz: Nassau.

The specimens from the Orthoceratiten-Schiefer of Cramberg were transferred from the Museum of Practical Geology.

Two imperfect specimens represent this species in the Collection.

Orthoceras Dannenbergi, d'Archiac and de Verneuil.

1842. *Orthoceratites Dannenbergii*, d'Archiac & de Verneuil, Trans. Geol. Soc. ser. 2, vol. vi. p. 345, tab. xxviii. ff. 1, 1 a.

1847. *Melia Dannenbergii*, d'Orbigny, Prodr. de Paléont. vol. i. p. 56.

1856. *Orthoceras undato-lineolatum*, G. & F. Sandberger, Die Verstein. Nassau, p. 163, Taf. xviii. ff. 6, 6 a-6 d.

1866. *Orthoceras Dannenbergii*, F. A. Roemer, in Palæontographica, Band xiii. p. 211, tab. xxxiii. f. 16.

1884. *Orthoceras Dannenbergii*, Kayser, Die Orthoceras-schiefer, in Jahrb. d. königl. preussisch. geolog. Landesanst. u. Bergak. zu Berlin f. d. Jahr 1883, p. 18.

Sp. Char. Shell straight. Section circular. Rate of increase 1 in 14. Body-chamber $1\frac{1}{5}$ the diameter of its base in the specimen figured by d'Archiac and de Verneuil, which, however, does not appear to be perfect in this part. Septa distant from $\frac{1}{4}$ to $\frac{1}{5}$ the diameter. Siphuncle of medium thickness, central. Surface ornamented with transverse riblets, which are so strongly undulating as to have an obliquity in one part of their course of about 35° to the longitudinal axis of the shell. The riblets are rounded, and are about $\frac{1}{2}$ line distant from each other; they are divided by spaces of about the same breadth. The riblets and interspaces are covered with fine striæ, having an upward imbrication. About eight of these occupy a space equal to two riblets, including the space dividing the latter.

Remarks. There is a slight discrepancy between the description of this species by d'Archiac and de Verneuil, and that of the Doctors Sandberger, viz. in the position of the siphuncle; the former declare it to be "rather large, elliptical, and touching the edge;" while the latter, on the other hand, describe and figure it as *central*. I think there can be no doubt of the accuracy of the latter allocation of this organ; and it appears to me, judging by d'Archiac and de Verneuil's figure, that those authors were misled by the crystalline infilling of their shell into supposing the siphuncle to be marginal. I cannot otherwise account for the disagreement between the two diagnoses.

Assuming therefore, as did the Brothers Sandberger themselves, that *O. Dannenbergi* and *O. undato-lineolatum* are identical, the law

of priority demands that the former name should be reinstated, at the expense of the latter.

Horizon. Orthoceratiten-Schiefer; Lower Devonian.

Locality. Wissenbach, Nassau.

One imperfect specimen represents this species in the Collection; it was presented by J. E. Lee, Esq., F.S.A., F.G.S.

Orthoceras cingulum, Hall.

1879. *Orthoceras cingulum*, Hall, Pal. of New York, vol. v. pt. ii. p. 240, pl. lxxvi. ff. 2, 3.

Sp. Char. Shell straight. Section apparently elliptical. Rate of increase 1 in 6. Body-chamber too imperfect for its proportions to be ascertained. Septa distant about $\frac{1}{6}$ the diameter; somewhat undulating. Siphuncle central, or subcentral, small. "The ventral side is indicated by a longitudinal raised line or carina (normal line?) on the cast of the septate portion. Test and surface markings unknown" (*Hall*).

Remarks. This species is nearly allied to *O. fluctum*, Hall, but, as that author remarks, the septa in *O. cingulum* are wider apart than they are in the latter species, which also wants the keel along the ventral side.

Horizon. Schoharie Grit, Lower Devonian.

Locality. Schoharie, New York State.

Represented in the Collection by three imperfect specimens transferred from the Museum of Practical Geology.

Orthoceras Vennense¹, Foord.

1840. *Orthoceras cylindraceum*, Sowerby, Trans. Geol. Soc. 2nd series, vol. v. p. 703*, and Expl. of Plates, &c. pl. lii. ff. 6, 7. (*Not of Fleming.*)

1841. *Orthoceras cylindraceum*, Phillips, Pal. Foss. of Cornwall, Devon, and West Somerset, p. 113, pl. xliii. f. 213, *a, b, ? c.* (*Not of Fleming.*)

[*Cf.* 1840. *Orthoceratites regularis*, Münster, Beitr. z. Petrefactenkunde, Heft iii. p. 95, Taf. xvii. ff. 3, 4.]

Sp. Char. Shell very elongated; slowly tapering; sometimes a little curved. Section circular. Septa rather widely separated,

¹ The name *O. cylindraceum* having been employed previously by Fleming (*Annals of Philosophy*, vol. v. 1815, p. 202), I have substituted for it that of *O. Vennense*, after the village of Venn, near Barnstaple (N. Devon), where the species was first collected.

about one half the diameter distant; deeply concave. Siphuncle central, cylindrical, rather large. Body-chamber unknown.

Remarks. All the specimens are very imperfect, so much so that Sowerby adds to his brief description that the name of the species must be considered only as temporary.

Horizon. Middle Devonian.

Locality. Mudstone Bay, near Torquay, Devonshire.

Fairly well represented in the Collection by specimens presented by J. E. Lee, Esq., F.S.A., F.G.S.

Orthoceras laterale ?, Phillips.

1841. *Orthoceras laterale*, Phillips, Pal. Foss. of Cornwall, Devon, and West Somerset, p. 110, pl. xli. f. 205 *a*, not *b*, *c*, *d*, *e*.

? 1868. *Orthoceras laterale*, Holl, Quart. Journ. Geol. Soc. vol. xxiv. p. 447.

[Not 1855. *Orthoceras (Loxoceras) laterale*, M'Coy, British Pal. Foss. fasc. iii. p. 572.]

Sp. Char. "General figure elongate conical, but near the aperture somewhat fusiform; surface (?); section elliptical, with diameters as 10 to 12; septa oblique, waved, distant $\cdot 27$ to $\cdot 35$ diameter, rather shallow; siphuncle eccentric (on, or nearly on, the conjugate axis)." (*Phillips*.)

Remarks. I have referred a specimen, consisting of a polished section only, with much doubt to this species. The septa are very close, their distance being from $\frac{1}{5}$ to $\frac{1}{6}$ the diameter. The rate of increase is apparently rather rapid, about 1 in 6.

Horizon. Middle Devonian (Lower Slates?).

Locality. Mudstone Bay, near Torquay, Devonshire.

Represented only by a section, which was presented by J. E. Lee, Esq., F.S.A., F.G.S.

Orthoceras, sp.

Fragment of a large *Orthoceras*, measuring about $2\frac{1}{2}$ inches in breadth; the septa distant about $5\frac{1}{2}$ lines or $\frac{1}{7}$ the diameter (?). The siphuncle cylindrical, about $2\frac{1}{2}$ lines wide. The specimen is crushed and flattened, so that its natural shape cannot now be made out. It may be compared with Phillips's figure 204 *b* on pl. xli. (*loc. cit.*).

Horizon. Middle Devonian (Lower Slates?).

Locality. Hope's Nose, near Torquay, Devonshire.

Presented by J. E. Lee, Esq., F.S.A., F.G.S.

Orthoceras (?) tentaculare, Phillips.

1841. *Orthoceras tentaculare*, Phillips, Pal. Foss. of Cornwall, Devon, and West Somerset, p. 112, pl. xliii. f. 210, a-e.

1868. *Orthoceras tentaculare*, Holl, Quart. Journ. Geol. Soc. vol. xxiv. p. 433.

Sp. Char. "General figure a slender, elongated cone (some specimens arcuate near the apex); surface annulated by oblique, prominent (granulated?) ridges, distant about .25 diameter; section nearly circular; septa apparently distant as much as one or more than one diameter of the shell, most distant in young specimens; siphuncle(?)." (*Phillips*.)

Remarks. I cannot help sharing in the doubt felt by Professor Phillips, when this form first came under his scrutiny, as to what its affinities might be; but as he may have had better specimens than those I have access to, I give the species for the present the generic position he assigned to it.

Horizon. Middle Devonian (Lower Slates?).

Locality. Mudstone Bay, near Torquay, Devonshire.

A small slab with numerous specimens in it, presented by J. E. Lee, Esq., F.S.A., F.G.S.

Orthoceras tubicinella, Sowerby.

1840. *Orthoceras tubicinella*, Sowerby, Trans. Geol. Soc. 2nd series, vol. v. p. 703*, and Expl. of Plates, &c. pl. lvii. f. 29.

1841. *Orthoceras tubicinella*, Phillips, Pal. Foss. of Cornwall, Devon, and West Somerset, p. 112, pl. xliii. f. 211.

? 1843. *Orthoceras tubicinella* (var.), Portlock, Rep. on the Geol. of Londonderry, p. 367, pl. xxv. f. 4.

1856. *Orthoceras tubicinella*, Sandberger, Die Verstein. Nassau, p. 169, Taf. xix. ff. 6 a, 6 d.

Sp. Char. "General figure slowly tapering; surface ornamented with prominent, transverse, oblique rings, which are crossed by numerous thread-like ribs; section circular; siphuncle(?)." (*Phillips*.)

Remarks. The septa are seen in a longitudinal section of a specimen in the National Collection. They are from $1\frac{1}{2}$ to 2 lines distant, the diameter of the shell being 6 lines.

Horizon. Middle Devonian (Great Devon Limestone?).

Locality. Newton Abbot, Devonshire.

Represented in the Collection by a few small specimens.

Orthoceras, sp.

(Cf. *Orthoceras simplicissimum*, Sandberger, Die Verstein. Nassau, p. 172, Taf. xx. f. 7.)

A fragment of the septate portion of the shell. The septa are very close, their distance only slightly exceeding 1 line, where the shell has a diameter of 8 lines. The rate of tapering is about 1 in 5. The section is circular. Nothing can be seen of the siphuncle, and the shell is not preserved.

Horizon. Middle Devonian (Great Devon Limestone).

Locality. Newton Abbot, Devonshire.

Orthoceras, sp.

This is an interesting fragment of a cylindrical (?) shell, partly buried in a highly crystalline limestone matrix. Portions of the test are well preserved, the ornaments consisting of transverse, acute riblets, varying from $\frac{1}{2}$ to 1 line distant from each other. The summit of each riblet presents a double line so as to give a banded appearance to the test, somewhat resembling that of *Orthoceras bicingulatum*, G. & F. Sandb. The riblets have an obliquity of about 15° to the longitudinal axis of the shell. Neither septa nor siphuncle are preserved.

Horizon. Middle Devonian (Great Devon Limestone).

Locality. Torquay, Devonshire.

Presented by J. E. Lee, Esq., F.S.A., F.G.S.

Orthoceras typus, Saemann.

1854. *Orthoceras typus*, Saemann, Ueber die Nautiliden, in Palæontographica, Band iii. p. 164, tab. xx. ff. 1, a-e.

Sp. Char. Shell straight. Section circular. Rate of increase about 1 in 12. Dimensions of body-chamber not precisely ascertainable. Septa rather remote, about $\frac{1}{3}$ the diameter apart. Siphuncle slender, cylindrical, slightly eccentric. Surface of the test with irregular transverse striæ of growth.

Horizon. Schistes de Couvin (Eifélien); Middle Devonian.

Localities. Nismes, Boussu en Fagne, Belgium.

Represented by two fairly good specimens transferred from the Museum of Practical Geology.

Orthoceras crebrum, Saemann.

1854. *Orthoceras crebrum*, Saemann, Ueber die Nautiliden, in Palæontographica, Band iii. p. 165, tab. xx. ff. 2, a, b, c.

1856. *Orthoceras planiseptatum*, G. & F. Sandberger, Die Verstein. Nassau, p. 160, Taf. xvii. ff. 4, 4 a-i.

1884. *Orthoceras planiseptatum*, Kayser, Jahrb. d. königl. preussisch. geolog. Landesanst. und Bergak. zu Berlin f. d. Jahr 1883.

Sp. Char. Shell straight. Section elliptical, the ratio of the two diameters being as 15 : 18. Rate of tapering about 1 in 5. Dimensions of the body-chamber unknown. Septa distant about $\frac{1}{8}$ the diameter. Siphuncle slender, eccentric in position, varying from $\frac{2}{5}$ to $\frac{1}{4}$ along the shorter diameter. Surface of test quite smooth.

Remarks. Finding no characters of sufficient importance to separate *O. planiseptatum* from *O. crebrum*, I have united these two species under Saemann's name, which has the priority over that of the Brothers Sandberger. A specimen from the Ardennes, consisting of a cast of the apical portion of the shell, is probably identical with this species.

Horizon. Stringocephalen-Kalk; Middle Devonian.

Locality. Gerolstein, Eifel.

Fairly well represented in the Collection by examples presented by J. E. Lee, Esq., F.S.A., F.G.S.

Orthoceras arcuatellum, G. & F. Sandberger.

1856. *Orthoceras arcuatellum*, G. & F. Sandberger, Die Verstein. Nassau, p. 166, Taf. xix. ff. 2, 2 a-g.

Sp. Char. Shell straight, short. Section circular. Rate of tapering very rapid, about 1 in 3. Septa direct, distant about $\frac{1}{3}$ the diameter. Siphuncle slender, central. Surface ornamented with transverse undulating striæ, from four to five in the space of 1 line, their distance increasing with the growth of the shell.

Horizon. Stringocephalen-Kalk; Middle Devonian.

Locality. Buntensbock, North-west Hartz.

Represented by one imperfect specimen.

Orthoceras lineare?, Münster.

1840. *Orthoceratites linearis*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 99, Taf. xix. f. 1, a, b.

1854. *Orthoceras lineare*, F. A. Roemer, Palæontographica, Band iii. p. 17, tab. iii. f. 23.

1879. *Orthoceras lineare*, Gümbel, Geogn. Beschreib. des Fichtelgebirges, in Geogn. Beschreib. des König. Bayern, Abth. iii. p. 498.

Sp. Char. This species is characterized by its exceedingly fine transverse striæ. The septa are distant about $\frac{1}{3}$ the diameter. The siphuncle is central.

Remarks. The specimen in the Collection from the Middle Devonian bearing this name resembles Roemer's form more nearly than Münster's, which is a much more robust shell, though this may be only a question of growth.

Horizon. Stringocephalen-Kalk (? = Goslarer Schiefer); Middle Devonian.

Locality. Buntentock, North-west Hartz.

Represented by a very imperfect specimen.

Orthoceras, sp.

(Cf. *Orthoceratites gregarius*, Münster, Beitr. z. Petrefact. Heft iii. p. 97; non Sowerby.)

Two specimens with rather approximate septa, central siphuncle, and portions of the body-chamber are too imperfect for specific determination.

Horizon. Eifelien; Middle Devonian.

Locality. Eifel.

Orthoceras, sp.

(*Ante*, p. 59.)

(Cf. *Orthoceras subannulare*, Münster, Beiträge zur Petrefactenkunde, Heft iii. 1840, p. 99, Taf. xix. f. 3.)

A small, abraded fragment, partly buried in the matrix, may be compared with Münster's species.

It possesses the faint annulations and fine and regular raised lines characteristic of that form.

Horizon. Upper Devonian¹.

Locality. Dunscombe, near Chudleigh, Devonshire.

Presented by J. E. Lee, Esq., F.S.A., F.G.S.

Orthoceras striatulum, Sowerby.

1840. *Orthoceras striatulum*, Sowerby, Trans. Geol. Soc. 2nd series, vol. v. p. 703*, and Expl. of Plates, &c. pl. liv. f. 20.

1840. *Orthoceras striatulum*, Phillips, Pal. Foss. of Cornwall, Devon, and West Somerset, p. 112, pl. xliii. f. 212.

1868. *Orthoceras striatulum*, Holl, Quart. Journ. Geol. Soc. vol. xxiv. p. 447.

Sp. Char. "General figure rather rapidly tapering; surface with prominent transverse rings, crossed by numerous fine threads, which alternate with still finer lines; annulations sharp, oblique, distant $\cdot 33$ or $\cdot 5$ diameter; section (?); septa rather more approximate than the annulations; siphuncle (?).

¹ These beds are placed by Mr. H. B. Woodward (Geol. of England and Wales, 2nd edition, p. 134) in the Middle Devonian, but Dr. Ferdinand Roemer correlates them with the "Red nodular limestone" (Goniatiten-Kalk) of Oberscheld, &c., which is of Upper Devonian age.

The annexed table exhibits very clearly the relationship between the Devonian strata of England and that of the Rhineland and Westphalia.

“Distinguished by its figure and much finer striations from *O. tubicinella*.” (Phillips.)

Remarks. The *O. scalare* of Goldfuss (= *O. striolatus*, H. von Meyer, Nov. Act. Acad. Leop.-Carol. vol. xv. pt. ii. p. 59, pl. lv., not pl. lvi. ff. 1-12) is a closely allied species.

Horizon. Upper Devonian (Petherwin limestone).

Locality. Petherwin, Cornwall.

Represented in the Collection by a fragment.

It is extracted from a paper by Dr. Roemer entitled “Notice of the occurrence of Upper Devonian Goniatite Limestone in Devonshire,” contributed to the Geological Magazine (Decade ii. vol. vii. 1880, p. 145).

		Devonshire and Cornwall.	Rhineland and Westphalia.
UPPER DEVONIAN.	Clymenien Stage.	5. Grey and greenish slate with nodular limestone near Petherwin, Cornwall, with <i>Clymenia</i> , <i>Goniatites</i> , and <i>Spirifer Verneuili</i> .	Clymenia limestone in Nassau (Kirschhofen, near Weilburg) and Westphalia (Warstein).
	Intumescens Stage.	4. Red clay-slate of Saltern Cove, near Torquay, Devonshire, with <i>Goniatites retrorsus</i> , <i>G. auris</i> , <i>Bactrites</i> [<i>Orthoceras</i>] <i>Schlotheimi</i> , <i>Cardiola retrostriata</i> , &c. Red ironstone, thin conformable limestone, and nodular limestone of Lower Dunscombe, near Chudleigh, with <i>Goniatites intumescens</i> , <i>G. multilobatus</i> , <i>Orthoceras</i> , &c., <i>Phacops cryptophthalmus</i> , <i>Cocosteus</i> sp. indet.	Goniatite slate of Budesheim. Red nodular limestone of Oberscheld in Nassau, and of Adorf in Weldeck.
MIDDLE DEVONIAN.		3. Compact grey limestone of Newton Bushel, Torquay, Plymouth, with <i>Stringocephalus Burtini</i> , <i>Uncites gryphus</i> , <i>Megalodon cucullatus</i> , numerous corals.	Paffrath limestone (<i>Stringocephalus</i> , limestone), Paffrath, Elberfeld Schwelm, and in the Eifel.
		2. Grey or yellowish clay-slate of Ogwell House, Torquay, with <i>Calceola sandalina</i> ; Brachiopoda; <i>Fenestella</i> , &c.	Eifel limestone.
LOWER DEVONIAN.		1. Clay-slate of Looe, Cornwall, with <i>Pteraspis cornubicus</i> , <i>Pleurodictyum problematicum</i> , <i>Orthis laticosta</i> . Clay-slate of Meadsfoot Sands, near Torquay, with <i>Homalomonotus</i> , sp.	Coblentz Grauwacke (“ <i>Spirifer</i> sandstone” of the Brothers Sandberger).

Orthoceras lineare ?, Münster.

(Ante, p. 89.)

Sp. Char. Shell straight, compressed. Section elliptical. Rate of increase about 1 in 8. Septa approximate, distant about $\frac{1}{4}$ the diameter. Siphuncle apparently subcentral. Surface marked with very fine, transverse, raised lines, about 10 in the space of 1 line.

Horizon. Goniaticen-Kalk; Upper Devonian.

Locality. Adorf, Waldeck.

Represented in the Collection by an imperfect specimen.

Orthoceras subflexuosum ?, Münster.

1840. *Orthoceratites subflexuosus*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 100, Taf. xix. f. 9, a, b.

1854. *Orthoceras subflexuosum ?*, Roemer, Palæontographica, Band iii. p. 27, Taf. iv. f. 13.

1879. *Orthoceras subflexuosum*, Gümbel, Geogn. Beschreib. des Fichtelgebirges, in Geogn. Beschreib. des König. Bayern, Abth. iii. p. 498.

Sp. Char. Shell straight. Section elliptical. Rate of increase very slow. Septa approximate. Siphuncle submarginal. Surface with distant, wavy, transverse lines, about $\frac{1}{2}$ line distant from each other.

Horizon. Goniaticen-Kalk; Upper Devonian.

Locality. Oberscheld, Nassau.

Represented in the Collection by several somewhat imperfect specimens; some of which were presented by J. E. Lee, Esq., F.S.A., F.G.S., and others transferred from the Museum of Practical Geology.

Orthoceras compressum, F. A. Roemer.

1843. *Orthoceratites compressus*, F. A. Roemer, Die Verstein. des Harzgebirges, p. 36, Tab. x. f. 7.

1854. *Orthoceras compressum*, F. A. Roemer, Palæontographica, Band iii. p. 110.

1856. *Orthoceras compressum*, G. & F. Sandberger, Die Verstein. Nassau, p. 158, Taf. xviii. ff. 1, 1 a-d.

Sp. Char. Shell straight, compressed. Section elliptical, the ratio of the two diameters being as 2:3. Rate of increase very slow. Septa strongly arched, somewhat drawn down at each side. Siphuncle submarginal. Surface quite smooth.

Remarks. This species is nearly related to the preceding one, but the surface ornamentation of *O. subflexuosum* serves at once to distinguish it from *O. compressum*, which is quite smooth.

Horizon. Cuboides-Kalk ; Upper Devonian.

Locality. Iberg, Switzerland.

Represented by two small fragments.

Orthoceras irregulare ?, Münster.

1840. *Orthoceratites irregularis*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 100, Taf. xix. f. 11.

Sp. Char. Characterized by its irregular transverse striæ. Perhaps Gümbel¹ is correct in making this species synonymous with *O. lineare*, but the specimen in the Collection is not sufficiently well preserved to afford conclusive evidence on this point.

Horizon. Orthoceratiten-Kalk ; Upper Devonian.

Locality. Elbersreuth, Bavaria.

Orthoceras subregulare, F. A. Roemer.

1843. *Orthoceratites regularis*, F. A. Roemer (*non* Schlotheim), Die Verstein. des Harzgebirges, p. 35, tab. x. ff. 4, 5.

1854. *Orthoceras subregulare*, F. A. Roemer, Beitr. z. geologisch. Kenntn. des nordwestlichen Harzgebirges, in Palæontographica, Band iii. p. 110.

1866. *Orthoceras subregulare*, F. A. Roemer, Beitr. z. geologisch. Kenntn. des norddeutschen Harzgebirges, Abth. 5, in Palæontographica, Band xiii. Lief. v. p. 231.

Sp. Char. Shell straight. Rate of increase about 1 in 7. Length of body-chamber about $2\frac{1}{2}$ times the diameter of its base. Septa distant less than $\frac{1}{3}$ the diameter, therefore numerous. Siphuncle central. Surface of test smooth.

Horizon. Iberger-Kalk ; Upper Devonian.

Localities. Grund, Winterberg, North-western Hartz.

Fairly well represented in the Collection.

Orthoceras pulchellum, F. A. Roemer.

1854. *Orthoceras pulchellum*, F. A. Roemer, Palæontographica, Band iii. p. 39, tab. vi. f. 5.

Sp. Char. Shell straight, subcompressed. Rate of increase about 1 in 7. Septa distant about $\frac{1}{3}$ the diameter. Siphuncle marginal. Surface ornamented with very strong, undulating transverse striæ, which have an upward imbrication. The striæ make a very distinct impression upon the cast.

Remarks. This species is doubtless allied to *O. dimidiatum*, Sow., but the imbrications are more distant.

¹ *Loc. cit.* (see p. 89).

Horizon. Iberger-Kalk ; Upper Devonian.

Locality. Grund, North-western Hartz.

Represented in the Collection by two small fragments.

Orthoceras dimidiatum, Sowerby.

(*Ante*, p. 52.)

1840. *Orthoceratites dimidiatus*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 98, Taf. xix. ff. 2, 5.

1879. *Orthoceras semicingulatum*, Gümbel, Geogn. Beschreib. des Fichtelgebirges, in Geogn. Beschreib. des König. Bayern, Abth. iii. p. 498.

Remarks. There are two fragmentary specimens in the Collection, bearing the characteristic ornamentation of this species.

Horizon. Orthoceratiten-Kalk ; Upper Devonian.

Locality. Elbersreuth, Bavaria.

Represented by two fragments in the Collection.

Orthoceras subannulare, Münster.

(*Ante*, p. 59.)

Horizon. Orthoceratiten-Kalk ; Upper Devonian.

Locality. Elbersreuth, Bavaria.

Represented by one small fragment. Also found in the Silurian.

Orthoceras speciosum, Münster.

1840. *Orthoceratites speciosus*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 96, Taf. xviii. ff. 1 a, 1 b, 3.

1879. *Orthoceras speciosum*, Gümbel, Geogn. Beschreib. des Fichtelgebirges, in Geogn. Beschreib. des König. Bayern, Abth. iii. p. 498.

Sp. Char. Shell straight. Section circular (?). Rate of increase about 1 in 6. Length of body-chamber not precisely ascertainable. Septa varying in distance from $\frac{1}{2}$ to $\frac{1}{4}$ the diameter. Siphuncle central (?). Surface of test smooth.

Horizon. Orthoceratiten-Kalk ; Upper Devonian.

Locality. Elbersreuth, Bavaria.

Fairly well represented in the Collection.

Orthoceras conoideum, Münster.

1840. *Orthoceratites conoideus*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 96, Taf. xviii. ff. 4, 5.

1879. *Orthoceras conoideum*, Gümbel, Geogn. Beschreib. des Fichtelgebirges, in Geogn. Beschreib. des König. Bayern, Abth. iii. p. 498.

Sp. Char. Shell straight, tapering rapidly. Section circular (?). Septa distant about $\frac{2}{7}$ of the diameter. Siphuncle central. Surface of test quite smooth.

Horizon. Orthoceratiten-Kalk; Upper Devonian.

Localities. Elbersreuth, Bavaria; Adorf, Waldeck.

Represented by two or three fragments.

Orthoceras, sp.

A fragment partly buried in the matrix appears to belong to a species not before met with in the German Devonian rocks.

The sculpture consists of transverse imbricating striæ, about 4 to 1 line, and these are covered by very fine lines parallel to the imbrications. The latter require rather a strong lens to make them visible.

Barrande has described a species from the Silurian rocks of Bohemia (Etage E), to which he has given the name of *O. consobrinum*¹, which has similar sculpture to the present form; but as that is the only character available in the latter for purposes of identification, I do not feel justified in uniting it with Barrande's species.

Horizon. Upper Devonian (Intumescens Stage).

Locality. Adorf, Waldeck.

Orthoceras striato-punctatum, Münster.

(*Ante*, p. 74.)

Horizon. Orthoceratiten-Kalk²; Upper Devonian.

Locality. Elbersreuth, Bavaria.

Fairly well represented. Also in the Silurian.

Orthoceras subtrochleatum, Münster.

1840. *Orthoceratites subtrochleatus*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 101, Taf. xix. f. 6.

1879. *Orthoceras subtrochleatum*, Gümbel, Geogn. Beschreib. des Fichtelgebirges, in Geogn. Beschreib. des König. Bayern, Abth. iii. p. 498.

Remarks. This species appears to be known only by a fragment the characters of which are scarcely sufficient to my mind to separate it from other forms having similar sculpture. The latter consists of fine raised lines, about seven in the space of 1 line, and very oblique to the long axis of the shell. The rate of tapering cannot be ascertained. The siphuncle is subcentral.

¹ Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 366, pl. cccv. ff. 7-11.

² See Gümbel, *loc. cit.*

Horizon. Orthoceratiten-Kalk ; Upper Devonian.

Locality. Elbersreuth, Bavaria.

Represented by a fragment.

Orthoceras Bavaricum, Foord.

1840. *Orthoceratites striatulus*¹, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 102, Taf. xx. f. 5, a-d.

Sp. Char. The sculpture of this species is so peculiar as to constitute in itself a sufficiently distinguishing character. It consists of fine zigzag lines covering the whole of the shell in a longitudinal direction.

Horizon. Clymenien-Kalk ; Upper Devonian.

Locality. Schübelhammer, Bavaria.

Represented by an imperfect specimen.

Orthoceras ellipticum, Münster.

1840. *Orthoceratites ellipticus*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 97, Taf. xviii. f. 2, a, b.

1879. *Orthoceras ellipticum*, Gümbel, Geogn. Beschreib. des Fichtelgebirges, in Geogn. Beschreib. des König. Bayern, Abth. iii. p. 498.

Sp. Char. The distinguishing feature in this species is its broad, compressed form, which gives an elliptical section, whose diameters are as 36 : 23.

Horizon. Upper Devonian.

Locality. Gattendorf, Bavaria.

Fairly well represented in the Collection.

Orthoceras angustiseptatum, Gümbel.

1840. *Orthoceratites gregarius*, Münster (*non* Sowerby), Beiträge zur Petrefactenkunde, Heft iii. p. 97, Taf. xviii. f. 1 b.

1873. *Orthoceras gregarium*?, Kayser, Zeitsch. der deutsch. geol. Gesell. Band xxv. p. 635.

1879. *Orthoceras angustiseptatum*, Gümbel, Geogn. Beschreib. des Fichtelgebirges, in Geogn. Beschreib. des König. Bayern, Abth. iii. p. 498.

Sp. Char. This species, as observed by Münster, is distinguished from all others from the Orthoceratiten-Kalk of the Fichtelgebirges by the close proximity of its septa.

Horizon. Orthoceratiten-Kalk ; Upper Devonian.

Locality. Elbersreuth, Bavaria.

One very imperfect specimen.

¹ This name having been employed by Sowerby for another species I have changed it as above.

Orthoceras acuarium, Münster.

(Ante, p. 43.)

Remarks. In an interesting paper contributed to the Geological Magazine¹, Dr. Ferdinand Roemer recognized in the Upper Devonian limestone of Lower Dunsecombe, Devonshire, two species of Goniatites, viz. *G. intumescens*, Beyr., and *G. multilobatus*, Beyr. (*G. sagittarius*, G. & F. Sandberger), remarking that "besides these Goniatites, a subcylindrical *Orthoceras* is especially abundant. It is perhaps identical with *O. acuarium*, Münster, which the brothers Sandberger have obtained at Oberscheld; but it is too imperfect to admit of identification with certainty."

The species here referred to has been lately supplied in abundance to the National Collection by the late Mr. John Edward Lee, of Torquay.

I have, however, nothing to add to Dr. Roemer's observations as touching its identity.

Horizon. Orthoceratiten-Kalk, Goniatiten-Kalk; Upper Devonian (Intumescens Stage).

Localities. *British.* Lower Dunsecombe, near Chudleigh, Devonshire (Intumescens Stage).—*Foreign.* Elbersreuth, Heinersreuth, Bavaria (Orthoceratiten-Kalk). Oberscheld, Nassau (Goniatiten-Kalk).

Orthoceras Strombecki?, F. A. Roemer.

1866. *Orthoceras de Strombeckii*, F. A. Roemer, Beitr. z. geologisch. Kenntn. des nordwestlichen Harzgebirges, in Palæontographica, Band xiii. Lief. v. p. 210, tab. xxxiv. f. 12.

Remarks. A fragment, consisting of three or four septa and part of the body-chamber, with indications of longitudinal, close-set ridges marked upon the cast, is referred doubtfully to this species.

Horizon. Goniatiten-Schiefer; Upper Devonian.

Locality. Büdesheim, Eifel.

Orthoceras Schlotheimi, Steininger.

1853. *Orthoceratites Schlotheimii*, Steininger (*non* Quenstedt), Geognostische Beschreib. der Eifel, p. 40, Taf. i. ff. 12, 12 a.

1877. *Orthoceras Schlotheimi*, Lee, Geol. Mag. dec. ii. vol. iv. p. 100, pl. v. ff. 10, 11.

Sp. Char. Shell straight, extremely slender, cylindrical, very

¹ New Series, decade ii. vol. vii. 1880, p. 145.

slowly tapering. Length of body-chamber at least eight times the diameter of its base. Septa distant from about $\frac{1}{2}$ to $\frac{2}{3}$ the diameter. Test unknown.

Remarks. The specimens from the Red Clay-slate of Saltern Cove are very fragmentary, but they appear to belong to Steininger's species, and to be identical with the examples from Budesheim, as determined by Dr. Woodward and Mr. Lee.

Quenstedt's species is a *Bactrites*.

Horizon. Goniatiten-Schiefer; Upper Devonian.

Localities. British. Saltern Cove, near Torquay; Devonshire.—
Foreign. Budesheim, Eifel.

Represented by numerous specimens from the Lee Collection.

Orthoceras, sp.

Remarks. This specimen is too imperfect for specific identification. It consists of a fragment of a large shell of elliptical form in the cross section, and a somewhat rapid rate of tapering. The shell is preserved, but it is buried in the rock, to which it adheres very tenaciously, and cannot be removed. The cast is perfectly smooth. Neither septa nor siphuncle are preserved.

Horizon. Upper Devonian (Pilton Beds¹).

Locality. Pilton, near Barnstaple, Devonshire.

Orthoceras Bebryx, var. Cayuga, Hall.

1876. *Orthoceras Bebryx*, Hall, Geol. Surv. of the State of New York; Illustrations of Devonian Fossils: Cephalopoda; Explanation of plate xxxix.

1879. *Orthoceras Bebryx*, var. *Cayuga*, Hall, Pal. of New York, vol. v. pt. ii. p. 276, pl. xxxix. f. 1, pl. lxxxvi. ff. 3-5, pl. xci., pl. xcii.

Sp. Char. "Shell robust, straight, regularly enlarging from the apex. Transverse section, allowing for the degree of compression, subcircular. Apical angle eight to ten degrees; the variation being due to the compressed condition of the specimens.

"Chamber of habitation not fully observed. Air-chambers regular, increasing in depth from the apex, and varying in different individuals from six to ten millimetres.

"Septa smooth and thin so far as observed. Sutures, in specimens not distorted by compression, straight and horizontal.

"Siphuncle moniliform, expanding between the septa, and having

¹ Mr. A. J. Jukes-Browne (Student's Handbook of Historical Geology, p. 217) places these beds at the base of the Carboniferous System, but the weight of authority is in favour of the position here assigned to them.

a diameter equal to, or two-thirds the depth of, the air-chambers. The septa are usually macerated, or broken from compression, and the position of the siphuncle has not been satisfactorily determined. One small fragment, referred to this species with doubt, retains the septa, and shows the siphon in a slightly eccentric position.

“The test has not been preserved. The casts of the interior indicate a transversely lamellose-striate surface. . . . This species is distinguished by its size, the moniliform siphuncle, and the distance between the septa”

The above is Prof. J. Hall's description of *Orthoceras Bebryx*, which occurs in the Hamilton Group, “in various localities in Central New York.”

The variety *Cayuga*, which has been observed in the lower members of the Chemung Group, is said to differ from the species only in “the comparatively deeper air-chambers, which are about as three to four in the two forms, when measurements are made at points on the tube having the same diameter in the different specimens. From the specimens included in this variety several additional features have been observed, not clearly shown in the individuals from the Hamilton Group. The transverse section is circular. Chamber of habitation cylindrical, well developed, its full extent not being observed. Septa smooth and thin. Siphuncle excentric, distant from the dorsal and ventral margins in the ratio of 3 to 7, or twelve and twenty-eight millimetres, where the tube has a diameter of forty millimetres. . . .

“The specimens embraced in this variety and in the species above constituted are all very imperfect.”

Horizon. Chemung Group, Upper Devonian.

Locality. Ithaca, State of New York.

Represented by one imperfect specimen, presented by J. E. Lee, Esq., F.S.A., F.G.S.

Orthoceras, sp.

Remarks. These specimens are not in a condition for specific identification. They consist of three or four fragmentary casts much distorted, crushed, and weathered. The matrix is a sandstone. Two of the specimens exhibit the septa, which have a considerable obliquity, and are highly arched. The siphuncle appears to have been eccentric. The rate of tapering cannot be accurately made out, but it was rather slow.

I have consulted Messrs. Sharpe and Salter's Memoir on the Devonian Fossils of the Cape Colony (Trans. Geol. Soc. 2nd series,

vol. vii. pp. 203 *et seq.*), but *Orthoceras* is not mentioned therein. Prof. T. Rupert Jones in his "Notes on some Fossils from the Devonian Rocks of the Witzenberg Flats, Cape Colony" (Quart. Journ. Geol. Soc. vol. xxviii. 1872, p. 28), records the occurrence of *Orthoceras vittatum*, Sandb., amongst other Devonian mollusks, but I am unable to identify the specimens in the collection with this species.

Horizon. Devonian (division unknown).

Locality. Guerboom River, Plettenberg Bay, South Africa. Presented by W. E. Balston, Esq., F.L.S., F.G.S.

Orthoceras Chinense, Foord.

1856. *Orthoceras*, sp., S. P. Woodward, Quart. Journ. Geol. Soc. vol. xii. p. 378, pl. vi. f. 1.

1869. *Orthoceras*, sp., Kingsmill, Quart. Journ. Geol. Soc. vol. xxv. p. 126.

1897. *Orthoceras*, sp., Grieve, Trans. Nat. Hist. Soc. Glasgow, vol. i. (n. s.), p. 3, pl. vi.

Sp. Char. Shell straight, cylindrical. Rate of increase 1 in 9. Length of body-chamber unknown. Septa distant about $\frac{1}{2}$ the diameter or more, but becoming more crowded as they approach the chamber of habitation; direct; strongly arched; the necks very long, so as to reach nearly halfway across the space between two septa. Siphuncle central, cylindrical, very slightly constricted between the necks. Test unknown.

Remarks. This is the well-known "Pagoda-stone"¹ of the Chinese, and as it appears to be specifically separable from other Palæozoic Orthoceratites, I have judged it advisable to give it a specific name.

The species nearest to it is one described by M. Barrande from the Silurian rocks (Étage E) of the Bohemian basin, under the name of *Orthoceras jucundum*². From this it is distinguished by the much greater length of the necks of the septa.

The present species is known only by polished sections; there are therefore no surface characters by which to discriminate it.

The largest specimen in the Collection is about 2 feet 6 inches long, of which the small portion of the body-chamber preserved occupies 2 inches. Its greatest diameter is 4 inches. A smaller

¹ So called from the belief existing among the Chinese that the stone is formed underground in places upon whose surface the tower of a pagoda has thrown its shadow (Hochstetter, in 'Geologist' for 1860, p. 419).

² Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 518, pl. cccclxxx. ff. 4-7, pl. ccccix. ff. 7-10.

specimen measures 1 foot $6\frac{1}{2}$ inches in length. This is the one described and figured by Dr. S. P. Woodward (*loc. cit.*). Both were "obtained by Mr. Lockhart, of Shanghai, from some place 200 miles distant."

A good deal of uncertainty exists as to the horizon of the beds whence these Orthoceratites were procured. Mr. T. W. Kingsmill (*loc. cit.*) in his "Notes upon the Geology of China" (Provinces of the Lower Yangtse) gives a list of fossils (Crustacea, Mollusca, Corals, &c.), some of which he himself collected and others he procured in the "medicine-shops."

The list is as follows:—

At least one species of Orthoceratite.

Euomphalus, a species closely allied to, if not identical with, *E. pentangulatus*.

Some internal casts, probably *Cirrus*.

Aviculopecten, probably *A. duplicatus*.

Spirifer disjunctus, and four other species of the same genus.

Stringocephalus, three species.

Rhynchonella, five species.

Rhynchonella (*R. pleurodon*?).

Terebratula hastata?

Athyris?

Orthis, two species.

A Trilobite.

Cyprididæ.

Cyathophyllum?

Heliolites?

Remains of Encrinites.

Mr. Kingsmill adds that he had "no means of comparison with actual specimens," and therefore the fossils named are "merely put forward hypothetically." They were mostly collected on two islands (Tungting Islands) in Lake Taihu (or Taihoo) in the Province of Kiang-Su, in a limestone, No. 4 of Kingsmill's "Tungting series." Further on he observes: "Taking the whole Tungting system, there is a striking resemblance between it and the Devonian and Subcarboniferous rocks of the south of Ireland—the same succession of grits and shales at the bottom, and a similar development of limestone above; while the type of the few fossils found seems likewise to approach that of the Lower Carboniferous rocks of Europe."

In 1853¹ Mr. Thomas Davidson examined and described the fossil Brachiopods presented to the British Museum by Mr. Hanbury

¹ Quart. Journ. Geol. Soc. vol. ix. 1853, p. 353, pl. xv.

along with *Orth. Chinense*. Mr. Davidson referred them to "eight Devonian species, seven of which are common to several European localities," such as Ferques and Néhou (France), Belgium, and the Eifel. Dr. Grieve's paper throws no additional light upon the question of the age of the beds holding *Orthoceras Chinense*.

This species is mentioned in the volume upon the Palæontology of China¹ which accompanies F. von Richthofen's 'China,' but it was not represented among the fossils examined by the palæontologists engaged upon that work.

Horizon. Devonian?

Locality. The specimens whose dimensions are given above came "from some place 200 miles distant from Shanghai," and were presented to this Museum by Daniel Hanbury, Esq. Another specimen (No. 88,986) is stated to be "from the interior of the Province of Quang-Tung, China." The latter was presented by the Hon. R. Marsham, in 1877.

CARBONIFEROUS SPECIES.

Orthoceras cylindraceum, Fleming.

1815. *Orthocera cylindracea*, Fleming, Annals of Philosophy, vol. v. p. 202, pl. xxxi. f. 3 (not of Sowerby).

? 1844. *Orthoceras cylindraceum*, M'Coy, Carboniferous Foss. of Ireland, p. 7.

1855. *Orthoceras cylindraceum*, M'Coy, British Pal. Foss. fasc. iii. p. 569. [Not 1841. *Orthoceras cylindraceum*, Phillips, Pal. Foss. of Cornwall, Devon, and West Somerset, p. 113, pl. xliii. f. 213.]

Sp. Char. Shell straight. Section nearly circular. Rate of increase about 1 in 10. Septa very numerous, slightly waved. Siphuncle nearly central. Surface very minutely striated transversely.

Remarks. This species resembles Fleming's *O. pyramidale* in general habit, but it tapers more slowly, and has much more numerous septa. M'Coy observes (British Pal. Foss. *loc. cit.*) that the original Devonshire specimens figured by Sowerby in the Geological Transactions (2nd series, vol. v. pl. lii. ff. 6, 7) under the name *O. cylindraceum* are indeterminable fragments, and cannot be referred with certainty to this or any other species.

Horizon. Carboniferous Limestone².

Locality. Near Matlock (?), Derbyshire.

Represented in the Collection by a polished section.

¹ Beiträge zur Paläontologie von China, Abhandlungen von Dr. W. Dames, Dr. E. Kayser, Dr. G. Lindström, Dr. A. Schenk, und Dr. C. Schwager. Herausgegeben von F. F. von Richthofen. Besondere Ausgabe von F. von Richthofen's 'China,' Band iv. Berlin, 1883.

² Commonly known in England as the 'Mountain Limestone.'

Orthoceras, sp.

This resembles the last one very closely, excepting in its rate of increase, which is much more rapid, viz. 1 in 6. It has equally numerous septa with *O. cylindraceum*, and may be only a variety of that species.

Horizon. Carboniferous Limestone.

Locality. Unknown.

Orthoceras affine, Portlock.

? 1836. *Orthoceras ovale*, Phillips, Geol. of Yorkshire, pt. ii. p. 238.

1843. *Orthoceras affine*, Portlock, Rep. on the Geol. of Londonderry &c., p. 387, pl. xxvii. f. 9 (not *Thoracoceras affine*, Fischer).

? 1845. *Orthoceratites ovalis*, Murch., Vern., and de Keyserl. Géol. de la Russie d'Europe, vol. ii. p. 354, pl. xxv. f. 1.

1855. *Orthoceras ovale*, M'Coy, British Pal. Foss. fasc. iii. p. 572.

? 1860. *Orthoceras ovale*, Eichwald, Lethæa Rossica, vol. i. Seconde Sect. de l'ancienne Période, p. 1221, pl. xlix. f. 15, a, b.

Sp. Char. Shell straight. Section circular, but becoming oval towards the aperture. Rate of increase about 1 in 7. Length of body-chamber nearly twice the basal diameter, with a very perceptible constriction close to the aperture. Septa direct, distant about $\frac{1}{3}$ the diameter of the shell. Siphuncle small, central. Surface of the test smooth, or marked with irregular thread-like lines.

Remarks. This species may be identical with Phillips's *O. ovale*, but the description given of the latter is much too brief and general to be of use, unaccompanied by a figure. It runs thus:—"Elongate, section broad-oval, siphuncle a little eccentric, septa without wave."

M'Coy's description agrees very well with the species described and figured by Portlock under the name of *O. affine*, to which I refer the specimens in the National Collection.

This species is distinguished from *O. inequisseptum*, Phill., and other allied forms, by the greater distance separating the septa.

Horizon. Carboniferous Limestone.

Localities. Ireland: Northampton; obtained from a boring 900 feet deep. The specimen from this last locality was presented by H. J. Eunson, Esq., F.G.S.¹

Fairly well represented in the Collection.

Orthoceras pyramidale, Fleming.

1815. *Orthocera pyramidalis*, Fleming, Annals of Philosophy, vol. v. p. 202, pl. xxxi. f. 2.

¹ See an interesting account of borings for water at Northampton in a paper by Mr. Eunson in the Quart. Journ. Geol. Soc. vol. xl. 1884, p. 482.

? 1843. *Orthoceras pyramidale*, Portlock, Rep. on the Geol. of London-derry, &c., p. 389.

1844. *Orthoceras pyramidale*, M'Coy, Carboniferous Foss. of Ireland, p. 7.

Sp. Char. Shell straight. Section circular. Rapidly tapering, at the rate of about 1 in 5. Septa slightly undulating, rather approximate, distant about $\frac{2}{7}$ the diameter. Siphuncle small and central. Test smooth?

Horizon. Carboniferous Limestone.

Localities. Chipping, near Preston, Lancashire; Rathfarnham, Dublin.

Well represented in the Collection by specimens presented by John Rofe, Esq.

***Orthoceras amabile* ?, de Koninck.**

1880. *Orthoceras amabile*, de Koninck, Cal. Carbonifère de la Belgique, p. 57, pl. xxxix. ff. 7, 8, pl. xl. f. 4, pl. xlii. f. 3.

Sp. Char. Shell straight. Section circular. Rate of increase about 1 in 5. Dimensions of body-chamber a little more than $\frac{1}{4}$ the total length of the shell. Septa nearly equidistant in the upper part of the shell, but a little closer together and less equally spaced in the lower part; about eight can be counted within the space of one inch. The siphuncle is slightly eccentric. The surface of the test is perfectly smooth.

Remarks. The specimen in the National Collection comes very near to this species, albeit there are some points of difference between them. In the former the rate of tapering is higher than in *O. amabile*, and also the siphuncle, instead of being only slightly eccentric, as it is in de Koninck's species, is submarginal. In all other respects the two forms agree closely enough, and I have little hesitation in considering them as identical.

Horizon. Carboniferous Limestone.

Locality. Kildare.

Fairly well represented in the Collection by examples presented by S. P. Pratt, Esq.

***Orthoceras perellipticum*¹, Foord.**

1844. *Orthoceras (Loxoceras) distans*, M'Coy, Carboniferous Foss. of Ireland, p. 8, pl. iv. f. 1 (not of Sowerby).

¹ As the subgenus *Loxoceras* has been given up, and as the specific name *distans* has been employed by Sowerby, I have substituted the above name for M'Coy's.

Sp. Char. Shell straight. Section elliptical, the ratio of the two diameters being as 12 : 8 in the type specimen, as figured by M'Coy, but as 28 : 15 in the specimen in the National Collection. Length of body-chamber not ascertainable, but it was at least $1\frac{1}{2}$ times the diameter of its base. Septa very oblique, appearing somewhat distant in the example figured by M'Coy, but in the adult shell they are distant only $\frac{1}{4}$ of the diameter. Siphuncle nearly central, its structure being unknown. Surface of test quite smooth.

Remarks. It seems to be pretty clear that the specimen in the National Collection is the adult form of the species. The strongly oblique septa and compressed form of the shell are very characteristic, and in these features it exactly resembles M'Coy's type.

I am by no means certain that *O. perellipticum* does not belong to the same group as *Actinoceras imbricatum*, Wahl., and *A. undulatum*, Sow., but as there is no trace of the siphuncle in the specimen before me, I cannot solve this question.

Horizon. Carboniferous Limestone.

Locality. Cork, Ireland.

Represented in the Collection by a single example.

Orthoceras inæquiseptum, Phillips.

1836. *Orthoceras inæquiseptum*, Phillips, Geol. of Yorkshire, pt. ii. p. 238, pl. xxi. f. 7.
1843. *Orthoceras calamus*, de Koninck, Précis élém. de Géol., par J. J. d'Omalus, p. 516.
1844. *Orthoceras calamus*, de Koninck, Descrip. des Anim. Fossiles de la Belgique, p. 506, pl. lix. f. 2.
1845. *Orthoceratites calamus*, de Verneuil, Géologie de la Russie d'Europe, vol. ii. Paléont. p. 356.
1849. *Orthoceratites calamus*, d'Orbigny, Prodr. de Paléont. stratigraphique, vol. i. p. 113.
1851. *Orthoceras calamus*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 234.
1855. *Orthoceras inæquiseptum*, M'Coy, British Pal. Foss. fasc. iii. p. 571.
1860. *Orthoceras Martinianum*, Eichwald, Lethæa Rossica, vol. i. Seconde Sect. de l'ancienne Période, p. 1218 (not of de Koninck).
1880. *Orthoceras calamus*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 52, pl. xxxviii. f. 6.

Sp. Char. Shell straight, very elongated and gradually tapering. Length of body-chamber in the type specimen (which is imperfect) about five times its basal diameter. "Septa very numerous, five occupying the space of one diameter in specimens varying from a little more than two lines in diameter (about four in a diameter when a little smaller), moderately concave, their edges nearly even, and

at right angles to the long axis of the shell, but very slightly waved; surface not distinctly seen, but apparently smooth" (M'Coy). Siphuncle moderately large, nearly central.

Remarks. This species is distinguished from *O. cylindraceum* by its more numerous chambers. M. de Koninck observes with reference to the Belgian form of the present species, that it is found exclusively in the upper beds of the "Calcaire carbonifère," in which horizon it is found in abundance at Visé (Assise vi.). It was found also by M. de Verneuil in the "calcaire" of Cosatchi-Datchi in the Oural, which belongs to the same beds. M. de Koninck adds:—"If, as I suppose, the *O. inæquiseptum*, J. Phillips, is identical with the preceding species [*O. calamus*], it exists also in the [Carboniferous] limestone of Bolland, in Yorkshire." De Koninck mentions also the occurrence of his species at Settle, Yorkshire, in various places in Ireland, and in Scotland. It therefore appears that *O. calamus* and *O. inæquiseptum* are identical; and that being the case, Phillips's species takes precedence.

Horizon. Carboniferous Limestone.

Localities. *British.* Bolland, Yorkshire; Ell Bolton.—*Foreign.* Visé, Belgium.

Fairly well represented in the Collection. One of the specimens forms part of the "Gilbertson Collection" in this Museum, and was figured by Phillips in his 'Geology of Yorkshire' (*loc. cit.*).

The specimen from Ell Bolton was presented by J. E. Lee, Esq.

Orthoceras cinctum, Sowerby.

1829. *Orthocera cincta*, Sowerby, Min. Conch. vol. vi. p. 168, tab. dlxxxviii. f. 3.

1836. *Orthoceras cinctum*, Phillips, Geol. of Yorkshire, pt. ii. p. 237, pl. xxi. f. 1.

1840. *Orthoceratites cinctus*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 99, Taf. xix. f. 4, a, b.

? 1841. *Orthoceras cinctum* (?), Phillips, Pal. Foss. of Cornwall, Devon, and West Somerset, p. 109, pl. xli. f. 204.

? 1842. *Orthoceratites cinctus*, d'Arch. & de Vern. Trans. Geol. Soc. vol. vi. pt. 2, p. 385.

1844. *Orthoceras cinctum*, M'Coy, Carboniferous Foss. of Ireland, p. 7.

1844. *Orthoceras cinctum*, de Koninck, Descrip. des Anim. Fossiles de la Belgique, p. 512, pl. xliii. f. 6, a, b, pl. xlv. f. 5, a, b, ? pl. xlvii. f. 3, a, b.

1876. *Orthoceras cinctum*, Armstrong, Young, and Robertson, Cat. of Western Scottish Fossils, p. 59.

Sp. Char. Shell straight. Section circular. Rate of increase about 1 in 8. Septa rather remote, judging by the example figured

by Phillips; in this they are distant about $\frac{1}{4}$ the diameter. The siphuncle is central. The surface is ornamented with numerous fine, thread-like, transverse lines, in which a certain regularity of grouping may be observed (Phillips's specimen); that is, there are broader lines with narrower ones (two or three) between them. The lines have a very markedly undulating course in Phillips's type specimen, but they are not so represented in Sowerby's figure, and therefore this may not be a constant character. They are figured by Münster and de Koninck also as perfectly direct.

Remarks. This species is recorded by d'Archiac and de Verneuil, de Koninck, and Eichwald as occurring in Silurian (? Ordovician) strata, but as these authors give no figures one cannot tell what their fossil really is.

Horizon. Carboniferous Limestone.

Localities. *British.* Bolland, Yorkshire.—*Foreign.* Tournai, Belgium.

The "Gilbertson Collection" in this Museum contains the specimen figured by Phillips in the 'Geology of Yorkshire' (*loc. cit.*).

Orthoceras dactyliophorum, de Koninck.

1843. *Orthoceras annulatum*, de Koninck, Précis élém. de Géologie, par J. J. d'Omalius, p. 515 (not of Sowerby).

1844. *Orthoceras dactyliophorum*, de Koninck, Description des Anim. Fossiles de la Belgique, p. 318, pl. xlvii. f. 2, pl. xlviii. f. 7, a, b.

Sp. Char. Shell straight. Section circular. Very slowly increasing. Septa rather strongly convex, distant about $\frac{1}{4}$ the diameter of the shell. Siphuncle central. Ornaments consisting of strong, obtusely rounded annulations, distant from each other rather more than their own width, *i. e.* about 3 lines, measuring from summit to summit. The entire surface is covered with fine, transverse riblets, and there are also obscure traces of longitudinal riblets.

Remarks. The species most nearly resembling this one is *Orthoceras* ("Cycloceras") *levigatum*, McCoy, but that is described as having a perfectly smooth surface, that is, it has no riblets. It has moreover, according to de Koninck's figures of it, a more rapid rate of tapering than the present species. *O. annulato-costatum*, Meek and Worthen (Palæont. of Illinois, vol. ii. 1866, p. 304, pl. xxiv. ff. 3 a, 3 b), is also an allied form, but like the last named it tapers more rapidly, and is besides somewhat compressed instead of circular.

Horizon. Carboniferous Limestone.

Locality. Kildare.

Fairly well represented in the Collection.

Orthoceras reticulatum, Phillips.

1836. *Orthoceras reticulatum*, Phillips, Geol. of Yorkshire, pl. xxi. f. 11.

Sp. Char. Shell straight. Section circular. Rate of increase rapid, about 1 in 4. Septa distant between $\frac{1}{4}$ and $\frac{1}{5}$ the diameter. Ornaments consisting of strong annulations which are distant about $\frac{2}{5}$ the diameter. The reticulate markings described by Phillips cannot now be made out upon the type specimen, which, however, may have lost a portion of its test since that author examined it. What remains of the test, which is probably the inner layer, is perfectly smooth.

Remarks. This species comes very near in form and ornamentation (excepting the alleged reticulate markings) to *O. Koninckianum*, d'Orb., but the annulations are more distant in the present species.

Horizon. Carboniferous Limestone.

Locality. Bolland, Yorkshire.

Represented by the specimen figured by Phillips, and now in the "Gilbertson Collection," which was acquired by purchase in 1841.

Orthoceras sulcatum, Fleming.

1793. *Orthoceratites* . . . *superficie sulcata*, Ure, History of Rutherglen and East-Kilbride, p. 306, pl. xvi. f. 2.

1815. *Orthocera sulcata*, Fleming, Annals of Philosophy, vol. v. p. 202, pl. xxxi. f. 6.

1815. *Orthocera undata*, Fleming, Annals of Philosophy, vol. v. p. 203, pl. xxxi. f. 7.

1836. *Orthoceras annulatum*, Phillips, Geol. of Yorkshire, pt. ii. p. 239, pl. xxi. f. 9, ? 10 (not of Sowerby).

1841. *Orthoceras lineolatum*, Phillips, Pal. Foss. of Cornwall, Devon, and West Somerset, p. 111, pl. xliii. f. 209 b.

1855. *Orthoceras (Cycloceras) undatum*, M'Coy, British Pal. Foss. fasc. iii. p. 574.

1874. *Orthoceras undatum*, Young and Armstrong, Trans. Geol. Soc. Glasgow, vol. iv. p. 281.

1876. *Orthoceras undatum*, Armstrong, Young, and Robertson, Cat. of the Western Scottish Fossils, p. 59.

Sp. Char. Shell straight or slightly curved. Section a little oval. Rate of tapering about 1 in 5. Septa very convex, distant. Siphuncle almost exactly central. Surface marked with prominent more or less acute annulations, which have an undulating course in encircling the shell. The annulations as well as the spaces between them are covered with fine thread-like lines, of which there are

four or five in the interspaces, and about the same number on the sides and summits of the annulations.

Remarks. I have united these two species of Fleming because I cannot find any sufficiently distinctive character by which to separate them. The only feature relied upon by Fleming to distinguish *O. undatum* from *O. sulcatum* was the alleged smoothness of the shell in the former; but this, as pointed out by M'Coy (*loc. cit.*), may be accounted for by the absence of the shell, the striations being too feeble to leave any marks upon the cast. It is true that the specimen figured by Phillips in the 'Geology of Yorkshire' (*loc. cit.*) differs slightly from the Scotch specimens in the Collection in the character of the ribbing, which is more prominent and acute, but the specimen is only a small fragment, and the feature observed may be an individual peculiarity. M'Coy remarks that *O. sulcatum* tapers more slowly than *O. undatum*; this may be so, but the specimens before me are too fragmentary to show such a feature satisfactorily.

From *O. dactylophorum*, de Kon., the present species differs in its more rapid rate of increase, and in the entire absence of longitudinal lines upon the surface of the shell, which are present in the former.

Horizon. Carboniferous Limestone.

Locality. Bowes, Yorkshire.

Represented by the specimen figured by Phillips (Geol. of Yorks.) and contained in the "Gilbertson Collection" in this Museum.

Orthoceras angulare, Phillips.

1836. *Orthoceras angulare*, Phillips, Geol. of Yorkshire, pt. ii. p. 238, pl. xxi. f. 4.

Sp. Char. A very imperfect fragment (the type specimen) is described by Phillips under this name; "subcylindrical with a few longitudinal furrows; septa very distant." The septa are slightly oblique, and are four lines distant in a diameter of eight lines.

Remarks. A faintly marked ridge is present upon what appears to be the inner shell-layer, and a shallow furrow is observable upon the cast, whence the shell has been removed, and it might be inferred from this that the shell was ridged longitudinally, but the specimen is too imperfect to justify a confident assertion on this point.

Horizon. Carboniferous Limestone.

Locality. Bolland, Yorkshire.

Represented by Phillips's type in the "Gilbertson Collection."

Orthoceras subcanaliculatum, de Koninck.

1844. *Orthoceras subcanaliculatum*, de Koninck, Descrip. des Anim. Fossiles de la Belgique, p. 519, pl. xlvii. f. 5, a, b.

1849. *Orthoceras subcanaliculatus*, d'Orbigny, Prodr. de Paléont. Stratigraphique, vol. i. p. 113.

Sp. Char. Shell straight or slightly curved. Section nearly circular. Septa very approximate, and very slightly convex. Siphuncle filiform, subcentral. Surface ornamented with about forty longitudinal smooth and prominent ridges, of which twenty are smaller and less elevated than the others, and alternate regularly with them. Between the larger and smaller ridges there are still finer ones, so that the whole of the shell-surface is covered with longitudinal lines.

Horizon. L'Argile Carbonifère (Assise i.)=Carboniferous Limestone.

Locality. Tournai, Belgium.

Fairly well represented in the Collection.

Orthoceras sagitta, de Koninck.

1851. *Orthoceras sagitta*, de Koninck, Descrip. des Anim. Fossiles de la Belgique (Supplément), p. 703, pl. lix. f. 3.

1880. *Orthoceras sagitta*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 51, pl. xxxviii. f. 4.

Sp. Char. Shell straight, very long and slender. Section circular. Rate of increase about 1 in 18. Septa pretty strongly convex, relatively very distant; their distance equals nearly $\frac{2}{3}$ of their transverse diameter. The body-chamber appears to have been very large, and to have occupied a little less than $\frac{1}{3}$ of the total length of the shell. The siphuncle is filiform, and is situated close to the margin. The surface of the test shows no trace of striæ or of other ornaments.

Remarks. This species is distinguished from *O. calamus*, *O. Martinianum*, *O. tibiale*, and *O. simile* by the distance of its septa, as well as by the marginal position of its siphuncle.

Horizon. Calcaire Carbonifère de Visé (Assise vi.)=Carboniferous Limestone.

Locality. Visé, Belgium.

Represented in the Collection by two fragments.

Orthoceras Martinianum, de Koninck.

1844. *Orthoceras Martinianum*, de Koninck, Descrip. des Anim. Fossiles de la Belgique, p. 505, pl. xlv. f. 4.

1849. *Orthoceratites Martinianus*, d'Orbigny, Prodr. de Paléont. Stratigraphique, vol. i. p. 113.
1851. *Orthoceras Martinianum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 236.
1880. *Orthoceras Martinianum*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 53, pl. xlv. f. 4.

Sp. Char. Shell straight, very slender at its inferior extremity. Section circular. Septa very slightly convex and rather approximate, so that in a fragment measuring $1\frac{1}{2}$ inch in length there are 22 septa. The body-chamber occupies about $\frac{1}{3}$ of the total length of the individual; its margin is a little oblique. The siphuncle is narrow and filiform, and slightly eccentric in position. The surface of the test is perfectly smooth, there being nothing but a few slight oblique undulations produced by the growth of the shell.

Horizon. Calschiste de Tournai (Assise i. e) = Carboniferous L.

Localities. Tournai, Visé, Belgium.

Fairly well represented in the Collection.

Orthoceras Muensterianum, de Koninck.

1843. *Orthoceras irregularis*, de Koninck, Précis élém. de Géologie, par J. J. d'Omalius, p. 516 (not of Münster).
1844. *Orthoceras Muensterianum*, de Koninck, Descrip. des Anim. Fossiles de Belgique, p. 506, pl. xliii. f. 5, & pl. xlvi. f. 13 (excl. pl. xliii. f. 1, & pl. xlv. f. 1) (not of d'Orbigny).
1849. *Melia Muensteriana*, d'Orbigny, Prodr. de Paléont. Stratigraphique, p. 114.
- ? 1873. *Orthoceras Muensterianum*, Meek & Worthen, in Worthen's Geol. Surv. of Illinois, vol. v. pl. xxiii. f. 5, a-d.
1880. *Orthoceras Muensterianum*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 52, pl. xlii. f. 9.

Sp. Char. Shell straight; often compressed, but regularly conical when well preserved. Rate of tapering about 1 in 5 in a compressed specimen, measured along its greatest diameter. The septa are tolerably deep, and the last ones are distant about 4 lines. The body-chamber, of which the walls are perfectly straight, occupies about $\frac{1}{3}$ the total length of the shell. The surface of the test is quite smooth.

Remarks. M. de Koninck observes that the depressed form of a great number of specimens of this species, which is the cause of the elliptical form of their transverse section, is purely accidental, as is shown by well-preserved specimens.

Horizon. Calschiste de Tournai (Assise i. e) = Carboniferous L.

Locality. Tournai, Belgium.

Fairly well represented in the Collection.

Orthoceras ? cucullus, de Koninck.

1851. *Orthoceras cucullus*, de Koninck, Descr. des Anim. Fossiles de la Belgique (Supplément), p. 54, pl. lix. f. 1, *a*, *b*.

1880. *Orthoceras cucullus*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 64, pl. xlv. f. 1.

Sp. Char. Shell straight, but not regularly conical. The transverse section represents an ellipse the ratio of whose axes is about as 10 : 7, but this may be due to compression. The rate of tapering is very rapid, being about 1 in $2\frac{5}{6}$. The septa are somewhat shallow and moderately distant; they form a broad and shallow sinus on one side and curve rapidly upwards laterally. The siphuncle, of which the diameter is about $1\frac{1}{2}$ line, is situated $\frac{2}{5}$ across the smaller axis of the ellipse.

The surface of the test is perfectly smooth.

Remarks. This may be an *Actinoceras*. In the undulating form of the septa it resembles *Actinoc. striatum*, Sow., but its remarkably rapid rate of increase distinguishes it completely from that and other allied species.

The specimen in the National Collection being partly buried in the matrix, the siphuncle cannot be made out, and this information is necessary before any definite conclusion can be come to as to its affinities. At present I place it in the genus *Orthoceras*.

M. de Koninck makes no allusion in his description to the undulation of the septa, and figures them as if they were direct. He says that he was acquainted with but one specimen of the species, which he himself collected in the "Calcaire Carbonifère" of Visé (Assise vi.).

Horizon. Calcaire Carbonifère de Visé = Carboniferous Limestone.

Locality. Visé, Belgium.

Fairly well represented in the Collection.

Orthoceras Goldfussianum, de Koninck.

1843. *Orthoceras Goldfussianus*, de Koninck, Précis élém. de Géologie, par J. J. d'Omalius, p. 516.

1844. *Orthoceras Goldfussianum*, de Koninck, Descrip. des Anim. Fossiles de la Belgique, p. 510, pl. xliii. ff. 3, 4.

1844. *Orthoceras (Loxoceras) incomitatum*, M'Coy, Carboniferous Limestone Foss. of Ireland, p. 9, pl. i. f. 6.

1849. *Orthoceratites Goldfussianus*, d'Orbigny, Prodr. de Paléont. Stratigraphique, vol. i. p. 112.

1851. *Orthoceras Goldfussianum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 245.

1862. *Loxoceras inomitatum*, Griffith, Journ. Geol. Soc. of Dublin, vol. ix. p. 33.

1876. *Orthoceras Goldfussianum*, Armstrong, Young, and Robertson, Cat. of Western Scottish Fossils, p. 59.

1880. *Orthoceras Goldfussianum*, de Koninck, Faune du Calc. Carbonifère de la Belgique, pl. xxxviii. ff. 8, 9.

Sp. Char. Shell straight. Section circular, or nearly so, but generally elliptical through compression. Increasing rather slowly in diameter, at the rate of about 1 in 8. Septa very deep, approximate in the young, and becoming more distant as the shell increases in growth. About 40 septa may be counted in a complete individual. The body-chamber occupies $\frac{1}{3}$ of the total length of the shell. The margin of the aperture is slightly contracted, but not sinuous. Siphuncle subcentral; though of cylindrical form, it is slightly constricted as it passes through the necks of the septa. The surface of the test is smooth or marked only with fine striæ of growth.

Remarks. M. de Koninck refers *O. ovale* of Phillips to this species, but according to M'Coy's description of the former it tapers very slowly, and the septa are said to be only $1\frac{1}{2}$ line apart, whereas in *O. Goldfussianum* they are distant 3 lines.

Horizon. Calcaire Carbonifère (Assise vi.) = Carboniferous Limestone.

Locality. Visé, Tournai, Belgium.

Fairly well represented in the Collection.

Orthoceras conquestum, de Koninck.

1844. *Orthoceras conquestum*, de Koninck, Descrip. des Anim. Fossiles de la Belgique, p. 514, pl. xlv. f. 4.

1849. *Orthoceratites conquestus*, d'Orbigny, Prodr. de Paléont. Stratigraphique, vol. i. p. 113.

1851. *Orthoceras conquestum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 251.

1880. *Orthoceras conquestum*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 68, pl. xli. f. 7.

[*Cf.* 1836. *Orthoceras filiferum*, Phillips, Geol. of Yorkshire, pt. ii. p. 238.]

Sp. Char. Shell straight, very elongate, and slowly tapering. The septa rather deep and subhemispherical; their distance about $\frac{2}{3}$ of their transverse diameter. The body-chamber has not been observed. The siphuncle is relatively broad, and its diameter is equal to $\frac{1}{10}$ th of that of the septum; its situation is submarginal. The test is ornamented with very regular, direct, transverse striæ, and these are accompanied by small and indistinct annulations, of which about twelve or thirteen occupy the space between two septa.

Remarks. This species resembles the *O. cinctum* of Sowerby, and the *O. Morrisianum* of de Koninck, but it is easily distinguished by its lesser transverse diameter, by the submarginal position of its siphuncle, and by its much slower rate of tapering.

Horizon. Calcaire Carbonifère (Assise vi.) = Carboniferous Limestone.

Locality. Visé, Belgium.

Tolerably well represented in the Collection.

Orthoceras Morrisianum, de Koninck.

1851. *Orthoceras Morrisianum*, de Koninck, *Descrip. des Anim. Fossiles de la Belgique (Supplément)*, p. 55, pl. lix. f. 4.

1880. *Orthoceras Morrisianum*, de Koninck, *Faune du Calc. Carbonifère de la Belgique*, p. 69, pl. xl. f. 3.

Sp. Char. Shell straight. Section elliptical, perhaps by compression. Rate of increase about 1 in 9. Septa deep, and separated from one another by intervals which are nearly equal to $\frac{1}{3}$ of the transverse diameter. The body-chamber is very spacious, and occupies nearly $\frac{1}{3}$ of the total length. The siphuncle is narrow and central. The whole of the surface of the test is covered transversely with fine, thread-like lines, very regularly disposed.

Remarks. This species resembles in its ornamentation the *O. conquestum* and *O. salutatum* of de Koninck, but it differs from these in the central position of its siphuncle as well as by its much greater size. With the *O. cinctum* of Sowerby it may also be compared, but, judging by the figure in the 'Mineral Conchology,' Sowerby's species has much coarser ornamentation than *O. Morrisianum*.

Horizon. Calcaire Carbonifère (Assise vi.) = Carboniferous Limestone.

Locality. Visé, Belgium.

Represented in the Collection by one fairly good specimen.

Orthoceras Gesneri, Martin, sp.

1809. *Conchylolithus Nautilites Orthoceratites (Gesneri)*, Martin, *Petricata Derbiensia*, p. 17, pl. xxxviii. ff. 1, 2 (f. 2, young?).

1828. *Orthocera Gesneri*, Fleming, *British Anim.* p. 239.

1836. *Orthoceras Gesneri*, Quenstedt, *De Notis Nautil. primar.* p. 20.

1836. *Orthoceras Gesneri*, Phillips, *Geol. of Yorkshire*, pt. ii. p. 239, pl. xxi. f. 6.

1843. *Orthoceras Gesneri*?, Portlock, *Report on the Geol. of Londonderry*, p. 390.

1844. *Cyrtoceras tuberculatum*, M'Coy, *Carboniferous Foss. of Ireland*, p. 11, pl. iv. f. 2.

1844. *Orthoceras Gesneri*, de Koninck, *Descrip. des Anim. Fossiles de la Belgique*, p. 520, pl. xlvii. f. 4.
 ? 1854. *Orthoceras costellatum*, Roemer, *Palæontographica*, Band iii. p. 92, tab. xiii. f. 24.
 1855. *Orthoceras (Campyloceras) Gesneri*, M'Coy, *British Pal. Foss.* fasc. iii. p. 570.
 1860. *Orthoceras Gesneri*, Eichwald, *Lethæa Rossica*, vol. i. *Seconde Sect. de l'ancienne Période*, p. 1220.
 1862. *Cyrtoceras tuberculatum*, Griffith, *Journ. Geol. Soc. of Dublin*, vol. ix. p. 55.
 1876. *Cyrtoceras Gesneri*, Armstrong, Young, and Robertson, *Cat. of Western Scottish Fossils*, p. 58.

Sp. Char. Shell straight, or slightly curved. Section oval in adult specimens, nearly circular in the young. Rate of increase about 1 in 8. Septa simple, moderately numerous, averaging two lines apart. Siphuncle near the margin in the young, but approaching nearer the centre in the more aged. Surface ornamented with from 22 to 36 strong, equal, regular, narrow, prominent ridges, separated by slightly concave spaces, averaging twice the width of the ridges; the whole covered by very fine, transverse, raised lines, which in crossing the ridges form little arched squamæ, giving a nodose appearance to the ridges.

Remarks. This species has given rise to much difference of opinion among authors, especially as to whether the small, slightly curved specimen figured by Martin (f. 2) be the same as the large one (f. 1). M. de Koninck regards the former as a *Cyrtoceras*, on account of its curvature; but, as I have already remarked elsewhere, that is a feature which is very commonly met with in the genus *Orthoceras*, especially in the section *Angulati*, to which the present species belongs, and therefore it cannot be considered of generic value.

The difference in the position of the siphuncle represented in de Koninck and Phillips's figures is probably due to the difference in age of the individuals described by them. Such a change in position is by no means uncommon in Cephalopods, both recent and fossil.

With regard to the tuberculation existing upon the ridges in this species, Professor M'Coy remarks that as his *Cyrtoceras tuberculatum* was founded upon this character, it must merge into Martin's species, "as has been already recognized by M. de Koninck in his supplement." It should be remarked that the Belgian specimens have a slower rate of tapering than the English ones.

Horizon. Carboniferous Limestone.

Localities. *British.* Bolland, Yorkshire.—*Foreign.* Tournai, Belgium.

Represented by numerous specimens, including the one figured by Phillips (*loc. cit.*), which forms part of the "Gilbertson Collection" in this Museum.

Orthoceras unguis, Phillips.

- ? 1825. *Conilites unguatus*, de Blainville, Manuel de Malacologie, p. 378, pl. xi. f. 4.
 1836. *Orthoceras unguis*, Phillips, Geol. of Yorkshire, pt. ii. p. 238, pl. xxi. f. 2.
 1843. *Orthoceras unguis*, Portlock, Rep. on the Geology of Londonderry &c. p. 385.
 1844. *Orthoceras (Campyloceras) unguis*, M'Coy, Carboniferous Foss. of Ireland, p. 9.
 1844. *Cyrtoceras unguis*, de Koninck, Descrip. des Anim. Fossiles de Belgique, p. 524, pl. xlvi. ff. 8, a, b, c.
 1850. *Cyrtoceras unguis*, d'Orbigny, Prodr. de Paléont. Stratigr. prem. vol. p. 112.
 1851. *Cyrtoceras unguis*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 204.
 1862. *Campyloceras unguis*, Griffith, Journ. Geol. Soc. Dublin, vol. ix. p. 55.
 1876. *Cyrtoceras unguis*, Armstrong, Young, and Robertson, Cat. of the Western Scottish Fossils, p. 58.
 1877. *Cyrtoceras unguis*, Barrande, Céphalopodes, Etudes générales, pl. cccclxxxvii. case xii.
 1878. *Cyrtoceras unguis*, Barrande, Syst. Sil. de la Bohême, vol. ii. supplém. pl. cccclxxxvii. case xii.
 1880. *Cyrtoceras unguis*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 18, pl. xxxiv. ff. 2-5.
 [Not 1854. *Cyrtoceras unguis*?, Roemer, Palæontographica, Band iii. p. 93, tab. xiii. f. 28.]

Sp. Char. Shell very slightly curved towards its pointed extremity, and nearly straight in the superior portion. Transverse section nearly circular at first, but becoming oval at a slight distance from the initial point and preserving this form to the extremity of the anterior portion. The rate of tapering is about 1 in 5. The body-chamber is very large, making up about $\frac{1}{2}$ of the total length of the shell. Septa rather approximate, not deep, undulating. Siphuncle very slender, almost filiform, and cylindrical; central in the young, and subcentral in the adult. The surface is quite smooth. Some examples preserve traces of the original colouring of the test; this consists of a great number of transverse bands of colour, alternately light and dark, the colour-bands being wider on the inferior third than upon the superior part of the shell, where they become indistinct, and finally disappear. Specimens are not

uncommon in which the cicatrix is preserved upon the initial point as figured by Hyatt and reproduced by Barrande (1878, *loc. cit.*). It consists of a little elongate cleft or depression, having the direction of the long axis of the shell. This interesting phenomenon is observable in one of the specimens in the National Collection, from Bolland, Yorkshire. A specimen from Tournai, Belgium, shows zig-zag bands of colour, such as M. de Koninck mentions as occurring in a specimen from that locality recorded by him in 1844 (*Descrip. des Anim. Fossiles &c.*).

Remarks. This species is subject to great variation in outline owing to compression, because of the extreme tenuity of the test. The species nearest to it is *Orthoceras* ("Cyrtoceras") *digitus*, de Kon., in which, however, the section is circular, and the siphuncle nearer the margin than in *O. unguis*.

Horizon. Carboniferous Limestone; Calcaire Carbonifère (Assise vi.).

Localities. *British.* Bolland, Yorkshire.—*Foreign.* Visé, Tournai, Belgium.

Represented in the Collection by numerous specimens from Yorkshire and Belgium.

Orthoceras tenue, de Koninck, sp.

1851. *Cyrtoceras tenue*, de Koninck, *Descrip. des Anim. Fossiles de la Belgique* (Supplément), p. 56, pl. lix. f. 5.

1880. *Cyrtoceras tenue*, de Koninck, *Faune du Calc. Carbonifère de la Belgique*, p. 22. pl. xxxvi. f. 13.

Sp. Char. This small species is remarkable for its slight and irregular curvature and very slender form. It is generally curved only at the apex, often being nearly straight for more than two thirds of its length. The initial point is obtuse and very slightly curved. No trace of the cicatrix has been found. The transverse section is circular. The septa are numerous and very close to each other; regularly convex, and not deep. The body-chamber does not appear to have been very large. The siphuncle is very slender and filiform; it is eccentric, and situated between the centre and the margin. The surface of the test is perfectly smooth.

Remarks. *C. subulare*, de Kon., which is the nearest to this species, is distinguished by its less slender and shorter proportions.

Horizon. Calschiste de Tournai = Carboniferous Limestone.

Locality. Tournai, Belgium.

Fairly well represented in the Collection.

Orthoceras digitus, de Koninck, sp.

1880. *Cyrtoceras digitus*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 20, pl. xxxiv. ff. 11, 12.

Sp. Char. Shell slightly curved in the inferior portion, but nearly straight above. Section circular. Rate of increase rather rapid, between 1 in 4 and 1 in 5. The septa are numerous and disposed a little obliquely; they are not deep, and regularly concave. The siphuncle is situated on the ventral (?) side, near the border. The dimensions of the body-chamber are unknown; probably the extreme tenuity of the test has caused it to be broken off before fossilization. The surface is almost completely smooth, except a few faint striæ of growth, visible by the aid of a lens. The cicatrix is not observable, though the tip of one of the specimens in the Collection is preserved.

Remarks. M. de Koninck mentions the occurrence of this species in the Carboniferous Limestone in the neighbourhood of Rathkeale, Ireland, he having seen the specimen from this locality in the Museum of the Geological Survey at Dublin.

Horizon. Calcaire Carbonifère = Carboniferous Limestone.

Locality. Visé, Belgium.

The Collection possesses two examples of this species.

Orthoceras Frearsi, de Verneuil.

1845. *Orthoceratites Frearsi*, de Verneuil, in Murchison, de Verneuil, and de Keyserling, Géol. de la Russie d'Europe, vol. ii. Paléont. p. 356, pl. xxv. f. 3.

1849. *Orthoceratites Frearsi*, d'Orbigny, Prodr. de Paléont. Stratigraphique, vol. i. p. 113.

1860. *Orthoceras Frearsi*, Eichwald, Lethæa Rossica, vol. i. Seconde Sect. de l'ancienne Période, p. 1223.

Sp. Char. Shell straight. Section circular. Rate of increase about 1 in 5. Body-chamber too imperfect to characterize. Septa rather approximate, two lines distant in a diameter of ten lines; preserving an almost uniform distance in a fragment two inches and two lines in length. Siphuncle small, submarginal. Test unknown.

Remarks. The specimen figured by de Verneuil presents the very anomalous character of a diminution in diameter towards the aperture, which one is inclined to think must be due to some accidental circumstance of preservation. This diminution, as described by de Verneuil, begins at the third or fourth septum nearest the body-chamber. One might suppose, he adds, from this that the aperture

was half closed as in *Gomphoceras*. No such appearance is observable in the specimen in the National Collection.

Horizon. Calcaires Carbonifères blancs = Carboniferous Limestone.

Locality. Miatchkova, near Moscow.

Represented in the Collection by a single example.

Orthoceras Geinitzi, d'Orbigny.

1848. *Orthoceratites* —, Geinitz, Die Verstein. des deutschen Zechsteingebirges, p. 6, tab. iii. f. 8.

1849. *Orthoceratites Geinitzii*, d'Orbigny, Prodr. de Paléont. Stratigraphique, p. 163.

1861. *Orthoceras Geinitzi*, Geinitz, Die Animal. Ueberreste der Dyas, p. 43, Taf. xi. f. 8.

Sp. Char. Shell straight. Section apparently elliptical. Rate of tapering about 1 in 9. Septa rather remote, nearly $\frac{1}{2}$ the diameter distant from each other. Siphuncle very small, central. Surface characters unknown.

Horizon. Carboniferous Limestone.

Locality. Asturias, Spain.

One imperfect example of this species, presented by S. P. Pratt, Esq.

Orthoceras Koninckianum, d'Orbigny.

1844. *Orthoceras anceps*, de Koninck, Descrip. des Anim. Fossiles de la Belgique, p. 517, pl. xlv. f. 7, *a, b* (not of Münster).

1847. *Orthoceratites Koninckianus*, d'Orbigny, Prodr. de Paléont. Stratigr. prem. vol. p. 113.

Sp. Char. Shell straight. Section elliptical. Rapidly tapering at the rate of about 1 in 3. Septa distant about $\frac{1}{4}$ the diameter. Siphuncle situated about halfway between the centre and the periphery. Surface ornamented with a number of prominent rather distant annulations, which form at each extremity of the ellipse a small and well-marked sinus. The whole of the surface of the shell is covered with very fine, close-set raised lines.

Remarks. This species is distinguished from the *O. sulcatum* of Fleming by its much more rapid rate of tapering, and by the position of the siphuncle.

Horizon. Coal-Measures (Système Houiller).

Locality. Chockier, Belgium.

Fairly well represented in the Collection.

Orthoceras ? pygmæum, de Koninck.

1844. *Orthoceras pygmæum*, de Koninck, Descrip. des Anim. Fossiles de la Belgique, p. 507, pl. xlv. f. 5, *a, b*.

[? 1840. *Orthoceras*, sp., Sowerby, Trans. Geol. Soc. ser. 2, vol. v. pl. xl. f. 4.]

1876. *Orthoceras pygmæum*, Armstrong, Young, and Robertson, Cat. of the Western Scottish Foss. p. 59.

Sp. Char. A small compressed fragment, elliptical in section, and measuring 5 lines in length, consisting of part of the septate portion of the shell. The test is perfectly smooth, and so thin and transparent as to show the septa through it. These are very slightly convex and pretty near to each other, so that thirteen or fourteen of them can be counted in the specimen. The siphuncle is very slender and quite marginal. The rate of increase is about 1 in 5. The shell appears to be straight.

Remarks. This may be identical with Sowerby's species, its small size, coupled with the marginal position of the siphuncle, making the resemblance between the two forms somewhat striking. The position of the siphuncle and the decidedly elliptical cross section of this fossil points to its affinity with the Cyrtoceratidæ, but for the present it is perhaps better that it should remain where M. de Koninck has placed it.

O. pygmæum is recorded in the 'Catalogue of the Western Scottish Fossils' as occurring at Gare, and at South Hill, Campsie.

Horizon. Coal-Measures (Système Houiller), in the calcareous nodules of the "schiste alumineux" of Chockier.

Locality. Chockier, Belgium.

Represented in the Collection by the specimen figured and described by de Koninck.

Orthoceras læve, Fleming.

1793. *Orthoceratites* . . . *superficie lævi*, Ure, History of Rutherglen and East Kilbride, p. 306, pl. xvi. f. 3.

1815. *Orthocera lævis*, Fleming, Annals of Philosophy, vol. v. p. 201, pl. xxxi. f. 1.

1840. *Orthoceras læve*, Quenstedt, in Leonhard & Bronn's Neues Jahrb. p. 270.

1852. *Orthoceras læve*, Giebel, Fauna der Vorwelt, Band iii. p. 267.

1876. *Orthoceras læve*, Armstrong, Young, and Robertson, Cat. of the Western Scottish Fossils, p. 59.

Sp. Char. Shell straight. Section circular, though often much compressed, owing to the extreme tenuity of the test. Rate of tapering about 1 in 6. Septa numerous and somewhat oblique, distant about $\frac{1}{3}$ the diameter of the shell. Surface perfectly smooth. The siphuncle is small and central. The test is so thin and transparent that the septa can be readily seen through it. The dimen-

sions of the body-chamber cannot be determined owing to its imperfect preservation.

Remarks. The thinness and horny appearance of the test in this species is a feature which is met with in other forms in the Carboniferous shales both in Britain and in Belgium, and probably denotes a deficiency in the supply of calcareous matter in the water which these species inhabited.

Horizon. Calciferous Sandstone¹; Lower Limestone Group.

Localities. Eskdale, Dumfriesshire; Boghead, Lanarkshire; Redesdale, Northumberland; Fifeshire.

Some of the specimens from Redesdale were presented by J. E. Lee, Esq., F.S.A., F.G.S.

This species is represented in the Collection by a large number of specimens.

Orthoceras teres, Sowerby, sp.

1821. *Conularia teres*, Sowerby, Mineral Conchology, vol. iii. p. 108, tab. cclx. ff. 1, 2. [Not *Orthoceras teres*, Barrande, *ante*, p. 12.]

Sp. Char. Shell very slightly curved. Section nearly circular, but a little compressed. Rate of tapering nearly 1 in 5. Septa somewhat distant, that is about $\frac{1}{3}$ the diameter of the shell. Only three of the septa are visible, where the shell has been broken, at the apical end of the specimen. The siphuncle, which is seen only at the smaller extremity of the shell, is almost central. The surface of the test is beautifully ornamented with waved riblets, which form a deep sinus on the outer curvature of the shell, thence sweeping upwards in a broad arch on either side, and meeting in a very slight sinus on the opposite or inner curvature of the shell. About five of the riblets occupy the space of one line, the intervals between them being of about the same width as they. The apex, the tip of which is broken off, is quite smooth for a distance of about two lines, the riblets being at first crowded together, till at a height of

¹ The following is the succession of the rocks of the Carboniferous Limestone Series of Scotland in descending order:—

Carboniferous Limestone Series.	{	Upper Limestone Group.
		Edge Coal Group.
		Lower Limestone Group.
Calciferous Sandstone Series.	{	Cement-stone Group.
		Red Sandstone Group.

“The Carboniferous Limestone Series of Scottish geologists probably represents the upper part of the Carboniferous Limestone Series, or Yoredale Group of England.” (Dr. A. Geikie, ‘Text-Book of Geology,’ 1885, p. 739.)

about two lines above the smooth area they assume their ordinary size and spacing. The dimensions of the type specimen are:—Length 16 lines, greatest diameter 6 lines, least diameter 2 lines.

Remarks. Mr. John Young, of the Hunterian Museum, Glasgow, writes to me concerning this species as follows:—"The fossil named by Sowerby *Conularia teres* is what we now term *Orthoceras subcentrale*, de Kon.¹ At one time it was identified as *Orthoceras sulcatulum*, M'Coy², but de Koninck, on one of his visits to Glasgow, claimed it as his species."

Having Sowerby's shell before me, I find myself unable to identify it either with M'Coy's or with de Koninck's species. From the former it differs entirely by the much greater regularity of its ornaments, and from the latter by their being distinctly and strongly waved; whereas from what I can judge from de Koninck's description and figure of *O. subcentrale* that species has nearly if not quite direct riblets. Moreover, it has an eccentric siphuncle, and that organ is nearly central in *O. teres*, though one cannot place much reliance on this point, because the siphuncle is apt sometimes to change its position with the growth of the shell. However, I think that the present form is distinct from those above named.

A group of species of *Orthoceras* will be found on plates cccv. and cccvi. of Barrande's Syst. Sil. de la Bohême, which resemble the present species in the markedly sinuous character of their ornaments, and some of them (*O. curtum*, e. g.) in their short, conical form, but none of them approach *O. teres* sufficiently closely to suggest specific identity with it. Barrande's species belong to his Étages D and E (Silurian), the majority of them to the latter division.

Horizon. Upper Limestone Group³.

Locality. Thornliebank⁴, near Glasgow.

Represented by the type specimen contained in the "Sowerby Collection" in this Museum.

¹ Descrip. des Anim. Fossiles dans le Terrain Carbonifère de Belgique, p. 514, pl. xlv. f. 3, a, b (1844).

² Synop. of the Carboniferous Limestone Fossils of Ireland, p. 8, pl. i. f. 4 (1844).

³ Carboniferous Limestone Series (see footnote, p. 121).

⁴ This is written "Tronlie Bank" by Sowerby (*loc. cit.*). It is recorded under the heading "Thornliebank District" in the 'Catalogue of Western Scottish Fossils,' p. 91.

Orthoceras ?, sp.

1854. *Cyrtoceras unguis*?, F. Roemer, Palæont. Bd. iii. p. 93, t. xiii. f. 28.

1877. *Cyrtoceras unguis*?, Barrande, Syst. Sil. de la Bohême, vol. ii. Supplém. pl. cccclxxxvii. case xi. ff. 1, 2.

Two small fragments of the apical portion of a rather rapidly tapering shell with a subcentral siphuncle, septa moderately distant, and fine transverse undulating striæ, not quite parallel with the septa; the latter bend very sharply upwards at the sides. The test is very thin, so that the septa are seen through it.

Remarks. MM. Roemer and Barrande represent this species with the striæ quite parallel with the septa, which is not the case with the specimens in the National Collection. The present form bears some resemblance to *O. teres*, Sow., but the sculpture of the latter consists of strong riblets, and it appears also to taper less rapidly.

Horizon. Lower Limestone Group¹.

Locality. Lanark?

Represented by two specimens in the Collection.

Orthoceras sulcatum, Fleming. (*Ante*, p. 108.)

Among the specimens of *O. sulcatum* occurring at this horizon are several very small ones, which have proved upon examination to be the young shells. Their ornamentation is so peculiar as to merit description. It consists of faint, rather distant annulations, covered, together with their interspaces, by fine, transverse, thread-like lines, crossed longitudinally by similar, but somewhat more prominent raised lines, giving a finely cancellated appearance to the surface when viewed under a lens. Soon, however (within a distance of six or eight lines), the annulations grow more prominent, the longitudinal lines suddenly become obsolete, and the ornamentation assumes the aspect of the adult shell.

This remarkable alteration in the sculpture of the test was observed by Barrande in a species which he named *O. pseudocalamiteum* (p. 62). This also had in the very young state (*i. e.* for a distance of about seven lines from the initial point) a cancellated ornamentation, which abruptly gave place to the



Fig. 9.

Fig. 9.—*Orthoceras sulcatum*. Apical extremity, showing the ornamentation of the test in the young shell; enlarged.

¹ Carboniferous Limestone Series (see footnote, p. 121).

close-set annulations and strong longitudinal lines characterizing the adult shell. (See Barrande, Syst. Sil. de la Bohême, 1868, pl. cclxxxvi. ff. 14, 16.)

We have seen also in *Orthoceras teres* that the surface of the shell at its commencement is quite smooth; and it is not improbable that could we find the early stage of other species they would present a similar rudimentary condition of their ornamentation.

Horizon. Lower Limestone Group¹.

Localities. Boghead, Lanarkshire; Todmorden, Yorkshire.

Well represented in the Collection.

Orthoceras scalare, d'Archiac & de Verneuil.

1831. *Orthoceratites striolatus*, H. v. Meyer, Nova Acta Leop.-Carolin. vol. xv. pt. ii. p. 77, Taf. lv. ff. 1, 2 (non Taf. lvi.).
1842. *Orthoceratites scalaris* (Goldfuss, Bonn Museum), d'Archiac & de Verneuil, Trans. Geol. Soc. 2nd ser. vol. vi. p. 345.
1852. *Orthoceratites scalaris*, Giebel, Fauna der Vorwelt, p. 267.
1854. *Orthoceras scalare*, F. A. Roemer, Palæontographica, Band iii. p. 49.
1856. *Orthoceras scalare*, G. & F. Sandberger, Die Verstein. Nassau, p. 167, Taf. xxix. ff. 5, 5a.
1882. *Orthoceras scalare*, Kayser, Beitr. z. Kenntn. von Oberdevon und Culm am Nordrande des rheinisch. Schiefergebirges, in Jahrb. der königl. preuss. geolog. Landesanst. und Bergakad. zu Berlin für das Jahr 1881, p. 75.
1884. *Orthoceras scalare*, H. Woodward, Geol. Mag. new ser. dec. iii. vol. i. p. 538.

Sp. Char. Shell straight, very rapidly tapering at the rate of about 1 in 3. Section apparently elliptical, but the shell is always crushed, so that its form cannot be accurately made out. The siphuncle is unknown. The surface ornaments consist of direct, transverse, acute annulations, somewhat irregularly spaced, but about 2 lines apart in a diameter of $1\frac{1}{4}$ inch. Their breadth equals about half the nearly smooth space between them; the latter is covered with extremely fine transverse lines, which are seldom preserved. They are well figured by the Brothers Sandberger (*l. c.*).

Remarks. This rare shell is always found in a crushed and distorted condition, and very seldom has any of its test preserved, a hollow space representing it being generally found between the cast and the matrix. The septa were probably very thin and fragile, so that they could not have given much support to the test after the death of the animal; hence the collapsed condition of the fossils.

¹ Carboniferous Limestone Series (see footnote, p. 121).

The most remarkable feature in this species is its rapidly increasing diameter. I have already pointed out its resemblance in this respect to the *O. striatulum* of Sowerby, under the description of that species. The latter is, however, easily distinguished from the present form by its generally coarser sculpture, and especially by its possessing strong longitudinal riblets.

I think it is questionable whether these two species should not be removed from the genus *Orthoceras*, on account of their exceedingly conical form; but as our knowledge of them is incomplete, neither the body-chamber nor the siphuncle of either of them being known, it would be hardly judicious to remove them from their present position until further information about them can be obtained.

Horizon. Posidonomyen-Schiefer (Steinkohlenformation)¹, Culm-measures.

Localities. Herborn, near Dillenberg, Nassau; Marburg.—The specimen from Marburg was presented by J. E. Lee, Esq., F.G.S.

Well represented in the Collection.

Orthoceras striolatum, G. & F. Sandberger.

- ‡ 1831. *Orthoceratites striolatus*, H. von Meyer, Nova Acta Leop.-Carolin. vol. xv. pt. ii. p. 77, Taf. lvi. ff. 1-12 (not Taf. lv.)
- ‡ 1832. *Orthocera striolata*, von Dechen, Handb. der Geognosie von H. T. de la Beche, p. 536.
1842. *Orthoceratites striolatus*, d'Archiac & de Verneuil, Trans. Geol. Soc. 2nd ser. vol. vi. p. 345, tab. xxvii. ff. 5, 5a.
1852. *Orthoceras striolatum*, Giebel, Fauna der Vorwelt, p. 251.
1854. *Orthoceras striolatum*, F. A. Roemer, Palæontographica, Band iii. p. 49.
1856. *Orthoceras striolatum*, G. & F. Sandberger, Die Verstein. Nassau, p. 165, Taf. xix. ff. 3, 3 a-h.
1879. *Orthoceras striolatum*, Gümbel, Geogn. Beschreib. des Fichtelgebirges, in Geogn. Beschreib. des König. Bayern, Abth. iii. p. 498.
1882. *Orthoceras striolatum*, Kayser, Beitr. z. Kenntn. von Oberdevon und Culm am Nordrande des rheinisch. Schiefergebirges, in Jahrb. der königl. preuss. geolog. Landesanst. und Bergakad. zu Berlin für das Jahr 1881, p. 75.
1884. *Orthoceras striolatum*, H. Woodward, Geol. Mag. new ser. dec. iii. vol. i. p. 539.

Sp. Char. Shell straight, elongate. Rate of tapering about 1 in 5. Septa rather convex, horizontal, near together, two in the

¹ See Geinitz, 'Die Steinkohlen Deutschlands,' Munich, 1865, pp. 201 and 238.

space of one diameter. The siphuncle appears to be submarginal, but owing to the crushed condition of the specimens it is impossible to give its position accurately. The surface is entirely covered with close-set, irregular, flattish riblets, divided by interspaces about half their width. The riblets are crowded together in some places, but they average about five in the space of one line.

Remarks. This species differs from *O. cinctum*, Sow., in its more rapid rate of tapering, and in its finer ornamentation, as well as in the position of its siphuncle. This last point, however, is rather doubtful, owing to the imperfect condition of the majority of examples, as already mentioned.

The Museum is indebted to Mr. J. E. Lee for a large number of examples of *O. striolatum* collected by himself in the shales overlying the Devonian Limestones at Waddon Barton, near Chudleigh¹.

Horizon. Culm-measures² (Lower Culm-shale).

Localities. *British.* Waddon Barton, near Chudleigh; Bampton, Devonshire.—*Foreign.* Lautenthal, Harz (Posidonomyenschiefer).

TRIASSIC SPECIES.

Orthoceras politum, Klipstein.

1843. *Orthoceras politum*, A. v. Klipstein, Beitr. zur geologisch. Kenntn. der östlichen Alpen, p. 144, Taf. ix. f. 6.

1849. *Orthoceratites politum*, d'Orbigny, Prodr. de Paléont. Stratigraphique, vol. i. p. 179.

1859. *Orthoceratites dubius*, Stoppani (pars), Pétrifications d'Esino, p. 112, pl. xxiv. ff. 1-4.

1859. *Orthoceratites dimidiatus*, Stoppani, ibid. p. 113, pl. xxiv. ff. 5-6 (not of Sowerby).

1869. *Orthoceras politum*, Laube, Fauna der Schichten von St. Cassian,

¹ For a list of the fossils, and for other information regarding these deposits, see Dr. H. Woodward, in Geol. Mag. (*loc. cit.*)

² Mr. H. B. Woodward (Geol. of England and Wales, 2nd ed. p. 197) remarks that "Until the divisions of the Culm-measures are mapped out in detail, we must refrain from committing ourselves to any definite correlation. He gives the following "general divisions" in the Series:—

Culm-measure Series.	{	Lower Coal-measures?	Thick, even-bedded grey grits with slates and shales.
			Sandstones, grits and shales, with beds of culm.
		Millstone Grit?	Coddon Hill beds (local).
		Lower Carboniferous?	Shales, with thin grits, impersistent limestones, and occasional beds of culm.

Denkschr. d. k. k. Akad. d. Wissensch. Band xxx. p. 60, Taf. xxxvi. f. 8.

1877. *Orthoceras politum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte v. p. 1325, pl. cccclxxxviii. cases x. and xi.

1882. *Orthoceras politum*, Mojsisovics, Die Cephalopoden der Mediteranen Triasprovinz, in Abhandl. der k. k. geologisch. Reichsanst. p. 293, Taf. xcii. ff. 13, 14, Taf. xciii. ff. 7, 8.

Sp. Char. Shell straight. Section circular. Rate of tapering 1 in 10, as estimated from a specimen figured by Mojsisovics. Body-chamber constricted near the aperture. Septa very widely separated, their distance exceeding the shell-diameter. Siphuncle central according to Mojsisovics, but Klipstein describes it in a very young and imperfect individual (the type specimen) as a little removed from the central position. Surface showing fine transverse striae.

Remarks. Mojsisovics observes (*loc. cit.*) that this species belongs to a series with widely separated septa, in which *O. dubium*, v. Hauer, is contained, but that it is distinguished from the latter mainly by the different character of its shell-ornaments, and also by its rather more pointed apex.

These beds contain a remarkable fauna in which there is a commingling of Palæozoic and Mesozoic types, which serve in a measure to bridge over the gap between these two great divisions of the rocks. The following are some of the more important species of the Mollusca:—*Orthoceras elegans*, Münster.; *O. politum*, Klipstein; *Ammonites Aon*, Münster.; *A. Eryx*, Münster.; *Bellerophon nautilus*, Münster.; *Monodonta Cassiana*, Wissm.; *Macrocheilus obovatum*, M.; *Phasianella Bronni*, Wissm.; *Murchisonia Blumi*, Münster.; *Nucula lineata*, Goldf.; *N. strigilata*, Goldf.; *Gervillia angusta*, Münster.; *Cassianella gryphæata*, Münster.; *Cardita crenata*, Goldf.; *Koninckina Leonardi*, Wissm., &c. This list is taken from Credner's 'Elemente der Geologie,' 6th edition, p. 581. The most complete account of the fauna of the Alpine Trias is contained in a series of papers by Dr. G. C. Laube in the 'Denkschriften der k. Akad. der Wissenschaften,' Vienna, 1864–1869.

Horizon. Trias; Cassianer Schichten (St. Cassian Beds).

Locality. St. Cassian, South Tyrol.

Represented in the Collection by two very small specimens.

***Orthoceras elegans*, Münster.**

1834. *Orthocera elegans*, Münster, in Leonhard & Bronn's Neues Jahrb. p. 11.

1841. *Orthocera elegans*, Münster, Beitr. zur Geognosie und Petrefactenkunde des südöstlichen Tirol's, p. 125, Taf. xiv. f. 2.

1843. *Orthoceras Frieslebense*, Klipstein, Beitr. zur geolog. Kenntn. der östlichen Alpen, p. 143, Taf. ix. f. 4.
1849. *Orthoceras elegans*, Quenstedt, Die Cephalopoden, p. 478, Taf. xxxi. ff. 3-5.
1849. *Orthoceratites elegans*, d'Orbigny, Prodr. de Paléont. Stratigraphique, vol. i. p. 179.
- † 1851. *Trematoceras (Orthoceras) elegans*, Eichwald, Naturhist. Bemerk. als Beitrag zur vergleichenden Geognosie, Nouv. Mém. de la Soc. des Naturalistes de Moscou, vol. ix. p. 124, Taf. i. f. 3.
1852. *Orthoceras elegans*, Giebel, Fauna der Vorwelt, Band iii. p. 234.
1869. *Orthoceras elegans*, Laube, Fauna der Schichten von St. Cassian, Denkschr. d. k. k. Akad. d. Wiss. Band xxx. p. 59, Taf. xxxvi. f. 9.
1877. *Orthoceras elegans*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte v. p. 1324, pl. cccclxxxviii. case ix., and Supplém. p. 65, pl. cccclxxxiii. ff. 4-15.
1882. *Orthoceras elegans*, Mojsisovics, Die Cephalopoden der Meditteranen Triasprovinz, in Abhandl. der k. k. geologisch. Reichsanst. p. 291, Taf. xcii. ff. 10-12.

Sp. Char. Apical angle about 5° to $5^{\circ}5'$. Distance of septa variable, but less than the diameter of the preceding septum. Section circular, though somewhat elliptical in consequence of pressure. Siphuncle central. The shell is furnished with sharply defined, irregularly spaced transverse striæ, which are often entirely wanting. The initial point has been described and figured by Barrande. Eichwald took *Orthoceras elegans* as the type of his new genus *Trematoceras*, which he distinguished from *Orthoceras* by the fact that the siphuncle showed no continuous tube. *Orthoceras elegans* agrees substantially in its characters with *O. campanile* [Mojsis.], but as yet only very small examples have been found of it, of which many are provided with remains of the body-chamber, as observed by Quenstedt. A large example of *Orthoceras elegans* may yet be found in the St. Cassian beds, as happened in the case of *Orthoceras politum*, so that *Orthoceras campanile* [Mojsis.] could then no longer be considered as a valid species. (Mojsisovics, *loc. cit.*)

Horizon. Trias ; Cassianer Schichten (St. Cassian Beds).

Locality. St. Cassian, South Tyrol.

Represented in the Collection by several imperfect fragments.

Family ENDOCERATIDÆ.

Genus **ENDOCERAS**, Hall¹.

♀ [*Vaginati*, Quenstedt, 1836²; *Sannionites*?, Fischer, 1837³, emend. Hyatt, 1883⁴; *Cameroceras*, *Diploceras*, Conrad, 1839⁵; *Thoracoceras*, Fischer, 1844⁶ (pars); *Nothoceras*, Eichwald, 1860⁷ (not of Barrande); *Orthocères Longicones*—Groups 19–20, Barrande, 1874⁸.]

Fig. 10.

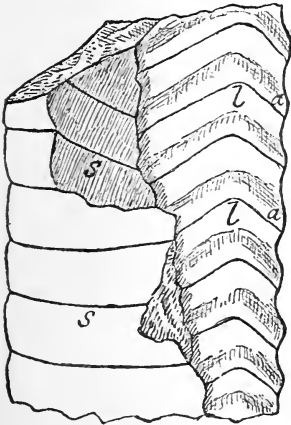


Fig. 11.

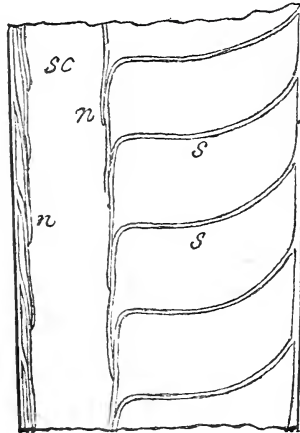


Fig. 10. Fragment of an *Endoceras*, with internal cast of siphuncle, showing at *l, l*, tongue-like lobes formed by the inwrapping septa; *a, a*, annulations; *s, s*, septa.

Fig. 11. A few septa taken from a polished section of *Endoceras Wahlenbergi*, to show the overlapping necks, *n, n*; *s, s*, septa; *sc*, siphuncular cavity. From the Ordovician of Sweden. Drawn from specimens in the National Collection. Both nat. size.

Gen. Char. Shell straight, elongate-conical, circular or elliptical in cross-section. Septa rather approximate; horizontal, somewhat

¹ Palæontology of New York, vol. i. 1847, p. 58.

² De notis Nautiliarum primariis.

³ Oryctogr. de Moscou, p. 125.

⁴ Proc. Boston Soc. Nat. Hist. vol. xxii. p. 266.

⁵ Journ. Acad. Nat. Sci. Philadelphia, vol. viii. p. 267.

⁶ Bull. Soc. Imp. des Nat. de Moscou, tom. xvii. no. 3, p. 755.

⁷ Lethæa Rossica, vol. i. p. 1193.

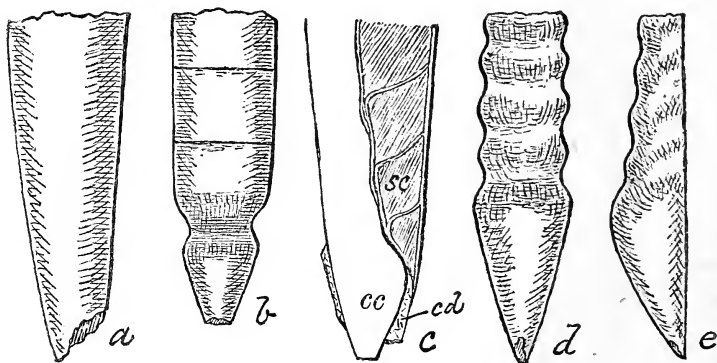
⁸ Syst. Sil. de la Bohême, vol. ii. Texte iii. p. 668.

undulating. The neck ¹ of each septum (as seen in section) extends backwards and partly overlaps the preceding one, thus forming a complete siphuncular tube (fig. 11, *n*). Siphuncle marginal, or sub-marginal, cylindrical, very large, sometimes attaining a diameter of one half of that of the shell; commencing with a conical chamber ². The surface of casts of the siphuncle is encircled by a series of oblique shallow grooves, alternating with annulations, caused by the over-

¹ Hyatt styles the necks "funnels;" but I think the term is objectionable, because it is used by some authors to designate another organ in the living Cephalopods (Division Siphonopoda). The French call the necks "goulots," the Germans "Siphonalduten."

² This very remarkable structure has been observed in a species of *Endoceras*, minutely described and figured by Dr. Gerhard Holm, of Upsala, in a paper entitled "Ueber die innere Organisation einiger silurischer Cephalopoden" (Dames & Kayser's 'Palæontologische Abhandlungen,' Band iii. Heft i. 1885, p. 1). I reproduce here reduced outlines of some of his figures:—

Fig. 12.

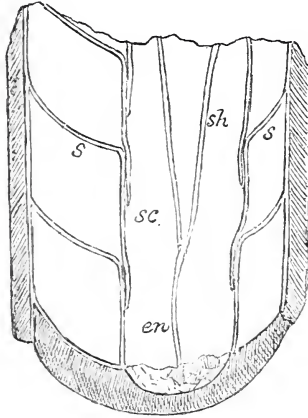


Endoceras belemnitifforme, Holm.—*a*, cigar-shaped extremity of the shell covered with the test: *b*, cast of conical initial part of the shell with two of the septal chambers, denuded of the test: *c*, longitudinal section of the initial part of the shell, showing conical chamber, *cc*, at the commencement of the siphuncle, with some of the septal chambers, *cc*, *cd*, calcareous "organic deposit" (organische Ablagerung) resembling that which is met with in the terminal septum of *Orthoceras truncatum* (ante, p. 24): *d*, fragment of cast of a detached siphuncle, the rings being produced by the overlapping of the septal necks: *e*, side view of the same.

Dr. Holm assumes that the large conical chamber, *cc*, is the "initial chamber," and that we have here therefore the largest known in any Tetrabranch; its size is certainly quite anomalous. Dr. Holm remarks, however, that he has in many cases observed the initial chamber to be much smaller than it is in

lapping of the posterior portion of the siphuncular necks. The siphuncle is provided internally with a series of funnel-shaped sheaths,

Fig. 13.



Endoceras Walenbergi.—Fragment of the septate part of the shell in longitudinal section, showing s, s, septa; sc, siphuncular cavity; sh, sheath; en, endosiphon. From the Ordovician of Sweden. Natural size.

E. belemnitifforme, and that "in an example of *E. Burchardii*, Dewitz, the initial part was cigar-shaped as it is in the former species. The point itself was broken off up to a diameter of a few millim.; but the septa were already developed." Touching the generic significance of the initial chamber, he observes:—"Whether the construction of the initial chamber and the beginning of the siphuncle in the genus *Endoceras* agree with *Endoceras belemnitifforme* is unknown." It appears to me, however, to be in the highest degree improbable that structural features of such importance as those just described should be peculiar to one or two species; and I am strongly inclined to the opinion that we have here the typical structure of the genus.

Dr. Holm states that only two examples of *E. belemnitifforme* are known to him. One comes from the upper red Orthoceren-Kalk of the Island of Oeland, Sweden, and the other from the Jaggowall water-fall in Esthonia, in the lowest beds of the Echinosphæriten-Kalk. These horizons correspond perfectly with each other. The species is also frequently found in boulders of the Orthoceren-Kalk at Heergermühle, near Eberswalde, Prussia, where they have been collected by Professor Remélé (Palæont. Abhandl. loc. cit. p. 9).

The following considerations regarding the functions of the siphuncle, resulting from Dr. Holm's studies of this most important and interesting species, are worthy of attention. He says that Zittel's supposition that the siphuncle is best explained, according to the developmental history of the animal, as a remnant of the visceral sac, and that a fixed physiological function cannot be discovered for it, is not only rendered probable, but

which are not very numerous, and occur at irregular intervals (fig. 13). An endosiphon¹ is present, but it is rarely preserved (fig. 13).

receives strong support from the structures observed in *Endoceras belemniti-forme*. He further observes that in the forms [of the Cephalopoda] having a small siphuncle, that organ is in a retrograde condition.

It may be interesting to notice, before quitting the subject of the embryonic condition of the shell in *Endoceras*, that Barrande described a fossil, which was collected at Phillipsburgh, in the Eastern Townships of Canada, in the limestone of the Quebec Group (Upper Cambrian or Lower Ordovician). This fossil he took to be "the initial part of the shell of an *Endoceras*," and gave it the name of *Endoceras Marcoui*. The figures of this fossil give one the impression that it is a portion of the siphuncle, because it is marked by a series of oblique rings, which are acutely bent upwards on one side, just as in fig. 10, *l* (*ante*, p. 129). The dark space represented in the cross sections I should judge to be one of the sheaths which occupy the cavity of the siphuncle in this genus. *E. Marcoui* is described in Barrande's Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 748, and figured on plate cccxxxi. ff. 11-15, and plate cccclxxxviii., Case vii.

¹ This term was first made use of by Prof. Hyatt (*loc. cit.* p. 261), who discovered the endosiphon in the present genus, and recognized its similarity to the central slender tube already well known to palæontologists in *Actinoceras*.

Exception might perhaps be taken to the word "endosiphon" on the ground that it seems to imply the existence of two siphuncles, an inner and an outer one. It will be found convenient, nevertheless, to designate what is doubtless the remains of the fleshy siphuncle (a diverticulum of the mantle) by some name which may serve to distinguish that organ from the shelly wall that separates it from the septal chambers. The term siphuncle having always been used in the latter sense, in relation to fossils, it would be difficult now to give it a wider signification without causing confusion, and therefore I think the employment of the additional name is justifiable.

Since Hyatt's discovery of the endosiphon in *Endoceras*, Dr. Holm has also met with it in the same genus, and he describes it as a "fine, cylindrical, tubular canal . . . surrounded by a very thin wall" ("Ueber einige bei dem Endoceren vom fleischigen Siphon im Siphonalrohre erzeugte Bildungen," Palæont. Abhandl., Band iii. 1885, Heft i. p. 11). He refers to Barrande's figures of *Endoceras insulare*, Barr., in which the endosiphon is clearly depicted. This species was obtained from the Ordovician rocks of the western coast of Newfoundland, near the French fisheries. It is figured in the Syst. Sil. de la Bohême, vol. ii. 1870, pl. cccxxx. ff. 5, 8, and pl. cccxxxi. f. 8.

Amongst the remarkable structures described in *Endoceras belemniti-forme*, there is one to which it seems desirable that I should revert; this is the calcareous deposit observed at the apical extremity of that species (see fig. 12 *c*, *cd*). Now as this appears to be strictly homologous with the conical deposit (*calotte conique*) described by Barrande in *Orthoceras truncatum* (*ante*, p. 23), it will be useful to consider here the more recent views put forward by Prof. Hyatt regarding the origin of such deposits (Proc. Amer. Assoc. for the Advancement of Science, 1883, vol. xxxii. p. 323).

Prof. Hyatt's opinion is expressed in the following passage (*loc. cit.* p. 336):—"The truncated shells of *Orthoceras* have been described by Barrande; and

“*Orthoceras duplex*,” Wahlenberg et auctt.—There are a great number of specimens of *Endoceras* in the Collection from Sweden, Russia, and Northern Germany, bearing the well-known name of “*Orthoceras duplex*,” Wahlenberg. On turning, however, to the original description (*Nova Acta Reg. Soc. Scient. Upsaliensis*, 1821, vol. viii. p. 86) it is found to be quite insufficient for purposes of identification, and has led to many diverse forms being united under Wahlenberg’s appellation. The essential part of the description is contained in the following passage, translated from the Latin original:—

“*Orthoceratites duplex* or *giganteus* is found in Westrogothia, and in this district only are complete and well developed specimens met with, particularly in Mt. Kinnekulle. The diameter is mostly a hand’s breadth, and sometimes as much as five Parisian inches, a size of the tube surpassing that of any other univalved many-chambered testaceous animal which I have seen alive or dead. Its form is rather cylindrical than conical, and in addition to its great breadth it has a length of six feet and more, so that we are convinced that it surpasses in magnitude all *Ammonites* hitherto discovered, and that it is thus the largest of all univalved testaceous

the plug [= *calotte conique* of Barrande] which fills up and rounds off the broken apex, accounted for as an external product due probably to the action of two arms which he supposed stretched out posteriorly from the aperture, as in *Argonauta*, and embracing the whole shell, and extending even beyond the broken end, filled it up by successive deposits of carbonate of lime. We have also studied this structure, and can confirm M. Barrande’s observation, and his conclusion that the plug is an external product with a peculiar bilateral structure; but that it was deposited by two arms extending backwards we do not regard as probable. The markings indicate that at the truncated apex the layers were laid on by an organ which was certainly double at the end, but not necessarily double all the way up to the aperture. The body of the whorl [*i. e.* the whole of the shell above the conical cap] in *Orthoceras* does not have any prolongations of the ventral and dorsal furrows of the plug, nor are there any longitudinal rows of spines or furrows, as in *Argonauta*, indicating the presence of two arms, capable of secreting shell, nor does the aperture with its entire outline give strong support to this proposition.

“We think it is possible to strike nearer home in homology; the fold of the mantle in *Nautilus* satisfies the conditions. This is an active shell-secreting organ, which was certainly present, and also functionally active, in the *Ammonoidea* and *Nautiloids*, and probably more important in these ancient forms than it is now in the modern *Nautilus*. This is also more consistent with the explanation of the structure of the *Belemnoid*, which, as is easily seen in the famous examples of the preserved animal, had no such pair of enlarged arms, and yet deposited externally a solid covering—the guard—which is in our opinion the homologue of the solid filling of the truncated end of *Orthoceras*. Branco, in his admirable paper on the structure of the curious Triassic *Belem-*

animals. Its siphuncle is mostly situated quite on the margin or on the circumference of the shell, and not quite hidden by the joints of the external shell; occupying about a third part of the entire shell. On account of its situation on the margin, the segmental partitions [septa] of the shell form very oblique rings on the surface of the siphuncle, and at the same time run outwards over its face, whence it results that the siphuncle seems as it were to consist of hoods or wrappers, set or inserted upon one another, as if it sent out processes. The outer wall of the siphuncle is entire and free from perforations, showing no point of communication between the cavity of the siphuncle and the chambers of the exterior shell."

The author then proceeds to describe the smaller *Orthoceras* lodged in the siphuncle of "*Orthoceras duplex*," from which circumstance the specific name originated. It need hardly be said that the included *Orthoceras* was introduced by accident into the capacious siphuncle of the larger one¹. Judging by

noid, *Aulacoceras*, shows that the secreting-organ of the guard must have been open, and proves it by his drawings of masses of foreign matter included in the layers of the guard. This and the channel which runs along the ventral side in the guard and is often single, and generally more persistent and longer than the dorsal channel, favour this view of the homologies. Quenstedt and von Ihering have both traced the Belemnoids to *Orthoceras*; and this opinion supports their views and accounts for the preservation of the protoconch [initial chamber], both as a useful organ containing the siphonal cæcum in its neck, and because of the protective guard built up around it at an early stage of growth. The tracing of Belemnoidea back to *Orthoceras* accounts for the dorsal and ventral channels, both of which are present in the plug of the truncated *Orthoceras*. It also permits us to explain the central hollow trace or tube in the guard of the Belemnoid as the homologue of a similar hollow trace or tube, the pseudo-siphuncle, which invariably occupies the centre of the plug in truncated *Orthoceratites*, and has not been heretofore accounted for."

Prof. Hyatt's explanation of the manner in which the conical cap was formed is not quite satisfactory, because if the extremity of the shell became periodically truncated, the calcareous deposit at its apex could not have been renewed each time by the mantle-fold, unless the shell were internal, or at least partly so, in order that its apex might be reached by the shell-secreting part of the animal's body. It is different with the shells in which no truncation has taken place, for in them the apical deposit was made at a very early stage of growth, when the shell was in immediate contact with the animal.

¹ This is, of course, no uncommon thing. Barrande gives numerous figures of *Endoceras* and *Orthoceras* into whose siphuncles young or smaller shells belonging to those genera have been introduced after the death of the animal and the partial destruction of its shell. (See *Syst. Sil. de la Bohême*, vol. ii. pl. cccxxxviii. figs. 9, 11; also *Pal. of New York*, by James Hall, vol. i. 1847, pl. xlviii. fig. 3.)

Wahlenberg's description, which is almost certainly confirmed by his reference to one of Klein's figures ('Descriptiones Tubulorum Marinorum,' 1731, tab. vi. figs. 1, 2), it was most probably *Endoceras trochleare*.

It appears that Wahlenberg's views regarding the imprisoned specimen were not shared in by some of his scientific brethren, for he observes with much naïveté that "many people interested in natural phenomena have regarded this internal *Orthoceratites* as a different species, on account of its annular form;" and the inhabitants of Mount Kinnekulle well distinguish it from the common *Orthoceratites* under the name "Svecico skrufstenar" [Swedish screw-stone], a by no means inapt sobriquet for *Endoceras trochleare*.

Eliminating from Wahlenberg's description of "*Orthoceras duplex*" those parts of it which are essential to a specific diagnosis, they are found to consist of two only, viz., the form of the shell, which is said to be "rather cylindrical than conical," and the proportionate size of the siphuncle, "occupying about a third part of the entire shell." These two characters would obviously not be sufficient for specific distinction; and the vagueness of the original description has given rise to a number of widely differing forms being placed under one specific name, according to the interpretation, generally a very liberal one, that each author has put upon the description. To make confusion worse confounded, another of that author's species—"*Orthoceras commune*"—has become entangled in the nomenclature of "*O. duplex*." According to the original description of the former (Nov. Act. loc. cit. p. 85) *O. commune* is not an *Endoceras*, but an *Orthoceras*, for the siphuncle is described as of moderate thickness, "equal to nearly a tenth part of the diameter of the whole shell, taken transversely," and "is for the most part situated midway between the axis and the circumference of the shell." Hisinger¹, who was the first to give figures of fossils under Wahlenberg's names "*duplex*" and "*commune*," adds very little to our knowledge of those forms, and to his brief description of the former he appends the words "an species distincta?"—a somewhat significant phrase, which seems to suggest the difficulty he experienced in identifying Wahlenberg's species.

Having thus failed in obtaining the required information from books, I explained my difficulties to Dr. Lindström, and he, with no less kindness than promptitude, caused enquiries to be made for

¹ Lethæa Svecica, 1837, p. 28.

me as to whether Wahlenberg's types of "*O. duplex*" and "*O. commune*" still existed in the museum at Upsala, where some of his types are preserved. But they could not be found, so that there is now no possibility of identifying Wahlenberg's species. Dr. Lindström informed me, moreover, that he had "searched in vain" in the "Hisinger Collection" preserved in the Royal Museum, Stockholm, for the original specimens of "*O. duplex*" and "*O. commune*" figured by Hisinger in the 'Lethæa Svecica.'

Under these circumstances it is desirable, as Dr. Lindström has suggested to me, that Wahlenberg's names should be relinquished, and new ones imposed upon all Swedish and Russian Endocerata which have hitherto fallen under them. This task has been already partly accomplished by such able palæontologists as Dewitz and Schröder in Germany and Holm in Sweden, and, so far as I am aware, there remain now very few forms requiring emendation. The collection of Swedish specimens of *Endoceras* in the British Museum has been greatly enriched within the last few years through the munificence of the late Mr. J. E. Lee, of Torquay, and it is principally upon this new material that the following description was based. I have named the first species after the illustrious Swedish naturalist Wahlenberg.

Endoceras Wahlenbergi, Foord.

1732. Species vi. *Orthoceratites siphone ad peripheriam posito crassiori*, &c., Breynius, Dissertatio physica de Polythalamiiis, p. 34, tab. iv. ff. 4-6.
1759. *Orthocerati recti . . . in Dahlia reperti*. De rariori quadam Orthoceratitibus Specie, in Suecica reperta, tractatus, &c., Nicholas de Himsel, Phil. Trans. vol. 1. pt. 2, p. 692, tab. xxiii. f. A.
- ? 1775. *Orthoceratites*, Walch and Knorr, Monumens des Catastrophes de la Terre, tom. iii. suppl. p. 140, tab. iv e. f. 1.
1837. *Orthoceratites duplex*, Hisinger, Lethæa Svecica, p. 28, tab. ix. f. 1.
- ? 1855. *Orthoceras duplex*, Barrande, in Leonhard and Bronn's Neues Jahrb. p. 264, Taf. iii. ff. 11, 11*.
1857. *Orthoceras commune*, Boll, Archiv für die Naturkunde von Mecklenburg, p. 12, Taf. ii. ff. 4, a, b (not of Hisinger).
- ? 1861. *Orthoceras duplex*, Roemer, Fossile Fauna von Sadewitz, p. 60, pl. vii. ff. 2, a, b.
1866. *Endoceras (Orthoc.) duplex*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, pp. 709, 713, pl. cccxxiii. f. 9, pl. ccccxviii. ff. 9-12.
- ? 1869. *Orthoceras duplex (giganteum)*, Karsten, Die Verstein. des Uebergangsgebirges in den Geröllten der Herzogthümer Schleswig und Holstein, p. 49, tab. xvii. ff. 6, a, b.

1875. *Orthoceras duplex*, Mallada, Bol. Com. Mapa Geol. España, tomo ii. p. 24.
1876. *Orthoceras duplex*, Roemer, Lethæa Geognostica, Theil i. Leth. Palæoz. Atlas, Taf. vi. f. 2, *a, b*.
1880. *Orthoceras duplex*, Angelin-Lindström, Fragm. Silurica, p. 1, tab. iii. ff. 9-11.
1881. *Endoceras duplex*, Schröder, Schriften der physikalisch-ökonomischen Gesell. zu Königsberg, Jahrg. xxii. Abth. i. p. 82, Taf. iii. ff. 1, *A, B*.
1882. *Endoceras cf. duplex*, Barrois, Terr. anciens des Asturies et de la Galice, p. 187, pl. iv. ff. 7, *a, b, c*.
1885. *Orthoceras (Endoceras) duplex*, Roemer, Lethæa erratica, in Dames and Kayser's Palæontologische Abhandl. Band ii. Heft v. p. 38, Taf. ii. ff. 2, *a, b*.
1887. *Endoceras Wahlenbergi*, Foord, Ann. & Mag. Nat. Hist. ser. 5, vol. xx. p. 393, ff. 1, *a-e*.

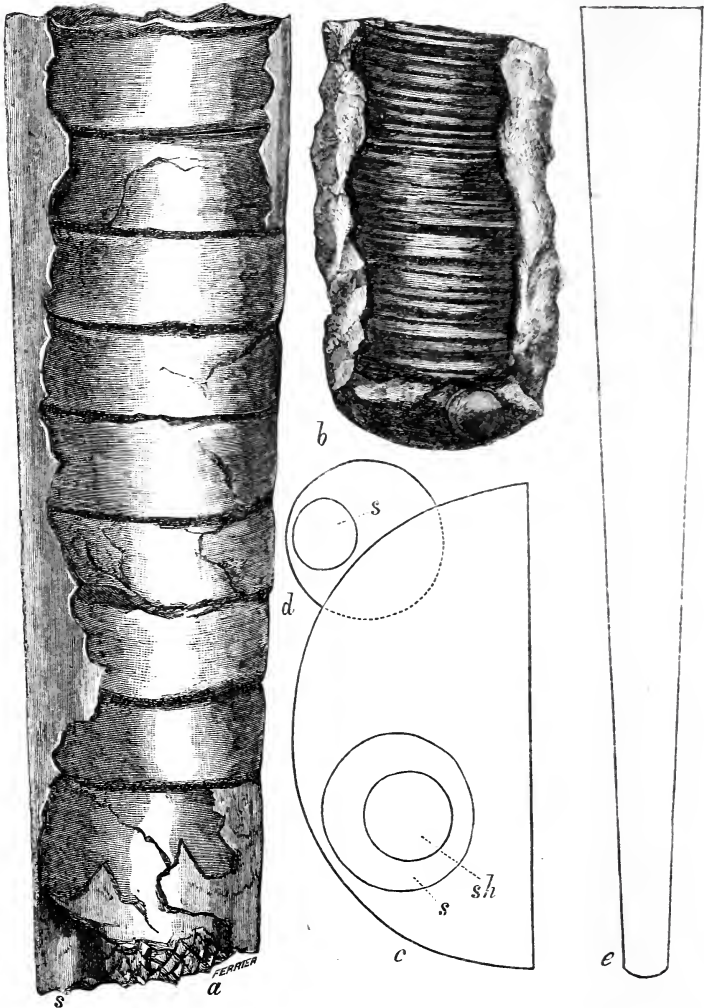
Sp. Char. Shell straight, very long. Tapering rather slowly at the rate of about 1 in 12, taking the average measurement of three adult specimens. Section circular. Complete body-chamber unknown. Septa moderately distant, that is, about 8 lines apart where the diameter is $2\frac{1}{4}$ inches, decreasing to a distance of 3 lines at a diameter of 8 lines. The distance of the septa varies considerably in different specimens, and even in different parts of the same individual. Thus in one measured the septa are 6 lines apart at a place where the diameter is 16 lines, while they are only 4 lines distant where the diameter has increased to 19 lines. But on the whole the septa increase their distance as the individual advances in age. Siphuncle proportionately larger in the young than in the adult, as is frequently the case in the testaceous Cephalopods; that is to say, it attains to nearly half the diameter in the young shell (fig. 14, *d*), while in the adult it measures only about one third the diameter (fig. 14, *c*). Test consisting apparently of two layers; the inner one being perfectly smooth and polished, whilst the outer, the surface of which is rarely preserved, is ornamented with transverse, irregular, slightly oblique riblets (fig. 14, *b*).

Remarks. The "*Orthoceras commune*" of Boll (not Hisinger), which I believe to be identical with *Endoceras Wahlenbergi*, is described by that author as having the "shell in well-preserved examples marked with obscure lines of growth, and in badly preserved ones these are so eroded that their sculpture can scarcely be recognized;" the latter is unfortunately the condition of most of the specimens in the National Collection.

It has been a matter of great difficulty to me to select out of the numerous and divergent forms, described and figured by various

authors, under the name of "*Orthoceras duplex*" those whose characters harmonize sufficiently with the species I have now instituted

Fig. 14.



Endoceras Wahlenbergi.—*a*, portion of the septate part of the shell (nearly one third of it), with some of the smooth inner shell-layer remaining, natural size (*s*, siphuncle); *b*, portion of the test of another specimen, natural size; *c*, part of section from fragment of a large specimen, showing siphuncle (*s*) and sheath (*sh*), natural size; *d*, section and siphuncle of young individual, natural size; *e*, diagram to show average rate of tapering of the species.

as to justify their incorporation with it. The descriptions of "*O. duplex*" have often been based upon imperfect fragments, consisting of casts, or even of sections only, of a few of the chambers, in which the distinguishing characters are necessarily reduced to a minimum. In some instances the siphuncle only has been figured.

In such circumstances I cannot vouch for the accuracy of all the references given above. The dubious ones are indicated by a note of interrogation.

Amongst the specimens of *E. Wahlenbergi* in the Museum Collection from Westrogothia two attain a considerable size, the longest measuring 1 foot $7\frac{1}{2}$ inches, the diameter at the larger end being $2\frac{1}{2}$ inches and at the smaller end 10 lines. The other measures 1 foot 5 inches in length, with a diameter of 2 inches and 8 lines at the larger extremity and 14 lines at the smaller, where it is broken, the chambers being here filled with coarsely crystalline calcite (fig. 14, a). A marble slab from Sweden contains a section of an *Endoceras* in which a portion of the body-chamber is preserved. This individual measures 2 feet $7\frac{1}{4}$ inches in length and increases very slowly in diameter, measuring only 1 line at the apical and 1 inch at the basal extremity. On the whole it would seem to belong to a more slender and slowly tapering species than *E. Wahlenbergi*.

It is difficult to conceive how shells of such great length and thinness of texture could have been preserved from fracture even during the lifetime of the animal. Professor Whitfield, of New York, who has had exceptional opportunities of studying the shells of *Endoceras* in the rich deposits of the Trenton Limestone, as well as in the splendid collection preserved in the American Museum of Natural History, affirms that he finds them "nearly always in a fragmentary condition, the earlier parts having been broken away or otherwise destroyed;" and he supposes that the sheaths formed within the siphuncle served to protect that part of the body of the animal which extended back into it in a "long finger-like projection." The sheaths, he adds, "were not only formed in case of accidents already having taken place, but were probably often formed to guard against future troubles; consequently we sometimes find them crowded together, so as to leave not more than an inch or so between them, and the intervening space filled with coarsely crystalline calc-spar, showing that the one below had not been injured so as to admit the access of foreign matter, which is always sure to be the case where injury has occurred to the individual sheath below the cavity so filled."

With reference to the number and disposition of the sheaths Professor Whitfield observes that in the American species he can "find

no regularity whatever in the distances at which they occur even in the same individual. They often occur quite close together, sometimes three or four of them being ensheathed within each other; and others again will have from 10 to 20 inches between them; and I have seen examples of the shell from 2 to 4 feet long without a trace of a sheath."¹

In the distance of the septa and proportionate size of the siphuncle this species resembles *Endoceras belemnitiforme*, Holm (*ante*, p. 130, footnote); but the septa in the latter are as distant in the earlier as in the later stages of the growth of the shell, which is not the case in the present species. The rare preservation of the apical extremity of these long and finely pointed shells will always make any characters founded upon the form of the apex but seldom available for purposes of specific distinction; and indeed such structures, connected, as they admittedly are, with the embryonic development of the shell, have too wide an import to be employed in such a way.

Horizon. *Orthoceras*-Limestone (= Arenig).

Localities. Uitby, near Lake Siljan, and Kinnekulle Hill (Westrogothia), Sweden; Fossum, River Glommen, near Dröbak, Norway; Reval (Esthonia), Russia; Wrietze, near Berlin.

Well represented in the Collection, many very fine specimens having been presented by J. E. Lee, Esq., F.S.A., F.G.S.

Endoceras vaginatum, Schlotheim, sp.

1820. *Orthoceratites vaginatus*, Schlotheim, Petrefactenkunde, p. 53.

† 1844. *Thoracoceras vaginatum*, Fischer, Bull. Soc. Impér. des Naturalistes de Moscou, tom. xvii. no. 3, p. 763, pl. xviii. f. 3.

1860. *Endoceras vaginatum*, Eichwald, Lethæa Rossica, vol. i. Seconde Section de l'ancienne Période, p. 1243, pl. xlvi. ff. 1, a-e. †

1869. *Orthoceras vaginatum*, Karsten, Verstein. des Uebergangsgebirges in den Geröllen der Herzogthümer Schleswig und Holstein, p. 49, Tab. xvii. ff. 2, a, b, † c.

1881. *Endoceras Zaddachi*, Schröder, Schrift. der physikal.-ökonom. Gesell. zu Königsberg, Jahrg. xxii. Abth. i. p. 93, Taf. iv. ff. 5, a, b, c, d.

Sp. Char. Shell straight. Rate of increase about 1 in 11. Section slightly elliptical, the ratio of the diameters being as 13:12. Septa very numerous, about 8 being contained in a length of 1 inch, where the shell has a diameter of 1 inch 2 lines; lessening very slightly in their distance apart as the shell augments in diameter. Siphuncle very large, occupying about half the longer diameter of

¹ Bull. American Mus. Nat. Hist. no. 1, New York, Dec. 23, 1881, p. 20.

the shell. Test very thin; composed of two or more layers, the internal one being covered transversely with minute incised, interrupted lines; the outer with very fine raised lines or riblets, about half a line apart, these being crossed longitudinally by still finer lines, which can only be seen with a lens. These last are very obscure.

Remarks. Eichwald has pointed out the mistake into which many authors have fallen in identifying this species with *E. trochleare*, Dalman. No doubt, as Eichwald observes, authors have been led into this error by Hisinger (*Lethæa Svecica*, p. 28), who adds to his description of *E. trochleare* the words "Orthoceras vaginatus?, Schloth." In point of fact *E. vaginatum* appears to have been overlooked by palæontologists until it was brought to light again and properly described and figured by Eichwald. It will be interesting to give here the main points of his description. The principal character of the species, he says, which was known to M. de Schlotheim only from Reval [Esthonia], is the possession of a nearly cylindrical shell, pierced by a large siphuncle, which attains at least half the width of the shell, goes along its margin, enlarging rather rapidly, so that it finally occupies nearly three fourths the width of the shell; it is fixed, as M. de Schlotheim expresses it, like a sword in its sheath; the surface of the test is transversely striated with very fine, close-set, slightly raised striæ.

These are the characters which suffice to distinguish our species from *trochleare*, *cancellatum*, and species provided with distinct transverse ribs, of which no mention is made in M. de Schlotheim's description. One of the principal characters of this species is the large and thick siphuncle, which generally exceeds half the width of the shell, which is not the case either with *trochleare* or with *cancellatum*, or with any other species of *Orthoceras* near to *vaginatum*. (*Eichwald.*)

The single specimen of *E. vaginatum* in the collection bears out the foregoing description. It is a fragment of the septate portion of the shell, about 5 inches in length, having a diameter of about 1 inch at the smaller, and nearly $1\frac{1}{2}$ inch at the larger extremity.

This is apparently a rare species. Eichwald observes that he is not aware that it has been found in Sweden, or, indeed, anywhere except in Esthonia.

Horizon. *Orthoceras*-Limestone (= Arenig).

Locality. Reval (Esthonia), Russia.

The Collection contains one example, presented by A. H. Foord.

Endoceras complanatum, Eichwald.

1732. *Orthoceratites siphone ad peripheriam*, Breynius, Dissert. phys. de Polythalamiis, p. 36, § 68, tab. v. ff. 1-4 (not f. 5).
- ? 1835. *Orthoceratites gigantei* (?), Kutorga, Beitrag zur Geognosie und Palæontologie Dorpati's, i. p. 32, Taf. vi. f. 6.
1849. *Orthoceratites duplex*, Quenstedt, Die Cephalopoden, p. 41, tab. i. ff. 2, a, b.
1855. *Orthoceras duplex*, Barrande in Leonhard and Bronn's Neues Jahrb. für Min. &c. p. 264, Taf. iii. ff. 12, 12*.
1857. *Orthoceras duplex*, Boll, Beitrag zur Kenntniss der Silur. Ceph., in Archiv für die Naturkunde von Mecklenburg, p. 10, Taf. i. f. 2.
1860. *Endoceras complanatum*, Eichwald, Lethæa Rossica, Seconde Section de l'ancienne Période, vol. i. p. 1242, pl. xlix. ff. 12, a, b, c.
1866. *Orthoceras duplex*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 709 (pars), pl. cccxxxviii. f. 31. "Espèce inconnue."
1880. *Endoceras Damesii*, Dewitz, Zeitschr. der deutsch. geol. Gesell. Band xxxii. Heft i. p. 390, Taf. xvi. ff. 1 A, 1 B, 1 C.
- ? 1880. *Orthoceras duplex*, Angelin-Lindström, Fragmenta Silurica, p. i (pars), tab. iii. ff. 1-4.
1881. *Endoceras Damesii*, Schröder, Schriften der physikalisch-ökonomischen Gesell. zu Königsberg, Jahrg. xxii. Abth. i. p. 90, Taf. iii. ff. 2 A, 2 B.
- ? 1881. *Endoceras rectestrigatum*, Schröder, *ibid.* p. 92, Taf. iv. f. 3 & ff. 4, A, B, C.

Sp. Char. Shell straight; very slowly tapering at the rate of about 1 in 32, and even less than this in some individuals. Section elliptical, the ratio of the two diameters being roughly as 20 : 17; the specimens are, however, too imperfect to admit of strictly accurate measurements. Septa strongly undulating, so as to have a considerable obliquity when viewed in some aspects; distant about $\frac{2}{3}$ the diameter. Siphuncle marginal, very large, being about $\frac{2}{3}$ the diameter of the shell. The test is described by Eichwald as consisting of "plusieurs membranes très-minces et striées transversalement, à stries très-fines et très-serrées, qui sont souvent confluentes;" so that the surface is very finely rugose, which is regarded as the principal character of the species. From the extreme fineness of these markings I should, however, be disposed to deem them to belong, not to the surface of the test, but to its inner layers; and if this be the case, they would have little or no specific importance, because minute sculpturing of this character occurs in other species of *Endoceras*, and has been figured by Barrande in *Orthoceras*, in his 'Système Silurien de la Bohême,' in numerous instances.

It is well seen also in *E. vaginatum*, Schloth., sp. None of the test is preserved upon the specimen in the National Collection.

Remarks. This species is well characterized by its exceedingly slow rate of increase, and by the large dimensions of its siphuncle. Regarding the first of these features, Eichwald records the measurements of an example in his own collection, which, in a length of 9 inches (including 30 chambers), increased in breadth only 2 lines, which gives a rate of increase of only 1 in 54.

Schröder, in his observations upon *E. Damesii*, expresses the opinion that Schlotheim was in error in comparing *E. vaginatum* with Breyn's figures (*loc. cit.*); and with this view I quite agree. The species described by Schmidt¹ from his "Schicht 2 a" as "eine nahe verwandte Form" [to "*O. duplex*"], but with thicker siphuncle, occupying half the shell-diameter, and with flatter chambers, is regarded by Schröder as belonging also to *E. Damesii*, that is, to the species under description. His further conclusion, however, that this species is identical with *E. vaginatum*, is one in which I cannot concur. *E. vaginatum* has a much higher rate of tapering and more crowded septa; in fact, in this respect it is very rarely excelled. Barrande has described a species (*Endoceras insulare*) from the Quebec group (Upper Cambrian and Lower Ordovician) of Newfoundland², which is apparently an allied form to this one, which it resembles in the large size of its siphuncle and slow rate of tapering. *E. insulare* is certainly identical with *Orthoceras* [*Endoceras*] *piscator*, Billings, from the same country and horizon³.

The sculpture of the test of *E. complanatum*, as described by Eichwald, agrees very closely with that of *E. rectestrigatum*, Schröder, and the large siphuncle, numerous septa, and slow rate of tapering in the latter add to the similarity between these species, which I am strongly disposed to regard as identical.

Horizon. *Orthoceras*-Limestone (= Arenig).

Locality. Russia.

Well represented in the Collection.

Endoceras vertebrale?, Eichwald.

1840. *Endoceras vertebrale*, Eichwald, Ueber das silurische Schichtensystem von Ehstland, p. 95.

¹ Archiv für die Naturkunde Liv-, Ehst- und Kurlands, Band ii. Dorpat, 1858, p. 195.

² Syst. Sil. de la Bohême, vol. ii. Texte iii. 1870, p. 721, pl. ccccxix. ff. 1-11, pl. ccccxixi. ff. 1-10.

³ Palæozoic Foss. vol. i. 1865, p. 251, f. 237.

1860. *Endoceras vertebrale*, Eichwald, Lethæa Rossica, vol. i. Seconde Section de l'ancienne Période, p. 1237, pl. xlvi. ff. 4, a, b, 5, & 6, a, b.

Sp. Char. Shell straight, very long, elliptical in section. Rate of increase rather rapid, that is to say about 1 in 7. Septa numerous, distant about $\frac{2}{3}$ the diameter of the shell. Siphuncle marginal, its diameter about $\frac{2}{3}$ that of the shell. Surface of test unknown.

Remarks. A crushed and distorted specimen in the Collection may belong to this species. It is not so decidedly elliptical in section as Eichwald's species, and its rate of tapering is not so rapid, but the distorted condition of the specimen prevents accurate measurement.

Horizon. *Orthoceras*-Limestone (= Arenig).

Locality. Russia.

Represented by two specimens, one being a polished section.

Endoceras incognitum, Schröder.

? 1869. *Orthoceras commune*, Karsten, Die Verst. des Uebergangsgewirges in den Geröllen der Herzogthümer Schleswig und Holstein, p. 50, tab. xvii. ff. 6, a, b.

1880. *Orthoceras speciei indeterminati*, Angelin-Lindström, Fragmenta Silurica, p. 2, tab. iv. f. 16.

1881. *Endoceras incognitum*, Schröder, Schrift. der physikal.-ökonom. Gesell. zu Königsberg, Abth. i. p. 86, Taf. iv. ff. 1 & 2 A-D.

Sp. Char. Shell straight. Rate of increase about 1 in 8. Section circular. Septa approximate, distant from each other about $\frac{1}{4}$ the diameter of the shell. Siphuncle marginal, its diameter about $\frac{3}{4}$ that of the shell. Surface of the shell perfectly smooth.

Remarks. At the end of the description of "*Orthoceras duplex*" by Angelin-Lindström (*loc. cit.* p. 2), we read, "In tabula iv. figura 16 depictum est *Orthoceras speciei indeterminati*, form inter præcedentes [viz. '*O. commune*' and '*O. duplex*'] intermedium, concamerationibus approximatis *O. duplicis* et siphone *O. communis*."

Upon this diagnosis and the figure accompanying it, Schröder has founded his species. He says that *E. incognitum* has often been described under *Endoceras duplex*, and that it is very difficult to judge from the figures which of the two species is intended. The peculiar character of *E. incognitum*, he continues, lies in the position of the transverse ridges and furrows upon the siphuncle. A better way of distinguishing the two species is by a comparison of the septa, which in *E. incognitum* are much closer together than they are in *E. duplex* [*E. Wahlenbergi*].

Horizon. *Orthoceras*-Limestone (= Arenig).

Locality. Kinnekulle Hill (Westrogothia), Sweden.

One good example, presented by J. E. Lee, Esq., F.S.A., F.G.S.

Endoceras Reinhardi? Boll, sp.

1857. *Orthoceras Reinhardi*, Boll, Beitrag zur Kenntniss der Silur. Ceph., in Archiv für die Naturkunde von Mecklenburg, p. 13, Taf. ii. ff. 5 a, 5 b.

1860. *Endoceras remotum*, Eichwald, Lethæa Rossica, vol. i. Seconde Section de l'ancienne Période, p. 1250, pl. li. f. 24.

? 1880. *Orthoceras commune*, Angelin-Lindström, Fragmenta Silurica, p. 1, tab. iii. ff. 7, 8.

Sp. Char. Shell straight, increasing very slowly in diameter. Section circular. Septa very remote, being distant nearly half the diameter of the shell. Siphuncle nearly marginal; its diameter about $\frac{2}{7}$ that of the shell. Surface of the outer shell probably smooth, but the inner shell-layer, according to Boll, is ornamented with close-set wrinkles, of hair-like fineness.

Remarks. Boll observes that his species is easily recognizable by its form and size, but in its fragmentary condition (he figures only four chambers) it allows of no complete diagnosis.

I entertain very little doubt about this species being identical with *E. remotum*, Eichw., the only difference between the two consisting in the compression of the latter, which may be accidental. The siphuncle appears, judging from the figures, to be quite as near the margin in the one species as it is in the other, though Eichwald states that its position in *E. remotum* is not quite marginal. I cannot myself find sufficient ground for separating the two species. In the distance of the septa and proportions of the siphuncle the *O. commune* of the 'Fragmenta Silurica' comes very near to this species, if it be not, indeed, identical with it.

The example in the Collection which I have referred to this species, to which it seems to come nearest, is contained in a polished slab of marble, in which it is seen on both sides. It has a total length of 1 foot $2\frac{1}{2}$ inches, but is broken at each end. Its greatest diameter is about 15 lines, its least 4 lines. The septa are 1 inch apart at the larger end, and 8 lines at the smaller. Owing to the manner in which the specimen has been cut, the siphuncle appears to be proportionately much larger than it is in *E. Reinhardi*.

Horizon. *Orthoceras*-Limestone (= Arenig).

Locality. Sweden.

Represented in the Collection by one specimen.

Endoceras avus, Eichwald, sp.

1845. *Orthoceratites duplex*, Murch., Vern., and de Keyserl. Géol. de la Russie d'Europe, vol. ii. pt. 3, Palæont. p. 351 (pars), pl. xxv. f. 2, a, b.

1860. *Cochlioceras avus*, Eichwald, Lethæa Rossica, vol. i. Seconde Section de l'ancienne Période, p. 1251, pl. xlvi. f. 4, a, b.

Sp. Char. Shell straight. Section circular. Rate of increase, roughly calculated, about 1 in 10, but the specimens are too fragmentary for accurate measurements to be taken. Septa rather approximate; in a small specimen 14 lines in length, with a diameter of $9\frac{1}{2}$ lines at the larger, and $8\frac{1}{2}$ lines at the smaller extremity, they are about 2 lines distant. In a larger specimen they are distant 5 lines where the diameter is $1\frac{1}{2}$ inch. The diameter of the siphuncle very slightly exceeds $\frac{1}{4}$ of that of the shell. A small fragment of the test adheres to one of the specimens, but whether this be the outer or the inner layer I am unable to state. It is perfectly smooth.

Remarks. Upon this species Eichwald founded the genus *Cochlioceras*, which, however, has not been recognized by palæontologists. He describes it as having a marginal siphuncle, with numerous constrictions ("étranglements"), by which the latter appears as if articulated. This appearance is caused by the narrowing of the septal necks, as may be seen in *Orthoceras simplicissimum*, G. & F. Sandb., to which Eichwald also refers. There is nothing whatever remarkable in such a feature; it is met with in many of the *Orthoceratidæ*.

Horizon. *Orthoceras*-Limestone (= Arenig-Llanvirn).

Locality. St. Petersburg.

Fairly well represented in the Collection.

Endoceras trochleare, Hisinger, sp.

1831. *Orthoceratites trochlearis*, Hisinger, Anteckn. i Physik och Geognosie, Häft. 5, p. 12, tab. iv. f. 3.

1837. *Orthoceratites trochlearis*, Hisinger, Lethæa Svecica, p. 28, tab. ix. f. 7.

? 1837. *Orthoceratites vaginatus*, Bronn, Lethæa Geogn. Zweite Aufl. Band i. p. 100, Taf. i. ff. 9, a, b (not f. 9, c).

1841. *Orthoceratites vaginatus*, von Buch in Karsten's Archiv für Mineralogie, &c. Band xv. Heft i. p. 37, tab. ii. f. 11.

? 1849. *Melia trochlearis*, d'Orbigny, Prodr. de Paléontologie, vol. i. p. 4.

? 1851. *Orthoceras vaginatum*, Salter, Quart. Journ. Geol. Soc. vol. vii. p. 177, pl. x. f. 7.

1857. *Orthoceras vaginatum*, Boll, Beitrag zur Kenntniss der Silur. Ceph., in Archiv für die Naturkunde von Mecklenburg, p. 9, Taf. i. ff. 1 a, 1 b.
1866. *Endoceras (Orthoceras) trochleare*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 710, pl. ccxxxviii. ff. 12, 13, pl. cccxli. ff. 25, 26.
- ? 1869. *Orthoceras trochleare*, Karsten, Die Verstein. des Uebergangsgewirges in den Geröllen der Herzogthümer Schleswig und Holstein, p. 50, Taf. xvii. f. 7 a (not f. 7 b).
- ? 1873. *Orthoceras vaginatum*, Malaise, Terrain Silurien du centre de la Belgique, p. 89, Tab. iv. f. 1.
1880. *Orthoceras vaginatum*, Angelin-Lindström, Fragm. Silurica, p. 2, Tab. vii. ff. 4-7, 11-12, ? 1-3.
- ? 1882. *Orthoceras (Endoceras) vaginatum*, Blake, British Foss. Ceph. pt. i. p. 164.

Fig. 15.

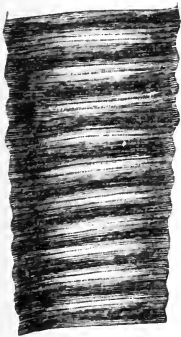


Fig. 16.

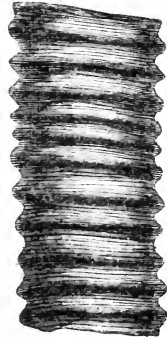


Fig. 15. *Endoceras trochleare*.—Fragment showing the sculpture of the test; natural size.

Fig. 16. Var. *percostatum*.—Fragment showing the coarser sculpture of the test as compared with the preceding; natural size.

Sp. Char. Shell straight or slightly curved. Section circular. Rate of increase varying from 1 in 12 to 1 in 9. Length of the body-chamber about three times the diameter of the last chamber; slightly constricted near the aperture. Septa approximate, that is from 2 to 3 lines distant, where the shell has a diameter of $1\frac{1}{2}$ inch. Siphuncle marginal, its diameter about $\frac{2}{5}$ that of the shell. Principal ornaments consisting of close-set, low, undulating annulations, varying somewhat in size and prominence in different parts of the shell, and becoming almost obsolete in adult individuals. The

annulations, of which six or seven are contained in the space of 1 inch, are crossed transversely by raised, thread-like lines, which run parallel with them. About three of them are contained in the space of 1 line; they are usually a little wider apart upon the annulations than between them (see fig. 15).

Remarks. This species was first figured by Hisinger in the *Anteckn. i Physik och Geogn. (loc. cit.)* in a somewhat unsatisfactory manner as regards the finer surface ornaments, which are represented as consisting of only two transverse striæ to each of the annulations, instead of six or seven. In other respects this figure gives one a better idea of the shell than does the one in the 'Lethæa Svecica,' because a greater length of it is shown, and thus the rate of increase can be better estimated; this amounts to 1 in 12.

Hisinger has added at the end of his description of *E. trochleare*, "Orthoceras vaginatus?, Schloth." In consequence of this many authors have supposed these two species to be identical. It has, however, been clearly shown by Eichwald that Schlothheim's species is perfectly distinct from *E. trochleare*. The frequent occurrence of the name *vaginatum* in my synonymy of the present species is thus explained.

The figures given by Klein¹ very probably represent *E. trochleare*.

I have omitted from the synonymy of this species "Cycloceras trochleare," Eichwald, which name it is proposed by Noetling², Schmidt, and Inostranceff to cancel, those gentlemen having failed to find the original specimen (figured by Eichwald, *Leth. Ross. pl. li. ff. 23, a, b*) in the "Eichwald Collection" at St. Petersburg, and not deeming Eichwald's description sufficient for identification. Both Eichwald's form and the one figured by Karsten (*loc. cit. f. 7 b*), are closely allied to *Orthoceras bifoveatum*, Noetling (*loc. cit. p. 111*), and consequently they do not belong to the same genus as *E. trochleare*.

Horizon. *Orthoceras*-Limestone (=Arenig), Sweden. Ardwell Group (Middle Bala), Scotland.

Localities. *British.* Ardwell, Ayrshire.—*Foreign.* Gerbz (Kopparberg³), and Skyrberga, Sweden.

Represented by several remarkably fine specimens.

¹ *Tubulorum Marinarum*, 1731, Species ii. *Circulis asperi*, Append. p. 11, Tab. vi. ff. 1-5.

² *Jahrb. der königl. preuss. geol. Landesanst. und Bergakad. zu Berlin*, für das Jahr 1883, p. 115.

³ The ancient province of Dalecarlia or Dalarne.

Var. **percostatum**, var. nov. (Fig. 16.)

1857. *Orthoceras vaginatum*, Boll, Beitrag zur Kenntniss der Silur. Ceph., in Archiv für die Naturkunde von Mecklenburg, p. 9, Taf. i. ff. 1 c, 1 d.
 1866. *Endoceras (Orthoceras) trochleare*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 710, pl. ccccxli. ff. 22-24.

The variety is distinguished from the species by the coarser character of its principal ornaments, which consist of very numerous and distinct rounded annulations, separated by interspaces of equal width. The annulations form a shallow sinus on the siphuncular side of the shell, and where they arch gently upwards on either side of it they are necessarily oblique to its long axis. The distance of the annulations from summit to summit varies from 2 to 3 lines according to the development of the individual measured. Both the annulations and the spaces dividing them are, as in the species, covered with fine, close-set, raised lines, which are more crowded (especially in the interspaces) than they are in the species.

Horizon. *Orthoceras*-Limestone (= Areuig).

Localities. Kinnekulle (Westrogothia), Sweden. Norindiholm (?), Norway.

Well represented in the Collection. Several of the specimens from Kinnekulle were presented by J. E. Lee, Esq., F.S.A., F.G.S.

Endoceras cancellatum, Eichwald, sp.

1842. *Orthoceratites cancellatus*, Eichwald, Die Urwelt Russlands, Heft 2, p. 67, Tab. iii. ff. 9, 10.
 1845. *Orthoceratites vaginatus*, Murch., Vern., and Keyserl. Géol. de la Russie d'Europe, vol. ii. Paléont. p. 349, pl. xxiv. ff. 6, a, b.
 1849. *Orthoceratites vaginatus*, Quenstedt, Die Cephalopoden, p. 42, pl. i. f. 3. (Copied from Eichwald, *loc. cit.*)
 1860. *Cycloceras cancellatum*, Eichwald, Lethæa Rossica, vol. i. Seconde Section de l'ancienne Période, p. 1226.
 1869. *Orthoceras cancellatum*, Karsten, Die Verstein. des Uebergangsgebirges in dem Geröll der Herzogthümer Schleswig und Holstein, p. 49, tab. xvii. ff. 2, a, b, c.
 1885. *Orthoceras (Endoceras) vaginatum*, F. Roemer, Lethæa erratica, in Dames and Kayser's Palæont. Abhandl., Band ii. Heft 5, p. 126 (373), Taf. ix. [xxxii.] ff. 1, a, b, c.
 [? 1837. *Orthoceratites sulcatus*, Fischer de Waldheim, Oryctogr. de Moscou, p. 125, pl. ix. ff. 1, 2.]

Sp. Char. Shell straight. Rate of increase about 1 in 17. Section subelliptical, the ratio of the two diameters being as 21 : 19. Septa numerous, slightly undulating, with a downward sweep on

the siphuncular aspect of the shell; distant from $2\frac{1}{2}$ to 3 lines, where the longer diameter is 23 lines. Siphuncle marginal, its diameter $\frac{3}{8}$ that of the longer diameter of the shell, where the latter has a diameter of 21 lines. Ornamentation consisting of coarse annulations divided by spaces of about equal breadth. Distance between the annulations from $3\frac{1}{2}$ to $4\frac{1}{2}$ lines. The annulations and their interspaces are covered transversely by very distinct riblets, running parallel to them. About six of these riblets are contained in the space of 2 lines. The whole is crossed longitudinally by fine thread-like lines which can only be detected with a lens.

Remarks. This is a well characterized species, and is distinguished from *E. trochleare*, its nearest ally, by its subelliptical section, slightly flattened on the siphuncular side, coarser and more distant annulations, as well as stronger and more distant riblets.

The fine longitudinal striæ described by Eichwald as occurring beneath the external layer of the shell cannot be regarded as of specific importance, as the same markings are met with in *E. trochleare*. The name *cancellatum* was therefore rather unfortunately chosen for this species. Fischer's figures (*loc. cit.*) very probably represent a species identical with the present one. That author knew neither the locality nor the horizon whence his form was obtained.

Horizon. *Orthoceras*-Limestone (= Arenig).

Locality. Reval (Esthonia), Russia.

Represented by two imperfect specimens, which, however, show the essential characters of the species.

Endoceras festinans, Blake.

1882. *Orthoceras (Endoceras) festinans*, Blake, British Foss. Ceph. pt. i. p. 163, pl. xvii. ff. 3, 3 a.

Sp. Char. "The section is not quite regular, and the specimen may have been therefore somewhat compressed; at present it is elliptic, having the radii in the ratio of 4 to 5. The rate of increase of the long diameter is 2 in 15. No body-chamber or ornaments are seen. The septa are slightly undulating, and are distant $\frac{1}{10}$ the diameter. They form long necks in the neighbourhood of the siphuncle, which they are seen to cross on the worn surface at a distance of one chamber towards the apex. Their convexity is about $\frac{1}{2}$ the diameter. The siphuncle is cylindrical, having a diameter of $\frac{1}{2}$ the longer diameter of the shell; it lies close against the side on the shorter diameter." (*Blake.*) The length of the shell is $3\frac{3}{4}$ inches, and the greatest diameter $3\frac{1}{2}$ inches.

Remarks. The only species I can find comparable with this is the *Orthoceras* [*Endoceras*] *Brongniartii* of Portlock (not *Conotubularia Brongniartii* of Troost), from the Bala beds of Desertcreat, Co. Tyrone. The present species is, however, distinguished from Portlock's by its much more rapid rate of increase, and by the position of its siphuncle, which is close to the margin, instead of being at a little distance from it, as in the former species.

Horizon. Bala Limestone.

Locality. Worthin, Shropshire.

Represented by the type specimen, which was presented by R. J. Moore, Esq.

Endoceras Rottermundi, Barrande.

1824. *Orthoceras*, sp., Bigsby, Trans. Geol. Soc. ser. 2, vol. i. p. 197, pl. xxvi. f. 2.

1866. *Endoceras Rottermundi*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 749, pl. ccxx. ff. 9-11.

? 1882. *Endoceras (Cameroceras) subannulatum*, Whitfield, in Chamberlin's Geol. of Wisconsin, vol. iv. pt. 3, Palæont. p. 230, pl. vii. ff. 15, 16.

Sp. Char. These cannot all be made out owing to the incompleteness of the type, as well as of another specimen referred to this species. The shell appears to have been elongated, and the rate of tapering may be roughly estimated at 1 in 5. The transverse section is circular. The septa are direct and very numerous, being, on an average, about $2\frac{1}{2}$ lines distant from each other, where the shell-diameter is about 3 inches. The siphuncle is marginal and very large, its diameter being about $\frac{2}{7}$ that of the shell, where the diameter of the latter is $3\frac{1}{8}$ inches. A large sheath occupies the centre of the siphuncle. No trace of the test remains. The length of the fragment figured by Barrande corresponds with that of its greatest diameter, viz. $3\frac{1}{8}$ inches.

Remarks. This species bears a considerable resemblance to *E. subannulatum*, Whitf., but it differs in its circular section and more rapid rate of increase. Regarding the former character Professor Whitfield states that his species has an oval section, "the relative diameters being as three to four." The siphuncle in *E. subannulatum* is described as being "proportionally large, fully equalling one-half the shorter diameter of the outer tube." In this respect it agrees with the present species, as also in the close proximity of its septa.

The exact locality whence Comte de Rottermund obtained the specimen figured by Barrande is not known, but the latter states that it was found "on one of the islands in Lake Huron, on the

horizon of the second fauna" (Ordovician). The matrix of the specimen in the British Museum (which is one half of the individual collected by de Rottermund, the other half being in the museum of the Jardin des Plantes, Paris) is a buff-coloured limestone, resembling that of Thessalon Island (Lake Huron), which has been assigned to the Black River Formation, and this is probably the horizon to which the present species belongs. If this be correct it corresponds very nearly with that of *E. subannulatum*, Whitf., from "the upper part of the buff limestone of the Trenton group, near Beloit, Wisconsin."

Another fragment in the Collection, much weathered and battered, exhibits characters which ally it with *E. Rottermundi*, especially the close proximity of its septa, and its large, marginal siphuncle. This also is from Lake Huron, but the precise locality has not been recorded. There is little doubt that the specimen figured, but not described, by Bigsby (*loc. cit.*) is conspecific with the present species.

Horizon. Black River Formation (=Llandeilo Limestone).

Locality. Lake Huron (Canadian side).

Represented by two specimens, one of which is the type figured by Barrande (*loc. cit.*).

Endoceras gladius, Holm.

1845. *Orthoceratites duplex*, Murch., de Vern., & de Keyserl. Géol. de la Russie d'Europe, p. 351, pl. xxiv. f. 7 (not pl. xxv. f. 2).

1885. *Endoceras gladius*, Holm, Palæontologische Abhandl. Band iii. Heft i. p. 13, Taf. ii., Taf. iii. f. 1 *a-i*, Taf. v. f. 1.

Sp. Char. Shell straight. Section apparently circular. The rate of increase may be computed roughly at about 1 in 7. The septa are widely separated, being distant about $10\frac{1}{2}$ lines where the shell has a diameter of $2\frac{2}{3}$ inches. They are strongly concave, and run a considerable distance up the inner side of the shell. Their depth scarcely equals $\frac{1}{3}$ of the shell-diameter. The siphuncle attained a diameter of probably nearly half that of the shell, though owing to the imperfect condition of the type specimen it was impossible to obtain an accurate measurement. There is a strongly inflated rim in the casts of the siphuncle where the necks of the septa overlapped. The outer shell appears to have been smooth and without ornaments of any kind.

Remarks. I have derived most of the characters of this species from Dr. Holm's careful and detailed description of it. In the admirable figures he gives those upon plate ii. (f. 3 *a-c*) represent

casts of the siphuncular sheaths¹, and the long slender tube in figure 1a, which extends from the broken sheath, is evidently the endosiphon. *E. gladius* has a wide geographical distribution, being found in Esthonia, Sweden, and Norway. It may be distinguished from *E. Wahlenbergi* by the great size of its siphuncle and distant septa.

Horizon. *Orthoceras*-Limestone (=Arenig).

Locality. Island of Oeland, Sweden.

The Collection contains one example presented by A. H. Foord.

Endoceras proteiforme, Hall.

1847. *Endoceras proteiforme*, Hall, Pal. of New York, vol. i. p. 208, pl. xlvi., pl. xlix., pl. l., pl. liii. f. 2.

1852. *Endoceras proteiforme*, Shumard, in D. D. Owen's Geol. Surv. of Wisconsin, Iowa, and Minnesota, p. 626.

1863. *Orthoceras proteiforme*, Billings, Geol. of Canada, Appendix, p. 950.

1875. *Orthoceras proteiforme*, Chapman, Outlines of the Geol. of Canada, Introd. p. xxiv, pl. iii. f. 37.

Sp. Char. "General form cylindrico-conical, more or less elongated, often compressed, tapering somewhat unequally in different specimens; . . . surface marked by distinct transverse striæ, which usually appear like narrow subimbricating bands, with one edge well defined and more elevated than the other, more or less distinctly striated longitudinally; striæ varying from extreme tenuity to distinct elevated thread-like lines; section circular; septa distant from one fifth to one fourth the diameter; siphuncle excentric or submarginal." (*Hall.*)

Remarks. A specimen in the Collection which may belong to this species exhibits traces of the septa externally, but the latter have been completely destroyed internally, and the cavity so produced is partly occupied by a smaller *Orthoceratite* in which one or two septa are preserved, the rest of the shell being filled with calc-spar, which has obliterated most of the septa, as well as the siphuncle.

Horizon. Trenton Formation (=Bala Limestone group).

Locality. Trenton Falls, New York State.

Represented in the Collection by two specimens.

[*Endoceras proteiforme*, Hall, var. *tenuistriatum*, Hall, and var. *tenuitextum*, Hall, Pal. of New York, 1847, vol. i. pp. 209, 210. The Collection contains some specimens which evidently agree with these forms, but it appears to me that the evidence is wanting to show that they belong to the genus *Endoceras*.

¹ German "Spiess;" French "broche."

Few, if any, will adhere now to the view originally expressed by Professor Hall (*loc. cit.* p. 208), that the siphuncular sheaths in *Endoceras* performed embryonic functions, and that they contained within themselves the young shells. But it was upon this hypothesis that Prof. Hall rested his conclusions as to the affinities of the forms in question. Judging from his figures I can see no necessary connection between *Endoceras proteiforme* and its so-called varieties. The siphuncle is figured in two instances, viz. pl. xlv. f. 4b (*E. proteiforme*, var. *lineolatum*) and pl. xlvi. f. 4b (*E. proteiforme*, var. *strangulatum*), but neither in size nor position does it resemble the siphuncle of an *Endoceras*. I am therefore strongly inclined to the opinion that these forms really belong to the genus *Orthoceras*; but in the absence of more abundant material to work upon, I cannot at present say anything positive upon this point.

It may be added that Prof. H. A. Nicholson, in his Report upon the Palæontology of Ontario (Toronto, 1875), p. 39, records the occurrence in the Utica shales of Whitley and Collingwood [Canada West] of "a species of *Orthoceras* which may be provisionally referred to *Endoceras proteiforme* of Hall, var. *tenuistriatum*." Prof. Nicholson remarks that these specimens, though resembling the genus *Theca* in their pointed triangular form, possess distinct septa, which are placed about one and a half lines apart, though these, he adds, are not always recognizable.

Horizon. Trenton Formation (=Bala Limestone Group).

Localities. Trenton Falls, New York State; Montreal.

Represented by a few fairly good specimens, those from Montreal presented by Dr. J. J. Bigsby, F.R.S.]

Endoceras magniventrum, Hall.

1847. *Endoceras magniventrum*, Hall, Pal. of New York, vol. i. p. 218, pl. liii. ff. 1 a-e.

Sp. Char. "Elongated, very gradually tapering; siphuncle very large, occupying about three fifths the diameter of the shell; septa extremely convex, distant one eighth the diameter of the shell. The specimen figured is a fragment of an individual, which, when perfect, could not have been less than six feet in length. The septa are more convex than in any other species known to me. . . . The siphuncle is proportionally larger, and the septa more approximate than in any other species described." (*Hall.*)

Remarks. A large fragment of this species is contained in the

National Collection. It measures 6 inches in length, 5 inches in its greatest and 4 in its smallest diameter. The specimen is broken along the longitudinal axis of the shell, so that only about half of its diameter is seen with part of the enormous siphuncle. No trace of the test is preserved.

Horizon. Trenton Formation (=Bala Limestone Group).

Locality. Albany, New York State.

Endoceras? Ommaneyi, Salter.

1852. *Orthoceras Ommaneyi*, Salter, in Appendix to Dr. P. C. Sutherland's Journal of a Voyage in Baffin's Bay &c., p. ccxxii, pl. v. ff. 16, 17.

1853. *Orthoceras Ommaneyi*, Salter, in a Memoir by Dr. P. C. Sutherland, Quart. Journ. Geol. Soc. vol. ix. p. 314.

1858. *Orthoceras Ommaneyi*, Haughton, Journ. Royal Dublin Soc. vol. i. p. 249.

1859. *Orthoceras Ommaneyi*, Haughton, in M'Clintock's 'Discovery of the Fate of Franklin and his Companions,' Appendix IV. p. 381.

?1865. *Orthoceras explorator*, Billings, Pal. Foss. vol. i. p. 253.

Sp. Char. "This fine large species seems to be frequently met with, and will be easily recognized by its large lateral siphuncle, and its waved and close septa. It must have been a foot long, and one inch and three-quarters wide. The shell tapers slowly and has a round transverse section. The septa are placed obliquely, the side farthest from the mouth of the shell being that in which the large siphuncle is placed, and externally they show a downward course on this side. They are very closely placed; in a specimen of an inch and a quarter diameter there are nine in the space of barely an inch. The septa are flattish, and the large siphon is placed less than half its own diameter from the edge. It would belong to the section *Cameroceras*." (*Salter*.)

Remarks. There are two small fragments in the Collection labelled with the above name, one of them with a reference to Salter's figure, but neither of them is the type. They are both young examples, one being in fact the apical extremity, and measuring not much more than $2\frac{1}{2}$ inches in length; the septa are very close, there being nine in the space of an inch.

The other specimen shows the siphuncle in section, and this is found to be somewhat less than one fourth the diameter of the shell.

Billings's species agrees so closely with this one that there can scarcely be any doubt as to the identity of the two species. In the former there are said to be about twelve septa to one inch, while in Salter's species we have seen that there are nine, but this was in a

specimen that measured an inch and a quarter in diameter, whilst Billings's measures only nine lines; so that the septa would naturally be closer together, following the general rule.

O. explorer is from the Quebec Group of Newfoundland.

With reference to the horizon of the rocks whence the present species was obtained, Salter observes (*loc. cit.* p. 233):—"The great formation which occupies the Arctic lands, or at least skirts their icy shores, is a limestone which, from all that can be gathered from the fossils, is of Upper Silurian age."

Horizon. Silurian.

Locality. Assistance Bay, Cornwallis Island, Arctic America.

Represented by two small specimens transferred from the Museum of Practical Geology.

Endoceras, sp.

1855. *Orthoceratites duplex*, Prado, Sur la géologie d'Almaden &c., in Bull. Soc. Géol. de la France, sér. 2, vol. xii. p. 186.

A very imperfect cast, 14 lines in length and 1 inch in diameter at the larger end, with a portion of the siphuncle protruding, does not present sufficient characters for specific determination. The septa can scarcely be recognized, and the specimen may be part of the body-chamber. It is doubtless the same form as that chronicled by M. Casiano de Prado, from Huerta del Llano, in the memoir cited above.

Horizon. Ordovician.

Locality. Almaden de Azogue (Ciudad-Real), Spain.

Transferred from the Museum of Practical Geology.

Endoceras, sp.

[Cf. *Endoceras multitubulatum*¹, Hall, Pal. of New York, vol. i. p. 59, pl. xviii. ff. 2 a, b.]

There is an interesting specimen in the Collection, consisting of a fragment (a polished section) of the siphuncle of a slowly tapering shell, which appears to be allied to, if not identical with, the *Endoceras multitubulatum*, Hall. It differs from this, however, in that the sheaths in the cavity of the siphuncle do not extend so far down, *i. e.* they make a more obtuse-angled cone than do those of Hall's

¹ Hyatt (Proc. Boston Soc. Nat. Hist. vol. xxii., April 1883) has founded the genus *Vaginoceras* upon this species, but so far as it has yet been characterized it appears to differ from *Endoceras* only in having more numerous siphuncular sheaths.

species. The dimensions of the specimen are:—length 2 inches, greatest breadth 2 inches, least $1\frac{1}{2}$ inch. There are about ten invaginated sheaths, succeeding each other with great regularity, and varying from 1 to 2 lines apart. No traces of the septa can be seen.

Horizon. Calciferous Sandstone (=Tremadoc).

Locality. Mingan Island, Gulf of St. Lawrence (?).

Genus **PILOCERAS**, Salter¹.

Gen. Char. Shell more or less broadly conical; slightly curved; somewhat compressed laterally; elliptical in section. Siphuncle marginal; formed, as in *Endoceras*, by the prolongation and conjunction of the necks of the septa; very large; partaking of the curvature of the shell; provided internally with one or more conical or funnel-shaped sheaths, which are united at the top with its margin. These sheaths apparently communicated with one another by means of the endosiphon which passed from the initial chamber into the siphuncular cavity by means of a large foramen (fig. 17, II. a), situated on the inner curvature of the siphuncle a little above the apical point².

The history of this genus is an interesting one.

It was founded by Salter upon the siphuncle of a shell closely allied to *Endoceras*. Salter supposed that the invaginated sheaths observed in the siphuncle of *Piloceras* “represented the siphuncle and septa combined,” the septate part of the shell not being preserved in the specimens described by him.

A year after the appearance of Salter’s memoir, E. Billings (at that time Palæontologist to the Canadian Geological Survey) described a fossil from the Calciferous Sandstone (=Tremadoc) under the name of *Piloceras Canadense*³. This exhibited the septate part of the shell in conjunction with the siphuncle.

The general form of this species was well characterized by Billings as that of a “short, thick, curved Orthoceratite.”

This appears to have been the first discovery of the septa of *Piloceras*, associated with its siphuncle; for the generic identity of Salter’s and Billings’s species is now put beyond all doubt.

¹ Quart. Journ. Geol. Soc. vol. xxv. 1859, p. 376.

² Hyatt in his definition of *Piloceras* (*loc. cit.* p. 266) states that it is “often annulated;” but this is evidently an inadvertence, because the outer shell was unknown when he wrote, and remained so until the specimens described by Prof. Whitfield saw the light, and these showed only “a few transverse wrinkles of growth.” He probably had in his mind the detached siphuncles, which have an annulated appearance caused by the adherent remains of the septa.

³ Canadian Naturalist and Geologist, vol. v. p. 171.

Again, in 1881 Sir William Dawson¹ described a new species of *Piloceras* (*P. amplum*) from the Calciferous Sandstone of Lachute, near Montreal, which threw much new light upon the internal structure of the shell.

But the most complete examples of *Piloceras* hitherto met with were collected in 1885 by Messrs. Seeley and Brainerd, at Fort Cassin, in the State of Vermont, from rocks considered to be of the age of the Birdseye Limestone (=the Lower Llandeilo, nearly). These fossils were described and beautifully illustrated by Professor R. P. Whitfield, of New York², who was enabled to show, by means of almost perfect specimens, the body-chamber, septa, siphuncle (in place), and even the test of the species, which he very appropriately named *Piloceras explanator*.

M. Barrande³, whose information about *Piloceras* was very scanty, constituted it a subgenus of *Cyrtoceras*, on account of its curvature; and Professor Blake⁴ disposes of it in the same way, though only provisionally, for he remarks, "The organism, whatever it is, must wait further elucidation by materials not yet extracted from the rocks."

Finally, in 1883, Mr. B. N. Peach, of the Geological Survey of Scotland, found specimens of *Piloceras* at the typical locality, Durness, Sutherlandshire, in which both septa and siphuncle were preserved, though in a very imperfect condition.

In comparing the structure of *Piloceras* with that of other Cephalopods, we are at once reminded of *Endoceras*, and the resemblance between these two forms did not escape Salter's experienced eye. In both genera the siphuncle is very large in proportion to the shell, and in both it is furnished with a series of conical or funnel-shaped sheaths, communicating with one another by means of an endosiphon.

Professor Hyatt, whose conclusions regarding the present genus are based upon Principal Dawson's paper, explains the origin of the sheaths in *Piloceras* to be due to the widening of what he terms the "fleshy siphuncle" near the body-chamber. The sheaths lie somewhat loosely in the siphuncle, and they are supposed by Dawson, upon the evidence of the specimen described by him (fig. 18), to have existed only temporarily, and to have been successively absorbed, the last one only becoming completely calcified. In the

¹ Canadian Naturalist, new ser. vol. x. no. 1.

² Bull. Amer. Mus. Nat. Hist. vol. i. no. 8, p. 323, pl. xxviii. (New York, 1886).

³ Syst. Sil. de la Bohême, vol. ii. Texte, v. 1877, p. 905.

⁴ British Foss. Cephalopoda, pt. i. p. 186.

Durness specimens, however, it is not an uncommon thing to find two or three of the sheaths preserved, their walls standing out in relief from the surrounding matrix, which has been removed by weathering.

Fig. 17.

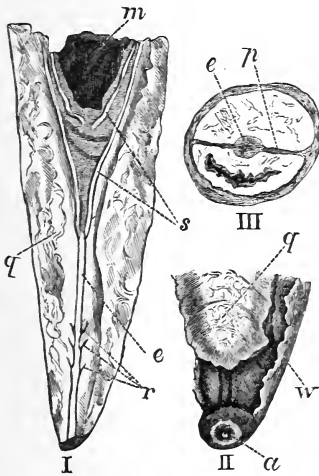


Fig. 18.

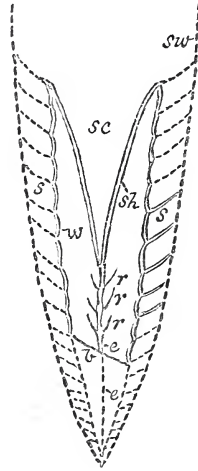


Fig. 17. I. Section of siphuncle of *Piloceras*, sp., from Durness, showing two of the funnel-shaped sheaths, *s*: *e*, the endosiphon, with *r*, remains of former sheaths?; *m*, matrix filling what remains of the cavity of the siphuncle; *q*, quartz-infilling. II. Posterior extremity of another siphuncle much eroded, but showing an aperture, *a*, at the apex, by which the endosiphon may have communicated with the initial chamber; *w*, wall of the siphuncle, and *q*, quartz forming the infilling between this and one of the sheaths. III. Transverse section of another siphuncle, showing in the centre the endosiphon *e*, and what appears to be a partition *p*, representing perhaps the septum or "central shelly plate" of Dawson. (All the figures are of natural size.)

Fig. 18. Vertical section of an imperfect siphuncle, with a few of the septa attached, of *Piloceras amplum*, Dawson, cut in the direction of the shorter diameter of the shell, which was of an elliptical form, judging by that of the siphuncle; *sw*, shell-wall; *sc*, siphuncular cavity; *sh*, sheath; *w*, internal wall of siphuncle; *s*, *s*, septa; *b*, broken extremity of siphuncle; *r* and *e*, same as in fig. 17, I. The dotted lines are restorations. (Slightly reduced from Dawson's figure, which is itself a little smaller than the original specimen.)

A series of short, upwardly projecting lines are observed to spring from the sides of the endosiphon (figs. 17 and 18), where it is slightly swollen. These lines are conjectured by Dawson to be the remains

of the membranous or fleshy sheaths which have become absorbed, as suggested by Hyatt. The close correspondence of these structures in the Scotch and Canadian species is very apparent in the figures. It is also noticeable that above the sheath whose apex is perforated by the endosiphon there is another one, in a somewhat shrunken condition; this appears also to be perforated, presumably for the passage of the endosiphon, if indeed that organ extended beyond the apex of the larger sheath below; but of this I have no proof, as no vestige of it can be seen above where it is figured.

It should be mentioned that Principal Dawson in his description of *P. amplum* speaks of a "vertical partition" crossing the lower part of the siphuncle; but Hyatt, recognizing its tubular character in Dawson's figure, refers to it as the endosiphon. Nevertheless there seems to have been an internal septum extending upwards from the lower part of the siphuncle, between the wall of the latter and that of the sheath into which the endosiphon opens. This septum shows itself in some transverse sections of the siphuncle in the manner indicated at fig. 17, III., and it can be traced for some distance upwards in the vertical section of this and of other specimens. The septum seems to have been penetrated by the endosiphon, as shown in the figure, but I am unable to give any satisfactory account of it, owing to its imperfect condition.

As regards the infilling of the siphuncle in *Piloceras*, it seems obvious that the space between the inner wall of the siphuncle and the first permanent sheath was not originally solid, because it is not filled with the matrix, but either with calcareous, or dolomitic, or siliceous matter, introduced by infiltration.

Whatever the functions of the endosiphon may have been, I do not imagine that it played such an important part in the vital economy of the animal as did the same organ in *Actinoceras*.

***Piloceras invaginatum*, Salter.**

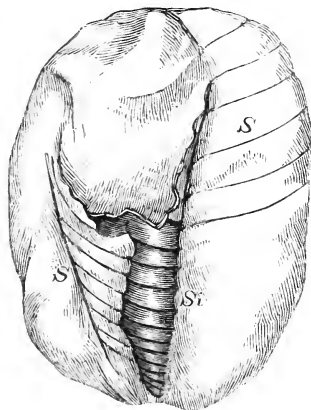
1859. *Piloceras invaginatum*, Salter, Quart. Journ. Geol. Soc. vol. xv. p. 376, pl. xiii. ff. 17-21, and woodcut, f. 7 c.
 1877. *Piloceras invaginatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte v. p. 905.
 1882. *Cyrtoceras (Piloceras) invaginatum*, Blake, British Foss. Ceph. pt. i. p. 186.
 1887. *Piloceras invaginatum?*, Foord, Geol. Mag. dec. iii. vol. iv. p. 542.

Sp. Char. Shell slightly curved. Section elliptical, judging by that of the siphuncle, the two diameters being in the ratio of about

17 to 20. Septa distant from $1\frac{1}{2}$ to $3\frac{1}{2}$ lines, according as they are measured at the narrower or broader end of the siphuncle. The latter is apparently marginal. The walls of the siphuncle (and septa?) are usually composed of orbicular chalcedony, formerly known as Beekite¹.

The rate of tapering of the shell cannot be precisely computed, but it was no doubt very high. No trace of the outer shell-sculpture has been seen in any of the specimens examined.

Fig. 19.



Piloceras invaginatum, Salter.—*S, S*, remains of septa; *Si*, siphuncle, a little restored in the lower part, with ridges marking the attachment of the septa. (One half natural size.)

Remarks. In the example I have figured above the septa appear as delicate lines upon the weathered surface of the rock. This is one of the specimens out of Mr. Peach's interesting and valuable collection, the whole of which was very kindly entrusted to me for examination by Mr. H. H. Howell, F.G.S., Director of the Geological Survey of Scotland.

In this fine series of specimens I have been able to demonstrate nearly all the structures in the siphuncle, as well as some of those of the chambered portion of the shell, which have been so ably discussed by Sir J. W. Dawson and Prof. Hyatt.

¹ This name is now, I believe, no longer in use among Mineralogists.

Seven species of *Piloceras* have now been described, viz. :—

P. invaginatum, Salter.

P. Canadense, Billings.

P. Wortheni, Billings.

P. Triton, Billings.

P. gracile, Billings.

P. amplum, Dawson.

P. explanator, Whitfield.

From a geological point of view *Piloceras* is interesting from its association in Scotland and in Eastern North America with a little group of fossils in which several species appear to be common to both countries.

Salter enumerates amongst others the following American species in the Durness Limestone, some of which, however, are too imperfect for accurate identification :—

Orthis striatula, Emmons (non Schlotheim).

Ophileta compacta, Salter.

Maclurea matutina?, Hall.

Orthoceras arcuoliratum, Hall.

O. undulostriatum, Hall.

O. vertebrale?, Hall (very doubtful).

In addition to these, there are among the fossils I received from the Geological Survey of Scotland, specimens of *Endoceras* in a very fragmentary condition, but resembling certain small (?) species with very closely approximate septa, described and figured by Billings from the Calciferous of Canada¹.

A *Cyrtoceras*, very probably the *Oncoceras*? referred to by Salter, is also in a condition unfit for determination.

Though the Durness fossils are by no means well preserved, yet it can hardly be disputed that their general facies, as Salter affirmed, is American rather than European².

Horizon. Durness Limestone (= Calciferous (?) of North America).

Locality. Durness, Sutherlandshire.

Fairly well represented in the Collection.

***Piloceras Canadense*, Billings.**

1860. *Piloceras Canadense*, Billings, Canadian Nat. and Geol. vol. v. p. 171, f. 16.

¹ Canadian Naturalist, 1859, vol. iv. p. 361.

² The bulk of the foregoing observations is contained in my paper published in the 'Geological Magazine,' Dec. 1887, "On the genus *Piloceras*."

1863. *Piloceras Canadense*, Billings, Geol. of Canada, Appendix, p. 951.

1864. *Piloceras Canadense*, Murray, Geol. Surv. of Newfoundland, Report for 1864, p. 23.

1865. *Piloceras Canadense*, Billings, Pal. Foss. vol. i. p. 256.

? 1866. *Cyrtoceras*. *Espèce indéterminée*, Barrande, Syst. Sil. de la Bohême, vol. ii. pl. cexx. ff. 6-8.

Sp. Char. "The form, as nearly as it can be determined, is that of a short, thick, curved Orthoceratite. The length of the largest specimen appears to have been about ten inches, and the diameter at the aperture four or five inches. The transverse section is oval, the narrowest side being that of the concave curvature. The siphuncle of one specimen is, at two inches and three fourths from the apex, seventeen lines in diameter in the dorso-ventral direction, and fourteen lines in the transverse direction. On the surface of this specimen there are, on an average, six septal rings in the length of one inch. Judging from the appearance of another specimen, the position of this siphuncle would be close to the ventral side of the shell. Another siphuncle about the same size shows seven septal rings to the inch. In a third, consisting of a portion of the larger extremity of an individual which, when perfect, must have been at least nine inches in length, there are six septa partly preserved, apparently those next the aperture. They are distant from each other about five lines, the whole being comprised within a length of thirty lines. The shell where these septa are situated is at least four inches in diameter in the transverse direction, and the siphuncle about two inches. The edges of the septa, in crossing the ventral or concave side, make at the surface a short curve towards the apex; but on the siphuncle the septal ridges cross from the dorsal to the ventral side obliquely, so that on the ventral side they are somewhat nearer the aperture than they are on the dorsal side. . . . On comparison with Salter's *P. invaginatum*, it will be seen that the septal rings do not cross the siphuncle in the same direction as they do in ours, and further, that that species is more broadly curved." (*Billings.*)

Horizon. Calciferous Formation (=Tremadoc).

Locality. Mingan Islands, Gulf of St. Lawrence.

Represented by two siphuncles, one of them presented by the late E. Billings, Esq., F.G.S., and the other transferred from the Museum of Practical Geology.

Family ACTINOCERATIDÆ.

Genus **ACTINOCERAS**, Bronn¹.

[*Cochleati*, Quenstedt, 1836² (pars); *Conilites*?, Pusch, 1837³ (non Lamarck); *Conotubularia*, Troost, 1838⁴ (pars); *Ormoceras*, Stokes, 1840⁵; *Nummularia*, de Koninck, 1844⁶; *Thoracoceras* (antea *Melia*), Fischer de Waldheim, 1844⁷ (pars).]

Gen. Char. Shell attaining to a very large size in some species; straight; elongate-conical. Section circular to subcircular. Septa

Fig. 20.

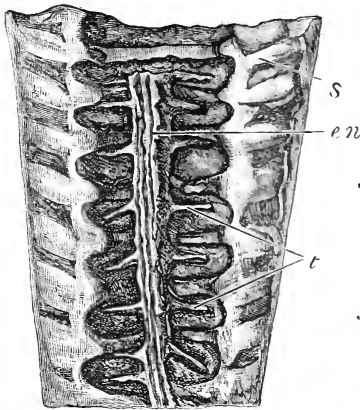


Fig. 21.

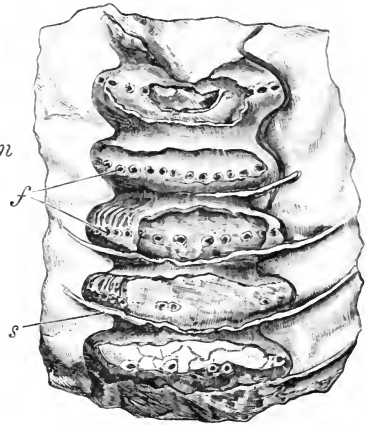


Fig. 20. Weathered fragment of *Actinoceras Bigsbyi*, showing the endosiphon, *en*, with some of its tubuli, *t* (these structures have been thickened by incrustations of pearl-spar); *s*, septa. Natural size. From the Black River Formation of Thessalon Island, Lake Huron.

Fig. 21. Fragment of the same species, showing the foramina, *f*, in the walls of the siphuncle, by which the tubuli thrown out by the endosiphon may have communicated with the septal chambers; *s*, septa. Natural size. From the Cincinnati Group, Versailles, Kentucky.

¹ *Lethæa Geognostica*, 1837, Zweite Aufl. Band i. p. 97. The genus *Actinoceras* appears to have been founded solely upon Bigsby's figures in the Geological Society's Transactions, 1824, ser. 2, vol. i. p. 193, pl. xxv. ff. 1, 2 (excl. f. 3), and while accepting it Stokes justly protests against the establishment of genera "from no other materials than figures published by other persons."

² *De Notis Nautiliarum primariis*.

³ *Polens Palæontologie*, p. 150.

⁴ *Mém. Soc. Géol. de France*, tom. iii. pt. i. p. 87.

⁵ *Trans. Geol. Soc.* vol. v. pt. iii. p. 709.

⁶ *Descrip. des Anim. Foss. de Belgique*, p. 508.

⁷ *Bull. Soc. Imp. des Nat. de Moscou*, tom. xvii. p. 755.

usually more arcuate than in *Orthoceras*; the necks very short and recurved, and often with crystalline deposits ("the anneaux obstrueteurs" or "dépôt organique," of Barrande), which sometimes fill the spaces in the siphuncular cavity not occupied by the endosiphon and its canals. Siphuncle very large, the diameter sometimes equalling half that of the shell; much inflated between the septa, so as to present a series of segments of a compressed-globular form¹.

Fig. 22.

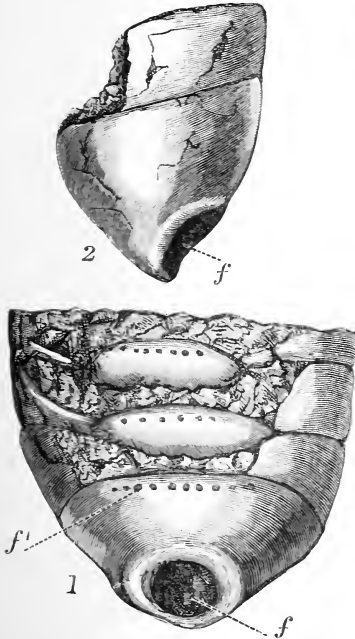


Fig. 23.

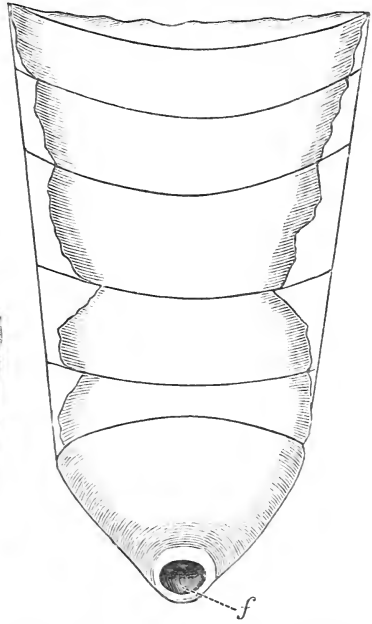


Fig. 22, 1. Front view of a weathered fragment of the apical extremity of *Actinoceras Bigsbyi*?, showing (*f*) the large foramen and the row of minute foramina situated at *f'*, the most elevated part of the siphuncular segments. Natural size. From the Black River Formation (?), Igloodik Island, Arctic America.

Fig. 23. View of part of a much eroded fragment of an *Actinoceras*, consisting of the internal cast of some of the septal chambers, and the siphuncular segment with its foramen (*f*). $\frac{2}{3}$ nat. size. Fig. 22, 2. Side view of part of the same specimen, showing the lateral position of the large foramen (*f*) in relation to the apex. Natural size. From the Great Slave Lake, British North America.

¹ These are called "rosettes" by Hyatt, who regards them as "internal or extra-endosiphonal deposits, and the successive sections of the outer wall of the siphon as strictly homologous with the successive sheaths of the endosiphon of *Piloceras* and *Endoceras*" (Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 271).

The shelly covering of these segments, which is composed of several layers, is very rarely preserved¹. The calcified lining membrane of the siphuncle is thrown into a series of folds which impart to it a puckered appearance which is very characteristic. The endosiphon is provided with a distinct wall², and gives off at regular intervals between the septa a number of radiating canals or tubuli³, which apparently penetrate the shelly covering or wall of the siphuncle, and, if so, they may have served, as suggested by Owen⁴, for the passage of blood-vessels to the lining membrane of the septal chambers. The spaces between the tubuli are sometimes filled up so that curved transverse partitions, which are formed originally in membrane, and are convex anteriorly, divide the siphuncle into a series of loculi. Nothing is seen of these partitions when the siphuncular cavity has been filled with calc-spar.

The first segment of the siphuncle is in the form of a broadly conical chamber, perforated above the apex by a large foramen, through which the endosiphon passed from the initial chamber into the siphuncular cavity⁵ (figs. 22, 23).

CAMBRIAN SPECIES.

Actinoceras? mendax, Salter.

1859. *Orthoceras mendax*, Salter, Quart. Journ. Geol. Soc. vol. xv. p. 374, pl. xiii. f. 24, a, b.

1882. *Orthoceras mendax*, Blake, British Foss. Ceph. pt. i. p. 81, pl. iii. f. 1.

Sp. Char. "General form very gradually tapering, with shallow close annulations ($\frac{1}{8}$ of an inch apart in a diameter of $\frac{3}{4}$ of an inch) in the older portion, in the young nearly smooth. Section circular. Septa numerous, close-set, one to each annulation in the older part; at a diameter of 4 lines there are 15 to an inch. They are only slightly concave, and bent down somewhat angularly towards the siphuncle, which is excentric, thick, smooth-edged (not at all beaded), and compressed in a direction from front to back. It also has a shallow groove along the side nearest to the

¹ Bigsby (*loc. cit.* p. 202). A specimen of *Huronina* in the National Collection (No. 36088, presented by Dr. Bigsby) shows this shelly investment very distinctly.

² This may be seen in a specimen in the Collection registered C 2142.

³ Bronn estimates their number to be about sixteen, but they certainly exceed this in some examples, as the number of foramina testify.

⁴ Palæontology, 1860, p. 85.

⁵ Cf. *Piloceras*, p. 159.

centre of the shell, so as to give in section a somewhat bilobed form." (*Salter.*)

Remarks. It is impossible to say anything decisive about fossils in the condition in which these are. The specimens representing this species in the National Collection are most of them weathered longitudinal sections, much injured by mineral agency, their walls being replaced by orbicular chalcedony ("Beekite"), so that all the original structure has been obliterated. Prof. Blake (*loc. cit.* p. 82) describes the siphuncle in this species as having a comparatively large-sized inner tube, untouched by the septa, and slightly folded longitudinally, and, he adds, "these features are seen in all specimens showing the interior, and proving that we have here a very remarkable type with a siphuncle of two distinctly preserved layers, the outer one being separated by obstructing deposits from the inner one."

Of this "inner tube" (endosiphon?) there are pretty clear indications in the specimens before me, and the "shallow groove" noticed by Salter was doubtless the remains of a similar organ split longitudinally, in which condition it is generally found.

Horizon. Durness Limestone¹ (= Calciferous(?) of North America).

Locality. Durness, Sutherlandshire.

Fairly well represented in the Collection.

¹ J. E. Marr ('Classification of the Cambrian and Silurian Rocks,' p. 67, 1882) states that the Durness Limestone "seems to be intermediate in character between the Orthoceras-Limestone of Sweden and the Craighead Limestone of Girvan. A ridge of pre-Cambrian rocks extends through Central Scotland, and the lowest Girvan beds were deposited against it on the south, and the Durness Limestone on the north. The Durness Limestone is probably therefore homotaxial with the Orthoceras-Limestone of Sweden, but of somewhat later date." This places the former upon a higher horizon than that to which Mr. Peach assigns it. In a Presidential address delivered before the Royal Physical Society of Edinburgh (1885) the latter makes the following observations regarding the age of the Ordovician Strata of the North-west Highlands of Scotland:—" . . . the fossils are of an American type, and do not resemble those found in the contemporaneous deposits of Wales and England. Indeed, so far as the order of succession of the beds and their fossil contents are concerned, we have an almost exact counterpart of the strata exposed along the axis of older Palæozoic rocks, stretching from Canada through the eastern States of North America. In the latter region, the Silurian strata of Sutherlandshire are represented by (1) the Potsdam Sandstone, always described as being vertically piped by *Scolithus*, like the 'pipe-rock'; (2) the Calciferous group; and (3) part of the Trenton Limestone. Now, it might be contended that this remarkable identity in the order of succession of the beds and fossil contents in these two widely separated areas points to contemporaneous deposition; and, on the other hand, it might be argued with greater probability that the beds are homotaxial, or in

ORDOVICIAN SPECIES.

Actinoceras Bigsbyi, Bronn¹.

1824. *Orthocera* . . . Bigsby, Trans. Geol. Soc. ser. 2, vol. i. p. 198, pl. xxv. ff. 1, 2 (excl. f. 3).
1837. *Actinoceras Bigsbyi*, Bronn, Lethæa Geogn. Band i. p. 98, Taf. i. f. 8 (after Bigsby).
1840. *Actinoceras Bigsbyi*, Stokes, Trans. Geol. Soc. ser. 2, vol. v. pt. 3, p. 707 (with reference to Trans. Geol. Soc. 1824, *loc. cit.*).
1840. *Actinoceras Lyonii*², Stokes, Trans. Geol. Soc. ser. 2, vol. v. pt. 3, p. 707, pl. lix. f. 1.
1843. *Actinoceras Lyonii*, Castelnau, Syst. Sil. de l'Amérique Septentrionale, p. 32, pl. ix. f. 4.
1847. *Ormoceras tenuiflum*, Hall, Pal. of New York, vol. i. p. 55, pl. xv., pl. xvi., pl. xvii. f. 1, *a, b*.
1853. *Actinoceras Bigsbyi*, Saemann, Ueber die Nautiliden, in Palæontographica, Band iii. p. 150, pl. xviii.
1860. *Actinoceras Bigsbyi*, Eichwald, Lethæa Rossica, vol. ii. Seconde Sect. de l'ancienne Période, p. 1253.
1861. *Ormoceras Lyonii*, Hector, Quart. Journ. Geol. Soc. vol. xvii. p. 439 (Salter's determination).
1863. *Orthoceras Bigsbyi*, Billings, Geol. of Canada, p. 149, ff. 107, *a, b*, and Appendix, p. 949.
1866. *Orthoceras (Ormoceras) tenuiflum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 7554, pl. ccxxxvii. ff. 5-7.
1869. *Orthoceras Bigsbyi*, Safford, Geol. of Tennessee (Trenton and Nashville Series), p. 289.
1874. *Orthoceras (Actinoceras) Bigsbyi*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. p. 734, pl. ccxxxi. ff. 4, 5 (after Bigsby, *loc. cit.*), pl. cccxxxvii. ff. 10-16.
1876. *Orthoceras Bigsbyi*, Chapman, Outlines of the Geol. of Canada, Introduction, p. xxiv.
1880. *Actinoceras Lyonii*, Whiteaves, Geol. Surv. of Canada, Report for 1878-79, pp. 46c, 48c, Appendix i.
1883. *Ormoceras tenuiflum* (?), Whitfield, Geol. of Wisconsin, vol. iv. pt. ii. p. 372.

other words that the same relative succession of events prevailed in the two areas, though not at the same time. Whichever view is adopted, I think there can be little doubt that some old shore-line or shallow sea must have stretched across the North Atlantic or Arctic Oceans, along which the forms migrated from one province to the other, and that some barrier must have cut off this area from Wales and Central Europe."

¹ Barrande (*infra*) makes Stokes the author of this species; but that is not correct, because Stokes did not describe it until 1840, that is three years after the publication of Bronn's name—*A. Bigsbyi*—which Stokes himself adopted.

² Named after Captain Lyon, who collected specimens at Igloolik, in Arctic America, where Sir Edward Parry's Expedition wintered in 1822-23.

Sp. Char. Shell straight. Section circular, or subcircular. Rate of increase somewhat rapid, about 1 in 7. Septa numerous, about 3 lines distant where the diameter of the shell is 19 lines, increasing to 4 lines where the diameter measures 26 lines. They have a very short recurved neck, and are united with the siphuncle up to a point just below its greatest expansion, where they leave it and sweep upwards till they reach the shell-wall. The siphuncle is very large and greatly expanded between the septa; the ratio of the height of a segment to its breadth being nearly as 4:13. The endosiphon is well developed, and the tubuli connecting it with the siphuncular walls are preserved in many specimens. In some examples from Thessalon Island, Lake Huron, the matrix filling the septal chambers has been dissolved away, exposing the endosiphon and tubuli completely to view, though their form is somewhat obscured by crystals of pearl-spar incrusting them. In section the endosiphon presents a very irregular outline, which suggests its originally membranous nature. Hall describes the outer shell as thin, and "connected with an interior one which often closely joins it by infiltration of mineral matter, when it presents a thickened appearance." The surface is "marked by longitudinal undulated fine thread-like lines."

Remarks. This species has a curious history. It was first named by Bronn in 1837, as the type of his genus *Actinoceras*, having been previously (1824) well figured by Bigsby, who also gives a very lucid description of it, but without bestowing a name. Bigsby's description and figures supplied in fact the material for the establishment of Bronn's genus. *A. Bigsbyi* was next briefly characterized by Stokes, who distinguished it from *A. Lyonii* because of its having a larger tube [endosiphon] within the siphuncle. The apparent superiority in size is really due to the incrustation of crystalline matter already mentioned. The interior of the type specimen of the latter species is filled with calc-spar, and this accounts for the absence of any of the radiating tubuli ("verticillations" of Stokes) which are always seen in well-preserved specimens. Their absence is remarked upon by Stokes as further evidence of the distinctness of his species.

Under the provisional name of *Ormoceras tenuifilum*, Hall described a form (*loc. cit.*) about whose identity with the present species there can be no doubt. That author, however, includes in the synonymy of his species *Ormoceras Backii*, Stokes, remarking that "the specimens of Mr. Stokes are from a locality in which the rock belongs to the lower stages of our system, and probably to a position precisely corresponding to the thin mass containing these

fossils upon the Black River." This observation, though applicable to some of Mr. Stokes's *Orthoceratites*, is erroneous as regards *Ormoceras Backii*, which is from the Niagara Formation (Silurian) of Drummond Island, Lake Huron.

Actinoceras ["*Conotubularia*"] *Cuvieri*, Troost¹, is easily distinguished from *A. Bigsbyi* by its much closer septa and its relatively smaller siphuncle.

Though Hall (*loc. cit.* p. 56) admits that he had little doubt of the identity of his species with *Actinoceras*, Bronn, "as figured by Stokes," he includes two species which are certainly distinct, namely, *A. Backii* and *A. Cuvieri*.

Billings implied his belief in the identity of *A. Bigsbyi* with "*Ormoceras*" *tenuifilum* by making the latter a synonym of the former²; and with this view I entirely agree.

Eichwald refers doubtfully to this species an *Actinoceras* found in the *Orthoceras*-limestone of Wesenberg and Nyby in Esthonia. He thinks that *Orthoceras leve*, Schmidt³, may also be identical with *A. Bigsbyi*. But in *A. leve* the greater diameter of the siphuncular segments is said to be only one fourth that of the chambers, whereas in *A. Bigsbyi* this diameter considerably exceeds one half. The segments are also oblique to the long axis of the siphuncle, which is not the case in *A. Bigsbyi*.

One of the specimens in the National Collection is interesting from its exhibiting a peculiar mammillated structure upon the surface of the cast, which is considered by Barrande to be the marks made by the mantle of the mollusk. Illustrations of these appearances are to be found in the 'Syst. Sil. de la Bohême,' vol. ii. pls. ccxxviii., ccxxix. The specimen showing them is from the Trenton Group of Eagle Cliff, Iowa.

Horizon. Black River (= Llandeilo Limestones?), Trenton (= Bala Limestone Group), Galena Limestone (Upper part of Trenton), Cincinnati Group (= Lower and Middle Bala?).

Localities. Igloolik Island, Fox Channel, Arctic America; Thessalon Island, Lake Huron; New York State; (Black River): Eagle Cliff, Iowa; (Trenton): Lake Winnipeg; Red River, Minnesota; (Galena Limestone): Versailles, Kentucky; (Cincinnati Group)⁴.

¹ Mém. Soc. Géol. de France, 1838, tom. iii. 1^{me} partie, p. 88, pl. ix. f. 1.

² Geol. of Canada, 1863, Appendix, p. 949.

³ Archiv für die Naturkunde Livlands, p. 194 (Dorpat, 1858).

⁴ There is some doubt as to the identity with the present species of the specimens from the last three localities, as they consist only of fragments of the siphuncle. These are remarkable for their size, the largest measuring 2½ inches in its greatest diameter.

Represented by a very fine series of examples, including the types figured by Bigsby and Stokes. A specimen from the Red River, Minnesota, was presented by W. Calwell, Esq.; and another, collected by Dr. Hector, near Lake Winnipeg, was transferred from the Museum of Practical Geology.

Actinoceras Beloitense, Whitfield.

1840. *Actinoceras Bigsbyi*, Stokes (pars), Trans. Geol. Soc. ser. 2, vol. v. pt. 3, p. 707: *ibid.* ser. 2, vol. i. pt. 2, 1824, pl. xxv. f. 3.
 ? 1843. *Actinoceras Richardsoni*, Castlenau, Syst. Sil. de l'Amérique Septentrionale, p. 30, pl. vii. ff. 1, 2.
 1868. *Orthoceras (Ormoceras) Backii*?, Meek & Worthen, Geol. Surv. of Illinois, vol. iii. p. 298, pl. i. f. 4.
 1874. *Orthoceras (Ormoceras) Bucki*?, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iv. 1877, p. 264, pl. cccclxxiv. f. 11.
 1877. *Orthoceras (Actinoceras) Beloitense*, Whitfield, Annual Report Geol. Surv. of Wisconsin, p. 97.
 1882. *Orthoceras (Actinoceras) Beloitense*, Whitfield, Geol. of Wisconsin, vol. iv. pt. iii. p. 226, pl. viii., pl. x. ff. 9, 10.

Sp. Char. "Shell large and robust, subfusiform, moderately expanding to a diameter of about four inches, then more gradually decreasing in size to the aperture. Section oval in all the examples noticed, and usually a little more flattened on one side than on the other, with the siphuncle submarginal on the flattened side. Septa shallow and not often symmetrically arranged, from seven to eight chambers occupy a length equal to the diameter of the largest of the number measured; towards the outer portion of the shell the septa become more crowded, and just below the outer chamber are sometimes less than half the usual length. Siphuncle large, strongly beaded within the chambers, with an inner core, in the casts, having radiating filaments [the tubuli of the endosiphon] extending to the centre of the bead in each chamber. Surface of the shell unknown." (*Whitfield.*)

Remarks. The identification of one of the specimens figured by Bigsby with *A. Beloitense* confirms the view held by Stokes that there might be more than one species figured on Bigsby's plate.

None of the test remains in any of the examples in the Museum Collection, and the septa have been removed by solvent action, leaving narrow intervals between the casts of the chambers. The specimens from which Prof. Whitfield drew up his description of the present species were derived from the Trenton Limestone (buff beds) near Beloit, Wisconsin.

Horizon. Black River (= Llandeilo Limestones?).

Locality. Thessalon Island, Lake Huron.

Fairly well represented in the Collection.

Actinoceras remotiseptum, Hall, sp.

1848. *Ormoceras remotiseptum*, Hall, First Regent's Rep. upon the New York State Cabinet of Nat. Hist. p. 173, pl. iv. f. 3.

Sp. Char. "Cylindrical, gradually tapering; septa moderately convex, distant half the diameter of the tube; siphuncle eccentric, large, swelling moderately between the septa, and but slightly contracted at the junction of the septa; character of the external surface unknown.

"The specimen described is a fragment which is worn down through the centre of the siphuncle. The proportions of this part of the fossil and the great distance of the septa contrast very strongly with the *Ormoceras* [*Actinoceras*] *tenuifilum* and with other known species of the genus." (*Hall.*)

Remarks. There is very little doubt in my mind that *Endoceras distans*, Hall (Pal. of New York, vol. i. p. 220), is conspecific with the present species; probably the marginal position of the siphuncle led to the former species being placed in the genus *Endoceras*.

Horizon. Trenton Formation (=Bala Limestone Group).

Locality. Canada, or United States; probably the former.

Represented by a single example, presented by J. Welsh, Esq.

Actinoceras Richardsoni, Stokes.

1840. *Actinoceras Richardsoni*, Stokes, Trans. Geol. Soc. ser. 2, vol. v. pt. 3, p. 708, pl. lix. ff. 2, 3.

? 1838. *Conotubularia Cuvieri*, Troost, Mém. Soc. Géol. de France, tom. iii. 1^{me} partie, p. 88, pl. ix. f. 1.

? 1866. *Orthoceras (Actinoceras) Richardsoni*?, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 737, pl. ccxxxiv. ff. 2, 3.

Sp. Char. Shell apparently slowly tapering. Section probably circular. Septa approximate; 4 lines distant where the shell has a diameter of 3 inches, arching strongly upwards. Siphuncle marginal, very large, its diameter nearly one half that of the shell; the interior filled with calcareous, vertical lamellæ, radiating from the endosiphon, and abutting against the walls of the siphuncle. A horizontal row of foramina are often seen upon the segments of the siphuncle, for the passage of the tubuli given off from the endosiphon. The surface of the test is ornamented with rather regular undulating, transverse, upwardly imbricating striæ.

Remarks. The type of this species is very imperfect and much abraded. It consists of a longitudinal section, exposing to view the septa and siphuncle. Stokes has figured only part of the specimen,

the remaining portion having most probably been overlooked at the time when the other was figured.

Barrande assigns to this species, on the authority of Comte de Castelnaud, a specimen collected by the latter on the Little Manitoulin (or Cockburn) Island, Lake Huron, which differs from Stokes's type in the greater distance of the septa.

This species is distinguished from *A. Bigsbyi* by its surface characters and slower rate of tapering.

Horizon. Galena Limestone, the equivalent of the upper part of the Trenton Formation (= Bala Limestone Group).

Locality. Lake Winnipeg¹.

Actinoceras crebriseptum, Hall, sp.

1847. *Ormoceras crebriseptum*, Hall, Pal. of New York, vol. i. p. 313, pl. lxxxvi. f. 2 a, pl. lxxxvii. ff. 2 a-e.

1863. *Orthoceras crebriseptum*, Billings, Geol. of Canada, p. 218, f. 228.

1870. *Orthoceras (Ormoc.) crebriseptum*, Barrande (*teste* Billings), Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 739, pl. ccccxxxiv. ff. 6-8.

1875. *Ormoceras crebriseptum*, Nicholson, Pal. of Ontario, p. 37.

1876. *Orthoceras crebriseptum*, Chapman, Outline of the Geol. of Canada, Introduction, p. xxv, pl. iv. f. 52.

Sp. Char. "Elongated, conical, somewhat rapidly tapering to an acute apex; septa numerous, approximate, deeply arched, distant about one seventh the diameter; siphuncle eccentric, enlarging in each cell and contracting at its passage through the septum; section circular; surface marked by longitudinal lines, which are visible in the cast. This species is readily recognized by its very approximate septa, which are highly arched . . ." (*Hall.*)

Remarks. The specimen representing this species in the Collection (which is a polished section) is remarkable for the variability of the diameter of the siphuncular segments, some of the earlier ones being larger than the later formed ones. This may possibly be due to curvature, by which the segments have not all been cut through their centres.

¹ An assemblage of fossils of Galena Limestone facies was collected by Dr. Hector (Q. J. G. S. vol. xvii. p. 439) on the Red River, near Lake Winnipeg. These fossils were named by Salter, and among them was the well known "lead coral" of the American geologists, *Receptaculites Oweni*, Hall (= *R. occidentalis*, Salter), so characteristic of the Galena Limestone in its typical localities in Wisconsin and Illinois. Some of the specimens of *Actinoceras Richardsoni* in the National Collection formed part of Dr. Hector's collection.

Horizon. Cincinnati Group (=Lower and Middle Bala?).

Locality. Cincinnati, Ohio.

Represented by a single imperfect fragment, presented by J. N. Pearson, Esq.

Actinoceras capitolum?, Safford.

1869. *Orthoceras capitolum*, Safford, Geol. of Tennessee, p. 290, pl. G 3. f. 1 a-c.

Sp. Char. The only description of this species is in these words—"intermediate in character between *Bigsbyi* and *anceps*" (the *Gonioceras anceps* of Hall). The figures represent a fragment of a large Orthoceratite with strongly waved, approximate septa, large, marginal siphuncle, and subtriangular outline; the latter probably due, at least partly, to pressure or weathering.

A portion of a siphuncle is figured, and numbered 1 c; but the description of the plate runs, "Fig. 1, a-b," without any notice being taken of "1 c."

The fragment of a siphuncle representing Safford's species in the Collection is doubtless identical with the one figured, and a label accompanies the specimen bearing upon it the same name and locality. But it is not conclusively shown by Safford that this siphuncle belongs to his species *capitolum*, though the inference in favour of that view is strong.

Horizon. Trenton Formation, Nashville Series (=Bala Limestone Group).

Locality. Nashville, Tennessee.

SILURIAN SPECIES.

Actinoceras baccatum, H. Woodward.

1868. *Actinoceras baccatum*, H. Woodward, Geol. Mag. vol. v. p. 133, pl. viii.

Sp. Char. Shell a little curved, perhaps by distortion. Section (?). Rate of increase about 2 in 13. Septa strongly concave, as seen in longitudinal section; distant rather more than $\frac{1}{3}$ the diameter. "The fossil has been fractured so as to remove the upper surface, exposing seven perfect and two fractured beads of the siphuncle, and giving evidence of ten septa; the chambers formed by which remain partially hollow, and are partially filled by calcareous spar. None of the exterior wall is visible from which the nature of the ornamentation of the shell, if any, might have been ascertained. . . ." (*Woodward.*)

Remarks. The greatest length of the shell described by Dr. Woodward was about 4 inches, the greatest diameter 2 inches, the least diameter 1 inch 4 lines. Neither the apex nor the body-chamber were preserved.

The specimen representing this species in the National Collection consists of five segments of the siphuncle, with two or three of the septa attached, the spaces between the latter being filled, as in the type specimen, with crystalline limestone.

Dr. Woodward observes that *A. baccatum* "most closely resembles *A. pyramidatum* of McCoy, both in the beaded form of the siphuncle and the general proportions of the chambers, but the beads of the siphuncle are much less spherical in *A. pyramidatum*, and the sides of the chambers form a less acute angle at their junction with the outer wall of the shell than in the fossil before us."

Horizon. Woolhope Limestone.

Locality. Aymestry, Herefordshire.

Represented by a single imperfect fragment in the Collection.

Actinoceras subconicum, d'Orbigny, sp.

1839. *Orthoceras conicum*, Sowerby, in Murchison's Sil. Syst. pl. xxi. f. 21. (Not of Hisinger.)

1849. *Orthoceratites subconicus*, d'Orbigny, Prodr. de Paléont. vol. i. p. 2.

1882. *Orthoceras subconicum*, Blake, British Foss. Ceph. pt. i. p. 150, pl. xii. f. 9.

Sp. Char. "The section appears to be not far from circular. The rate of increase is essentially great, at least 1 in 5. No body-chamber has been seen connected with the peculiar siphuncle of this species; but there are some specimens having about this rate of increase coming from lower rocks, which may belong to it; these have signs of a constriction below the aperture. The septa vary in distance with age, being $\frac{1}{6}$ of the diameter when young, and increasing in closeness up to $\frac{1}{10}$ when larger. The siphuncle is always central in the sections seen, and one shows it nearly central on the septal surface. The inner and outer coats of the siphuncle are always separated by deposits on their surface, and there are similar deposits in the septa; the outer coat had folds on its surface; the whole occupies from $\frac{1}{3}$ to $\frac{1}{2}$ the diameter." (*Blake.*)

Remarks. To this species I have referred some specimens which agree in all essential points with the characters of Sowerby's type as described by Prof. Blake. I have no hesitation in regarding this form as an *Actinoceras*; the structure of the siphuncle, with its inner tube, clearly indicates such an affinity. The closeness of its

septa and the rapid rate of tapering separate *A. subconicum* from other species with which it might be compared.

Horizon. Upper Ludlow.

Localities. Llanfrechfa, near Newport, and Horeb Chapel, Monmouthshire.

Represented by two imperfect specimens in the Collection, presented by J. E. Lee, Esq., F.S.A., F.G.S.

***Actinoceras nummularium* ?**, Sowerby, sp.

1839. *Orthoceras nummularium*, Sowerby, in Murchison's Sil. Syst. p. 632, pl. xiii. f. 24.

1872. *Actinoceras nummularium*, Salter, in Murchison's Siluria, 5th edition, Appendix, p. 534, pl. xxvi. f. 5.

1875. *Orthoceras nummularium*, L. Mallada, Sinopsis de las Especies Fósiles en España, in Bol. Com. del Mapa Geol. de España, tom. iii. cuad. 1 & 2, p. 25.

1880. *Orthoceras nummularium*?, Angelin & Lindström, Fragmenta Silurica, p. 6, tab. viii. ff. 4, 5.

1885. *Orthoceras nummularium*?, Lindström, List of the Foss. of the Upper Silurian Formation of Gotland, p. 6.

Sp. Char. These are imperfectly known; Sowerby describes them as follows:—"Conical?, smooth?; septa very numerous, very convex, $\frac{1}{3}$ their diameter apart; siphuncle large, inflated between the septa to about three times its own diameter and $\frac{1}{3}$ the diameter of the septum. Diameter about 4 inches."

Remarks. A large fragment from the Silurian of Norway, consisting of four or five septa, agrees fairly well with the above description, though the siphuncle is somewhat larger proportionally than that of Sowerby's type. The septa are distant about $\frac{1}{3}$ the diameter, so that the bulbs of the siphuncle have a depressed, nummuloidal form, which, added to the closeness of the septa, distinguishes this species from *A. cochleatum*.

The measurements of the Norwegian specimen in the Collection are:—length 2 inches, greatest diameter $3\frac{1}{2}$ inches.

A fragment of a large beaded siphuncle from Usk may also belong to this species; but it is too imperfect to warrant any confident statement regarding its affinities.

Horizon. Bed 8 i (= Wenlock?). Ludlow (the British specimen).

Localities. *British.* Usk, Monmouthshire.—*Foreign.* Norway.

Represented by two imperfect specimens.

Actinoceras Blakei, sp. nov.

1882. *Orthoceras (Actinoceras) cochleatum*, Blake, British Foss. Ceph. pt. i. p. 161, pl. xv. ff. 7, 8. (Not of Schlotheim.)

Sp. Char. Shell straight. Rate of tapering not ascertainable in the type specimen, owing to its imperfect state. The septa are strongly arched, and distant about $\frac{1}{2}$ an inch, where the diameter measures about 2 inches. The siphuncle, which is very much distorted or pushed out of place, is strongly inflated between the septa, so as to form a series of cushion-like bulbs, whose greatest transverse diameter is a little above the centre, so that the upper part of each element is a little more inflated above than below. Surface characters unknown.

Remarks. Through an oversight, only a portion of the specimen in the British Museum was figured by Prof. Blake, but the remainder adds very little to our information respecting the species. Each element of the siphuncle is marked by a series of longitudinal folds, which give it a wrinkled appearance. I regard this species as clearly distinct from *Actinoceras cochleatum*, and in this view Dr. Lindström coincides with me. In the latter the elements of the siphuncle are much broader and more depressed than they are in *A. Blakei*; so that the ratio of the vertical and transverse diameters is as 9:26, while in the latter it is as 5:10. The siphuncle, in fact, occupies a much smaller space in the shell in *A. Blakei* than it does in *A. cochleatum*.

Horizon. Upper Llandovery¹?

Locality. Gwernyfed, near Builth, on the borders of Radnorshire and Brecknockshire.

Represented in the Collection by the specimen figured by Blake (*loc. cit.*).

¹ Prof. Blake records this species from the Lower Silurian [Ordovician], doubtless on the authority of the label affixed to the specimen, which reads "L. Silurian." Entertaining considerable doubt as to the correctness of this view, I wrote to Mr. Clement Reid, of the Geological Survey, and he kindly forwarded my letter to his colleague, Mr. Aubrey Strahan, who is well acquainted with the district whence the specimen was obtained. That gentleman informs me in reply, that "Gwernyfed is situated on a very narrow band of Upper Llandovery," and that "immediately to the N.W. lies the Wenlock Shale, and to the S.E. the Llandeilo Flags;" adding, "it would be impossible to determine the age of your fossil unless the pit from which it was obtained could be identified."

However, taking into consideration the fact that all the British examples of *Actinoceras* (with the exception of *A. mendax* from the Durness Limestone) have been found in Silurian strata, and the appearance of the fossil in question suggesting that horizon for it, I have assigned it provisionally thereto.

Actinoceras, sp.[Cf. *Actinoceras cochleatum*, infra.]

Two imperfect specimens of an *Actinoceras* from Norway are comparable in many respects with the above species. One of them shows what appears to be the outer surface of the test, and it is perfectly smooth. Both these specimens are weathered longitudinal sections exposed upon the surface of the rock, but the matrix having been removed from beneath them, the shell is thus laid bare on that side. The septa are somewhat closer than they are in most examples of *A. cochleatum*; but in other features, such as the dimensions of the siphuncle, the rate of tapering, &c., the forms under discussion agree fairly well with that species.

Horizon. Étages 7 and 6 (= Valentian?).

Locality. Langö Island, near Holmstrand, Norway.

Actinoceras cochleatum, Schlotheim, sp.

1731. *Tubuli concamerati-cylindriformes*, Klein, Descrip. tubulorum marinorum, Appendix, p. 8, tab. ii. ff. 3, 4.
1732. Species ix. *Orthoceratites siphone ad peripheriam* &c., Breynius, Dissertatio physica de Polythalamiiis, p. 37, tab. vi. ff. 1, 2.
1813. *Orthoceratites cochleatus*, Schlotheim, Leonhard's Taschenb. für Mineralogie, Abth. i. p. 34.
1820. *Orthoceratites cochleatus*, Schlotheim, Die Petrefactenkunde, p. 55.
1821. *Orthoceratites crassiventris*, Wahlenberg, Nova Acta Reg. Soc. Scient. Upsaliensis, vol. viii. p. 90.
1831. *Orthoceratites crassiventris*, Hisinger, Anteckn. i Physik och Geognosie, Häft. v. p. 112, tab. iv. f. 9.
1837. *Orthoceratites crassiventris*, Hisinger, Lethæa Svecica, p. 30, tab. x. f. 3.
1840. *Orthoceratites cochleatus*, Quenstedt, Neues Jahrb. p. 264.
1842. *Orthoceratites cochleatus*, Eichwald, Die Urwelt Russlands, Heft ii. p. 24.
1845. *Orthoceratites cochleatus*, Murch., de Vern., and de Keyserl. Géol. de la Russie d'Europe, pt. 3, p. 393.
1846. *Orthoceratites cochleatus*, Quenstedt, Petrefactenkunde Deutschlands, Band i. Abth. i. p. 42, tab. i. f. 6 (not f. 8).
1849. *Orthoceratites cochleatus*, Quenstedt, Die Cephalopoden, p. 42, tab. i. f. 6.
1852. *Orthoceras cochleatum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 242.
1855. *Orthoceras crassiventre*, Barrande, in Leonhard and Bronn's Neues Jahrb. p. 402.

1857. *Orthoceras cochleatum*, Boll, Beitrag zur Kenntniss der Silur. Ceph., in Archiv für die Naturkunde von Mecklenburg, p. 21, Taf. v. f. 17.
1860. *Actinoceras cochleatum*, Eichwald, Lethæa Rossica, Seconde Section de l'ancienne Période, vol. i. p. 1253.
1861. *Orthoceras crassiventre*, Schmidt, Archiv für die Naturkunde Liv-, Ehst- und Kurlands, p. 194.
1866. *Orthoceras cochleatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 695, pl. ccxxxiii. ff. 12, 13, pl. ccxxxvii. ff. 8-10, pl. cccxxxix.
1876. *Orthoceras cochleatum*, Ferd. Roemer, Lethæa geognostica, Taf. xvi. f. 5.
1880. *Orthoceras cochleatum*, Kjerulf and Gurlt, Die Geologie des südlichen und mittleren Norwegen, p. 68.
1880. *Orthoceras cochleatum*, Angelin and Lindström, Fragmenta Silurica, p. 6, tab. viii. ff. 1-3, tab. x. f. 6.
1885. *Orthoceras cochleatum*, Lindström, List of the Fossils of the Upper Silurian Formation of Gotland, p. 6.
- [Not 1882. *Orthoceras (Actinoceras) cochleatum*, Blake, British Foss. Ceph. pt. i. p. 161, pl. xv. ff. 7, 8.]

Sp. Char. Shell large. Section circular? Rate of increase about 1 in 6. Septa distant about $\frac{1}{6}$ the diameter of the shell. Siphuncle submarginal, very large, rather less than $\frac{1}{2}$ the diameter of the entire shell, as nearly as can be estimated from imperfect specimens. The form of each siphuncular segment is that of a very compressed spheroid whose height is a little more than $\frac{1}{3}$ that of its breadth. The test has not been observed, but in a large individual figured by Barrande (*loc. cit.* pl. cccxxxix. f. 1) the impression of its ornaments (?) were seen. The markings consisted of longitudinal and transverse striæ, about equally spaced, so as to form a network of nearly square meshes.

Remarks. This fine species is always found in a fragmentary condition owing to the fragile nature of the septa. The siphuncle is often found detached, as are those of *Actinoceras* and *Huronina* from the Niagara Group of Drummond Island, Lake Huron. It is usually filled with coarsely crystalline calc-spar, and polished sections generally show more or less distinct traces of the endosiphon.

Barrande (*loc. cit.* p. 696) describes the siphuncle as having an elliptical form; but this must be the result of pressure, because I have a specimen before me in which it is perfectly cylindrical, and so most probably was the shell.

Horizon. Upper Ludlow.

Localities. Wisby, Island of Gothland, Sweden; Island of Rügen, Germany.

Well represented in the Collection.

Actinoceras lamellatum, Angelin, sp.

1880. *Orthoceras lamellatum*, Angelin and Lindström, *Fragmenta Silurica*, p. 6, tab. vii. ff. 24–26.

1885. *Orthoceras lamellatum*, Lindström, *List of the Fossils of the Upper Silurian Formation of Gotland*, p. 6.

Sp. Char. Shell straight. Section slightly elliptical, the ratio of the two diameters being as 32 : 35. Septa numerous, distant $2\frac{1}{3}$ lines, where the diameter of the shell is $2\frac{1}{3}$ inches, and maintaining about the same distance in a specimen measuring 5 inches in length; forming a broad, shallow sinus in the region of the siphuncle, and arching upwards laterally. Diameter of the siphuncle measuring $\frac{2}{5}$ that of the shell. Test smooth, according to Angelin, but with faint longitudinal lines upon the cast of the chambers.

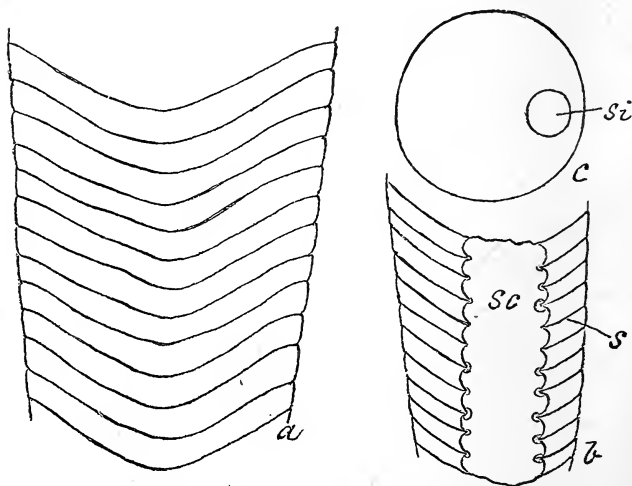
Horizon. Upper Ludlow.

Locality. Island of Gothland, Sweden.

The Collection contains two specimens presented by A. H. Foord.

Actinoceras imbricatum, Hisinger, sp.

Fig. 24.



Actinoceras imbricatum.—*a*, fragment of a cast, showing the disposition of the septa on the siphuncular aspect; *b*, section of a smaller individual, showing the large nummuloid siphuncle *sc*, and the septa, *s*; *c*, transverse section, showing the position of the siphuncle (*si*) and its diameter between the necks of the septa. *a* and *b* of the natural size; *c*, reduced $\frac{1}{2}$.

1831. *Orthoceratites imbricatus*, Hisinger (*non* Wahlenberg), Anteckn. i Physik och Geognosie, Häft. v. p. 112, tab. iv. f. 4.
1837. *Orthoceratites imbricatus*, Hisinger, Lethæa Svecica, p. 29, tab. ix. f. 9.
1842. *Orthoceratites imbricatus*, Eichwald, Die Urwelt Russlands, Heft ii. p. 24.
1845. *Orthoceratites imbricatus*, Murch., de Vern., and de Keyserl. Géol. de la Russie d'Europe, vol. ii. pt. 3, Paléont. p. 393.
1852. *Orthoceras imbricatum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 247.
1857. *Orthoceras imbricatum*, Boll, Archiv für Mecklenburg, xi. Jahrg. p. 21, Taf. vi. ff. 18, a-c.
1858. *Orthoceras (Ormoceras) imbricatum*, Schmidt, Archiv für die Naturkunde Liv-, Ehst- und Kurlands, Band ii. Lief. i. p. 194.
1860. *Actinoceras imbricatum*, Eichwald, Lethæa Rossica, Seconde Section de l'ancienne Période, vol. i. p. 1253.
1866. *Orthoceras pseudo-imbricatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 705, pl. ccxxviii. f. 1, pl. ccxxxiii. ff. 4-8, pl. ccccxl. ff. 1, 2.
- [Not 1821. *Orthoceratites imbricatus*, Wahlenberg, Nova Acta Reg. Soc. Scient. Upsaliensis, vol. viii. p. 89.—1870. *Orthoceras imbricatum*?, Barrande, *loc. cit.* p. 701, pl. ccccxl. ff. 3, 4.—1882. *Orthoceras imbricatum*, Blake, British Foss. Ceph. pt. i. p. 153, pl. xiv. ff. 1, 1 a, 3, 3 a, 4, 4 a, 5, 6.]

Sp. Char. Shell straight, rather rapidly tapering at the rate of about 1 in 9. Section apparently circular. Septa very approximate, the sutures forming a conspicuous sinus on the siphuncular aspect of the shell and sweeping upwards in a bold curve till they meet on the opposite side. In consequence of this they are oblique to the long axis of the shell, the angle of obliquity being about 22° . The diameter of the siphuncle (measuring the inflated part of it) is about $\frac{2}{5}$ that of the shell. Traces of the endosiphon and of the tubuli which connect it with the septal chambers are seen in polished sections. The outer test is unknown, but a fragment of what would appear to be the inner layer is perfectly smooth.

Remarks. The type described by Wahlenberg is stated to have an extremely slender, filiform, central siphuncle, and therefore it could not have belonged even to the same genus as Hisinger's *A. imbricatum*, much less to that species.

Barrande, to escape from this dilemma, appealed to Angelin, who supplied him with specimens which he had collected in the island of Gothland, and which he said he believed to be the species described by Wahlenberg under the name of *Orthoceras imbricatum*. There then remained Hisinger's *imbricatum* to be dealt with, and upon that Barrande bestowed the name of *pseudo-imbricatum*.

Not considering this a satisfactory way of settling the difficulty, I communicated with Dr. Lindström, who wrote to me (June, 1887) as follows:—" I have had the type specimen of Barrande's *O. imbricatum* as a loan from Prague, and it is as faithfully figured in his grand work as all his specimens prove to be. I have, however, strangely enough, not found a single Gotland Orthoceratite which I may pronounce as identical with that type. I see no other way but to drop *O. imbricatum*, Wahlenberg, and keep *O. imbricatum*, Hisinger, for that long so-named, as I have proposed long ago" Dr. Lindström adds, "I a fortnight ago inspected an old collection kept in Upsala, named the Marklinian Collection, a gift to the University by [Marklin] an old collector and contemporary of Wahlenberg. There I found both *O. imbricatum* and *angulatum*, with specimens quite such as we have always been wont to name with those names."

As Wahlenberg's description of his species was very brief and unaccompanied with figures, and as no specimens answering to his definition of it can now be found in any of the Swedish Collections, I think that the course suggested by Dr. Lindström is the most convenient under the circumstances, and accordingly I have adopted it.

It will now be unnecessary for me to make any further mention of *Orthoceras Marloense* Phillips (*ante*, p. 19), further than to say that I of course cannot accept Prof. Blake's view that it is identical with the *imbricatum* of Hisinger. Prof. Blake does not appear to have examined any actual specimens of *Actinoceras imbricatum*, or he could not have failed to note that the siphuncle, instead of being "very fine and filiform," is large and nummuloidal, and could therefore have no affinity with any such species as he describes under Wahlenberg's name.

Horizon. Upper Ludlow.

Locality. Island of Gothland, Sweden.

Well represented in the Collection. Two of the specimens were presented by A. H. Foord.

Actinoceras Backi, Stokes.

1824. *Orthocera*, Bigsby, Trans. Geol. Soc. vol. i. pt. 2, p. 204, pl. xxx. f. 1.
 1840. *Ormoceras Backi*, Stokes, Trans. Geol. Soc. vol. v. pt. 3, p. 709; with a reference to Bigsby's figures (*loc. cit.*).
 1857. *Orthoceras rotulatum*, Billings, Geol. Surv. of Canada, Report of Progress for the years 1853-1856, p. 334.
 1870. *Orthoceras rotulatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 732, pl. ccccxvii. ff. 1-5.

1878. *Orthoceras nummularium*, Etheridge, Quart. Journ. Geol. Soc. vol. xxxiv. p. 608. (Not of Sowerby.)

[Not 1868. *Orthoceras (Ormoceras) Backii*, Meek and Worthen, Geol. Surv. of Illinois, vol. iii. p. 298, pl. i. f. 4.—1870. *Orthoceras Backi*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 731, pl. cccxxxvii. ff. 17, 18.]

Sp. Char. Stokes's description is much too brief to be serviceable, consisting only of the words, "siphuncle larger than the preceding" [i. e. *A. Bayfieldi*], and a reference to plate vi. in Breynius's Dissert. phys. de Polythalam. I therefore give Billings's description, which was drawn up from more perfect specimens, and enables one to make out the characters of the species with tolerable accuracy:—"Septa very convex, four lines distant at a diameter of one inch eleven lines; siphuncle large, dilated between the septa, constituting an obliquely nummuloid cylinder fourteen lines in diameter, where the diameter of the perfect fossil was two inches, and situated within three lines of the ventral margin. The annulations have an obliquity of about 20° to the longitudinal axis, and they are evenly convex from one septum to another."

Remarks. The type specimen from Drummond Island is silicified, the walls of the siphuncle, of which five or six segments are preserved, having been replaced by orbicular chalcedony ("beekite"). A perforation is seen at both extremities of the siphuncle indicating the position of the endosiphon, and the tubuli given off by that organ are represented by a series of irregular horizontal cracks in the most prominent part of the siphuncle.

Two fragments, collected in the Arctic Regions during the expedition of the 'Alert' and 'Discovery,' are included provisionally in this species, but their condition is such as to make it impossible to do more than suggest their affinity with it.

Horizon. Niagara Group (Wenlock).

Localities. Cape Louis Napoleon, Smith Sound; Bessels Bay, Kennedy Channel; Arctic America. Drummond Island, Lake Huron; Canada (exact locality unknown).

Represented by the type specimen, which was presented to the Museum by Dr. J. J. Bigsby, F.R.S. The Arctic specimens, of which there are three, were transferred from the Museum of Practical Geology. There are two other specimens besides these, so that the species may be said to be well illustrated.

Actinoceras, sp.

1878. *Orthoceras imbricatum*, Etheridge (*non* Wahlenberg), Quart. Journ. Geol. Soc. vol. xxxiv. p. 607 (pars).

This specimen (labelled D 12) was placed by Mr. Etheridge under the name *Orthoceras imbricatum*, together with the one I have identified as *Orthoceras Darwini*, Billings (*q. v.*). It is a fragment of the septate portion of the shell much eroded, but showing traces of a siphuncle inflated between the chambers, so that there appears to be ground for regarding it as an *Actinoceras*. The septa are very approximate, their distance but slightly exceeding $\frac{1}{5}$ the diameter of the shell. The rate of increase may be roughly computed at about 1 in 5.

Horizon. Niagara Group (Wenlock).

Locality. Dobbin Bay, Smith Sound, Arctic America.

Represented by a single specimen in the Collection.

Actinoceras Whitei, Stokes, sp.

1824. *Orthocera* , Bigsby, Trans. Geol. Soc. vol. i. pt. 2, p. 204, pl. xxx. f. 2.

1840. *Ormoceras Whitei*, Stokes, Trans. Geol. Soc. ser. 2, vol. v. pt. 3, p. 709, with a reference to Bigsby's figures (*loc. cit.*).

1870. *Orthoceras Backi*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 731, pl. cccxxxvii. ff: 17, 18.

Sp. Char. Shell straight. The transverse section cannot be determined from the fragments of the species known. The septa are regular and horizontal, and distant about $\frac{2}{5}$ the diameter of the shell. The siphuncular bulbs are much inflated between the chambers, the relation of the height of a given bulb or segment to its breadth being as 4:7. In one of the specimens figured by Barrande (*loc. cit.* fig. 18) the endosiphon is delineated in two or three of the siphuncular segments which have been broken open. The foramina by which the tubuli of the endosiphon communicated with the septal chambers are noticeable in Stokes's type specimen. Nothing is known of the surface of the test.

Remarks. The fossil figured by Barrande (belonging to the Natural History Society of Montreal) was communicated to him by Billings, who suggested its identity with *A. Whitei*, Stokes, and I am quite in accord with this view of its affinities. It is clearly distinguished from *A. Backi*, to which Barrande refers it, by the form of its siphuncular elements, which are more globular than they are in the latter species; this also causes a greater space to intervene between the septa.

Stokes gives us no description whatever of this species, but refers the reader to Bigsby's figure, and observes that the species was "named after M. White, Esq., of the Army Medical Staff, who was stationed on Drummond Island, and collected this and many other specimens of these interesting fossils."

Horizon. Niagara Group (Wenlock).

Locality. Drummond Island, Lake Huron.

Represented in the Collection by the type specimen figured by Bigsby.

Actinoceras vertebratum, Hall, sp.

1840. *Ormoceras Bayfieldi*, Stokes, Trans. Geol. Soc. ser. 2, vol. v. pt. 3, p. 709, pl. lx. f. 1.

1852. *Ormoceras vertebratum*, Hall, Pal. of New York, vol. ii. p. 94, pl. xix. ff. 1, a-g.

1852. *Ormoceras Bayfieldi*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 264.

1855. *Ormoceras Bayfieldi*, Barrande, Bull. Soc. Géol. de France, sér. 2, tom. xii. p. 470, pl. A. f. 5.

1866. *Orthoceras (Ormoceras) Bayfieldi*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 738, pl. ccxxxi. f. 1.

Sp. Char. "Shell elongated, gradually tapering, section circular; siphuncle nearly central (?); surface unknown; septa four to five in the space of an inch; edges of the septa slightly projecting in the cast, and the spaces between them contracted or concave; siphuncle presenting the usual appearance of *Ormoceras*, the longitudinal diameter of the expanded portions being about one-half as great as the transverse diameter. . . . Many of the specimens are weathered, exhibiting the structure in a very beautiful manner, and showing also the variable aspects under which the same species may be presented." (*Hall.*)

Remarks. I entertain no doubt whatever as to the identity of Stokes's species with Hall's; and as we must depend upon the last-named author for an adequate description of the species, it is but just that his name should supersede that of Stokes. The diagnosis given by the latter is in the following words:—"Shell slightly conical. The laminæ of the septa separate from each other on one side of the shell so as to show a space between them." This latter character, which cannot, however, be regarded as of specific importance, is noted also by Hall, who describes one of the specimens figured by him (f. 1 c) as having the laminæ of the shell silicified and separated, "so that the septa and siphuncle appear to be composed of double laminæ," just as in Stokes's specimen.

Horizon. Niagara Group (Wenlock).

Locality. Drummond Island, Lake Huron.

Represented by the type specimen figured by Stokes.

Actinoceras spheroidale, Stokes, sp.

1824. *Huronina spheroidalis*, Stokes, Bigsby, Trans. Geol. Soc. ser. 2, vol. i. pt. 2, p. 203, and "Explanation of Plates," pl. xxviii. f. 5.

1840. *Huronina Portlockii*, Stokes, *ibid.* vol. v. p. 710, pl. lx. f. 5.

1866. *Orthoceras (Huronina) Portlocki*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 741, pl. ccxxxii. f. 4.

1866. *Orthoceras (Huronina) spheroidale*, Barrande, *ibid.* p. 742, pl. ccxxxii. f. 3.

Sp. Char. Shell straight. Section probably circular. The rate of increase may be roughly estimated at about 1 in 9. The septa, which are seen only as faint lines upon the surface of the rock, are distant about 8 lines, where the shell has a diameter of $2\frac{1}{4}$ inches. The siphuncular segments are of the form of flattened spheroids, the ratio of the vertical to the transverse diameter being nearly as 6:17. The foramina through which the tubuli thrown off by the endosiphon opened into the septal chambers are plainly discernible in one of the specimens; they consist of a row of minute apertures encircling transversely each siphuncular segment, their position being along a line a little above the greatest convexity of the segment. Nothing whatever is known of the test of this species, the specimens representing the latter consisting only of internal casts.

Remarks. In the specimen hitherto known as *Huronina Portlockii*, the siphuncle has been crushed so as to cause its several elements to appear narrower than they were originally. The specimen of *A. spheroidale* (the type) shows the segments of the siphuncle in what is probably their natural shape. This specimen also exhibits a transverse section of the endosiphon.

Barrande compared the present species with *A. rotulatum*, Billings, but it is distinguished from the latter not only by the horizontality of its siphuncular elements, which are oblique to the long axis of the shell in Billings's species, but also by the much greater distance separating the septa.

A. spheroidale is distinguished from *A. Clouéi*, Barrande, with which that author compares it, by the same characters that separate it from *A. rotulatum*, Billings. Moreover, *A. Clouéi* is alleged to be derived from rocks (in Newfoundland) which are of Ordovician age (Barrande's Second Fauna), and probably belong to the first stages of that system.

Horizon. Niagara Group (Wenlock).

Locality. Drummond Island, Lake Huron.

Represented by the type specimens figured by Stokes.

DEVONIAN SPECIES.

Actinoceras striatum?, Sowerby, sp.

(*Infrà*, p. 190.)

Cf. *Orthoceras Ludense*, Phillips, Pal. Foss. of Cornwall &c., 1841, p. 110, pl. xlii. ff. 206, a-c. (*Not* of Sowerby.)

To this species I refer, with a considerable degree of doubt, a large specimen from Lower Dunscombe, because many essential specific characters are lacking in it. The shell is completely devoid of test, and the septa can only be obscurely made out. The shell is elliptical in section, the ratio of the two diameters being as 29:34. The rate of increase measured along the broader diameter is about 1 in 9. The septa are apparently distant about 8 lines, where the shell has a diameter of about 2 inches.

Prof. McCoy says that he has "little doubt that the S. Petherwin and Marwood shell, referred by Prof. Phillips to the Silurian *O. Ludense*, belongs to this species" [i. e. *A. striatum*, Sowerby, sp.].

Horizon. Upper Devonian (Intumescens Stage).

Locality. Lower Dunscombe, near Chudleigh, Devonshire.

Represented in the Collection by one example presented by J. E. Lee, Esq., F.G.S.

CARBONIFEROUS SPECIES.

Actinoceras giganteum, Sowerby, sp.

1821. *Orthocera gygantea*, J. Sowerby, Mineral Conch. vol. iii. p. 81, tab. ccxvi.
1825. *Orthoceratites giganteus*, DeFrance, Dict. des Sciences naturelles, tom. xxxvi. p. 484.
1826. *Orthoceratites giganteus*, d'Orbigny, Tab. méth. de la classe des Céphalopodes, p. 72.
1828. *Orthocera gygantea*, Fleming, Hist. of British Animals, p. 239.
- ? 1829. *Orthoceratites Polyphemus*, Fischer, Bull. de la Soc. Imp. des Naturalistes de Moscou, p. 322.
- ? 1832. *Orthoceratites Polyphemus*, Goldfuss, in H. von Dechen's transl. of H. T. de la Beche's Handb. of Geology.
1836. *Orthoceras giganteum*, Phillips, Geol. of Yorkshire, pt. ii. p. 237, pl. xxi. f. 3.

1836. *Orthoceras giganteus*, Quenstedt, De Notis Nautiliarum Primariis, p. 19.
- ? 1837. *Orthoceratites Polyphemus*, Fischer, Oryctogr. de Moscou, p. 124.
1840. *Orthoceras giganteum*, Prestwich, Trans. Geol. Soc. ser. 2, vol. v. pt. iii. p. 492.
1840. *Actinoceras Simmsii*, Stokes, Trans. Geol. Soc. ser. 2, vol. v. pt. iii. p. 708, pl. lix. ff. 4, 5.
1842. *Orthoceratites giganteus*, d'Archiac & de Verneuil, Trans. Geol. Soc. ser. 2, vol. vi. p. 385.
1843. *Actinoceras Simmsii*, Portlock, Rep. on the Geology of London-derry &c. p. 391.
- ? 1843. *Orthoceras maximum* (pars), Portlock, *ibid.* p. 388. (*Not of Münster.*)
1844. *Orthoceras giganteum*, de Koninck, Descrip. des Anim. Fossiles de la Belgique, p. 510, pl. xlv. f. 2, pl. xlv. f. 3, pl. xlvi., and pl. xlvii. f. 1.
1844. *Actinoceras giganteum*, M'Coy, Carboniferous Foss. of Ireland, p. 11.
1844. *Actinoceras pyramidatum*, M'Coy, *ibid.* p. 11, pl. i. f. 5.
1848. *Orthoceras giganteum*, Bronn, Nomencl. palæont. p. 865.
1849. *Orthoceratites giganteus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 113.
1849. *Actinoceras giganteum*, d'Orbigny, *ibid.* p. 114.
1852. *Orthoceras giganteum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 245.
1854. *Actinoceras giganteum*, Roemer, "Beitr. z. geol. Kenntn. des nordwestl. Harzgeb.," Palæontographica, Band iii. p. 93, tab. xiii. ff. 27, a-c.
1854. *Actinoceras giganteum*, Morris, Cat. of British Fossils, 2nd ed. p. 289.
1855. *Orthoceras (Actinoceras) giganteum*, M'Coy, British Pal. Foss. fasc. iii. p. 571.
- ? 1860. *Orthoceras Polyphemus*, Eichwald, Lethæa Rossica, vol. i. Seconde Sect. de l'ancienne Période, p. 1217.
1862. *Actinoceras giganteum*, Griffith, Journ. Geol. Soc. of Dublin, vol. ix. pp. 33 and 55.
1862. *Actinoceras pyramidatum*, Griffith, *ibid.* p. 33.
1866. *Actinoceras pyramidatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 685, pl. ccxxxii. ff. 11, 12, pl. ccxxxiv. ff. 4, 5.
1866. *Orthoceras giganteum*, Barrande, *ibid.* p. 715, pl. ccxxxv. ff. 6-8.
1874. *Actinoceras giganteum*, Young & Armstrong, Trans. Geol. Soc. Glasgow, vol. iv. p. 280.
1876. *Orthoceras giganteum*, F. Roemer, Lethæa Palæozoica, pl. xlvi. f. 1.
1876. *Actinoceras giganteum*, Armstrong, Young, & Robertson, Cat. of the Western Scottish Fossils, p. 58.

1880. *Orthoceras giganteum*, de Koninck, Faune du Calc. Carbonifère de la Belgique, tom. v. p. 75, pl. xlv. ff. 5-10.

[Not 1835. *Orthoceratites giganteus*, Kutorga, Beitrag zur Geognosie und Palæontologie Dorpat's, p. 32, Taf. vi. f. 6.]

Sp. Char. Shell very large; straight. Section nearly circular. Rate of increase from 1 in 7 to 1 in 5. Septa moderately convex, increasing somewhat rapidly in their distance apart; for example, in a specimen measuring 2 feet 10 inches in length, the septa are only 1 line distant at the smaller extremity, while at the larger the interval between them has increased to 1 inch. In a large fragment consisting of the greater portion of the body-chamber, with two septa attached, the latter are distant $1\frac{1}{4}$ inch, the diameter being here about 7 inches. The siphuncle is not large in proportion to the dimensions of the shell; it is a little eccentric in the young, *i. e.* less than its own diameter from the centre, tending to become more nearly central in the adult shell; it is much inflated between the septa into depressed spheroidal segments twice as wide as long. The outer surface of the test is generally wanting, and the inner layer being quite smooth has led authors to describe the species as having a perfectly smooth shell; but there is a specimen in the Collection which has a distinctly striated surface, above the smooth layer, the ornaments consisting of fine transverse lines, of which there are about three in the space of a line¹.

Remarks. This shell in its great size and robustness of habit surpasses all others of its kind in the British rocks. M'Coy, in chronicling its occurrence in the red limestone of Castle Espie Comber, in Ireland, observes that it "sometimes attains a length of four feet, imperfect at both ends" ('Carbonif. Foss. of Ireland,' p. 11); and Sowerby (Min. Conch.) computes its length as sometimes exceeding 8 feet. A huge fragment, the whole of which appears to be septate, measures 2 feet 5 inches in length, the diameter of the larger extremity being about 8 inches, that of the smaller about $4\frac{1}{2}$ inches.

Horizon. Carboniferous Limestone. Calciferous Sandstone (Closeburn; Carluke District).

Localities. British. Bolland, Yorkshire; near Caldbeck, Cumberland; Newbery, Derbyshire; Closeburn, Dumfriesshire; Carluke District; Ireland.—*Foreign.* Visé, Belgium.

Represented by a magnificent series of specimens, containing the

¹ The specimen showing these markings is registered C 325 in the Collection, but without a locality. It is, however, without doubt British.

types figured by Sowerby in the 'Mineral Conchology,' and also Phillip's type figured in the 'Geology of Yorkshire.' A fine longitudinal section, showing the siphuncle, in a slab of polished marble was presented to the Museum by Francis Wright, Esq.; another very fine example formed originally part of Dr. Mantell's collection.

Actinoceras striatum, Sowerby, sp.

1814. *Orthocera striata*, Sowerby, Mineral Conch. vol. i. p. 129, tab. lviii.
1836. *Orthoceras undulatum*, Phillips, Geol. of Yorkshire, pt. ii. p. 238, pl. xxi. f. 8. (Not of Sowerby.)
1844. *Orthoceras lineare*, de Koninck, Descrip. des Anim. Fossiles de la Belgique, p. 519, pl. xlv. f. 6. (Not of Münster.)
1844. *Orthoceras lineale*, de Koninck, *ibid.*, Explication de la planche xlv.
1849. *Orthoceratites sublinearis*, d'Orbigny, Prodr. de Paléont. Stratigraphique, vol. i. p. 113.
1852. *Orthoceras lineale*, Giebel, Fauna der Vörrwelt, Band iii. Abth. i. p. 260.
- ? 1852. *Orthoceras striatum*, M'Coy, British Pal. Foss. fasc. ii. p. 405.
1855. *Orthoceras (Loxoceras) laterale*, M'Coy, British Pal. Foss. fasc. iii. p. 572. (Not of Phillips.)
1880. *Orthoceras lineale*, de Koninck, Faune du Calc. Carbonifère de la Belgique, tom. v. p. 79, pl. xli. ff. 9, 9 a-c, pl. xliii. ff. 8, 8 a-c.

Sp. Char. Shell straight. Section oval, the ratio of the two diameters being as 26 : 33 in a somewhat compressed example, and as 19 : 22 in one which is apparently uncompressed. Rate of tapering from 1 in 6 to 1 in 5. Septa not very distant, their distance about $\frac{1}{7}$ of the transverse diameter, forming a broad and shallow sinus on that side of the shell which corresponds with the longer diameter, and is nearest to the siphuncle. The latter is nummuloidal, of medium size, and is situated about $\frac{2}{5}$ across the shorter diameter, being equidistant from either extremity of the longer diameter. The external surface of the test is ornamented with a great number of longitudinal subparallel, nearly equidistant, straight striæ, four or five of which occupy the space of 1 line. No trace of any transverse striæ or lines of growth is perceptible.

Remarks. M. de Koninck admits that he at first supposed that his species was identical with Sowerby's. The differences by which he subsequently distinguished between the two can be easily reconciled. The first is an alleged difference in size in favour of *O. lineale*, the second the nummuloidal form of the siphuncle in the latter. To the first of these characters very slight importance need be attached,

because Sowerby's figure represents a shell quite equal in size to some of the examples figured by de Koninck. As to the character of the siphuncle, both forms agree perfectly; and I should judge from Sowerby's figure that the longitudinal striæ are quite as regular in his species as they are in de Koninck's, though the latter expresses a contrary opinion.

Horizon. Carboniferous Limestone.

Localities. Chipping, near Preston, Lancashire; Bolland, Yorkshire.

Fairly well represented in the Collection. The specimen from the first-named locality was presented by John Rofe, Esq.; the one from Bolland is the type figured by Phillips in the 'Geology of Yorkshire.'

Actinoceras Sowerbyi, M'Coy, sp.

1814. *Orthocera undulata*, Sowerby, Min. Conch. vol. i. p. 130, tab. lix.
(Not of Schlotheim.)

1814. *Orthocera Breynii*?, Sowerby, *ibid.* p. 132, tab. lx. ff. 5, 5*.
(Not of Martin.)

1828. *Orthocera undulata*, Fleming, British Anim. p. 328.

? 1841. *Orthoceras imbricatum*, Phillips, Pal. Foss. of Cornwall, Devon, and West Somerset, p. 111, pl. xlii. f. 207. (Not of Hisinger.)

1843. *Orthoceras subimbricatum*, Portlock, Report on the Geol. of Londonderry, p. 391.

1854. *Orthoceras undulatum*, Morris, Cat. of British Fossils, 2nd ed. p. 312.

1855. *Orthoceras (Loxoceras) Sowerbyi*, M'Coy, British Pal. Foss. fasc. iii. p. 573.

[Not 1836. *Orthoceras undulatum*, Phillips, Geol. of Yorkshire, pt. ii. p. 238, pl. xxi. f. 8.—1844. *Orthoceras laterale*, de Koninck, *Descrip. des Anim. Foss. de la Belgique*, p. 508, pl. xliii. ff. 2a, b.—1880. *Orthoceras migrans*, de Koninck, *Faune du Calc. Carbonifère de la Belgique*, tom. v. p. 59, pl. xlv. f. 4 (not of Barrande).—1880. *Orthoceras Breynii*, de Koninck, *ibid.* p. 73, pl. xxxviii. f. 11, pl. xxxix. f. 3.]

Sp. Char. Shell straight. Section elliptical, the ratio of the two diameters being as 14:16. Rate of tapering about 1 in 5. Body-chamber at least twice as long as its basal diameter; apparently a little constricted near the aperture. Septa numerous, forming a broad shallow sinus on the side nearest the siphuncle, and arching upwards laterally. Siphuncle eccentric, situated about $\frac{1}{3}$ of the distance across the shorter diameter; composed of a series of small inflated segments of moniliform aspect. Body-chamber, as seen in a Belgian specimen, at least twice the length of its basal diameter.

Surface of the test smooth, or marked only with minute striæ of growth.

Remarks. The changes in the nomenclature of this species are thus explained by Prof. M'Coy:—"I have been obliged to give a new specific name to this species, as Phillips's *O. laterale*, proposed as a substitute (in consequence of Sowerby's specific name having been previously used by Schlotheim), differs from the true species of Sowerby in having much more distant septa and more nearly central siphon. To the present species may probably, however, be referred the *O. imbricatum* from Marwood, figured in Phillips's Palæozoic Fossils . . ."

A. undulatum is said by M'Coy to be "rare in the Carboniferous Limestone of Closeburn, Dumfriesshire."

It appears from Sowerby's observations upon this species that he was very doubtful about its being identical with Martin's, for he says his [Martin's] species is more rapidly acuminate or conical, in his "the dissepiments are approximate, concave, oblique, almost entire" Sowerby adds:—"This species is said to vary considerably in size; we hope this figure will give occasion to inquiry whether they are the same species or not . . ."

M. de Koninck (*loc. cit.* p. 74) makes the present species synonymous with *A. Breynii*, Mart., sp.; but they appear to me to be very distinctly separable, the latter having the septa horizontal and wider apart than they are in the former. The marked obliquity of the septa in the present species would at once distinguish it from *A. Breynii*. The fossil which de Koninck has identified (under the name of *Orthoceras migrans*¹, not of Barrande) with the *A. Breynii*?, Sow., sp. (non Martin), does not agree with that species at all. The septa are much wider apart in de Koninck's form than they are in Sowerby's, and, moreover, judging by the figure, they are quite horizontal.

Horizon. Red Sandstone Group of the Calciferous Sandstone series² (Closeburn specimen); Carboniferous Limestone.

Localities. *British.* Scaleber, near Settle (the type of *A. undulatum*, Sow., sp.), Bolland, Yorkshire; Closeburn, Dumfriesshire; Orchard Quarry, near Glasgow.—*Foreign.* Visé, Belgium.

Well represented in the Collection, which, amongst other examples, includes Sowerby's types of *A. undulatum* and *A. Breynii*?, and a specimen from Closeburn, bequeathed to the Museum by Sir W. C. Trevelyan, Bart.

¹ See *ante*, p. 20.

² See footnote *ante*, p. 121.

Actinoceras Breynii, Martin, sp.

1809. *Conch. N. Orthoceratites Breynii*, Martin, Petrificata Derbiensia, pl. xxxix. f. 4.
 ? 1836. *Orthoceras Breynii*, Phillips, Geol. of Yorkshire, pt. ii. p. 238.
 ? 1844. *Orthoceras (Loxoceras) Breynii*, M'Coy, Carboniferous Limestone Foss. of Ireland, p. 8.
 1849. *Melia Breynii*, d'Orbigny, Prodr. de Paléont. Stratigraphique, vol. i. p. 114.
 1851. *Orthoceras Breynii*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 232.
 1855. *Orthoceras (Loxoceras) Breynii*, M'Coy, British Pal. Foss. fasc. iii. p. 567.
 1860. *Loxoceras Breynii*, Griffith, Journ. Geol. Soc. of Dublin, vol. ix. p. 55.
 1867. *Orthoceras Breynii*, Armstrong, Young, and Robertson, Cat. of the Western Scottish Fossils, p. 59.
 1880. *Orthoceras Breynii*, de Koninck, Faune du Calc. Carbonifère de la Belgique, tom. v. p. 73, pl. xxxviii. ff. 11, *a-c*; pl. xxxix. ff. 3, 3a.

Sp. Char. Shell straight. Section elliptical, the ratio of the two diameters being as 14:17. Rate of increase about 1 in 5. Septa horizontal, forming a shallow sinus on the side nearest the siphuncle, and arching upwards laterally. Siphuncle situated midway between the centre and the margin, in the line of the shorter diameter, the segments of which it is composed are considerably inflated between the septa. "Surface (indistinct) apparently marked with fine, obtuse, transverse striæ" (*M'Coy*).

Remarks. An excellent sketch of this species is given by Martin, and one has no difficulty in recognizing its characters in the specimens in the Collection. Some of these have unfortunately no locality recorded against them, but there is reason to suppose that they are from Derbyshire.

Horizon. Carboniferous Limestone.

Localities. Bolland, Yorkshire; Derbyshire?

Fairly well represented in the Collection.

Actinoceras inops?, Dawson.

1868. *Actinoceras inops*, Dawson, Acadian Geology, 2nd ed. p. 314, f. 133a.

Sp. Char. This small species, of which only a portion of the septate part of the shell is known, is remarkable for its high rate of tapering, viz. 1 in 3.

The siphuncle is very large according to Dawson's figure, in which

it is represented as occupying more than half the diameter of the shell. The septa are rather approximate. The proportions of the body-chamber cannot be determined, though some of it is preserved in the specimen in the National Collection.

Dawson gives no description of the species, merely stating that his example was "collected by Mr. D. Fraser on the East River of Pictou."

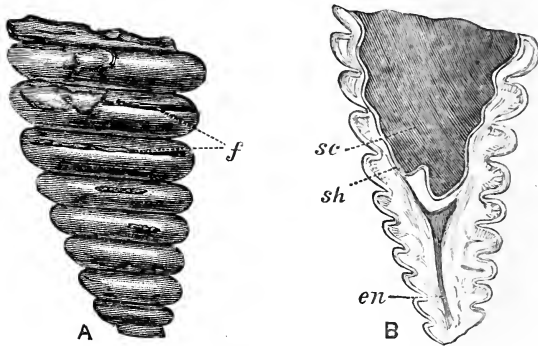
Horizon. Carboniferous Limestone.

Locality. Brookfield, Nova Scotia.

Represented by a single example transferred from the Museum of Practical Geology.

Genus **DISCOSORUS**, Hall¹.

Fig. 25.



Discosorus conoideus.—A. Longitudinal section of siphuncle, showing *sc*, siphuncular cavity; *sh*, sheath; *en*, endosiphon; B. External view of the other half of the same specimen, showing the ring-like segments of the siphuncle. Natural size.

Gen. Char. Shell slightly curved, tapering more or less rapidly. Siphuncle large, occupying a very considerable portion of the shell; marginal; composed, as in *Actinoceras*, of a series of nummuloidal discs or segments, which have an evenly rounded contour for about

¹ Pal. of New York, vol. ii. 1852, p. 99. The following is Hall's description:—"A body composed of discs or rings piled one above another, and gradually diminishing in size; outer edges rounded, joining surfaces broad and flat; internally fibrous or solid.

"I propose this name for a peculiar fossil body whose relations are at present unknown to me; and having but a single species, it is scarcely possible to give the generic characters that degree of comprehensiveness that may be required."

half their circumference, while in the other half they are flattened. A large funnel-shaped sheath, recalling the similar structures in the siphuncle of *Piloceras*, forms a conical chamber, which occupies the upper or more expanded part of the siphuncle. This sheath, doubtless originally membranous, has a sinuous outline, due to the concavities of the siphuncular segments, which it enters for a short distance, the indentations between the segments (where the septa originate) causing a corresponding projection in the wall of the sheath. The apical extremity of the latter is often digitate. The whole of the apical portion of the siphuncle, as well as the space around the sheath, is infiltrated with calcareous matter, the cavity of the sheath being filled with the matrix. Owing to the eccentric position of the siphuncle in the shell, its elements are somewhat oblique to the vertical axis. The septa are moderately approximate. The test, known only by a very small fragment, is extremely thin, and has a perfectly smooth surface. An endosiphon is present, but it is not very well preserved in any of the specimens I have examined. The largest example of *Discosorus* known to me is the one figured by Barrande (*loc. cit.* pl. cccclxxiv. ff. 7, 8), from the environs of Lake Michigan. This measures $3\frac{1}{2}$ inches in length, $1\frac{5}{8}$ inch in its greatest, and 7 lines in its least, diameter. The largest specimen in the National Collection does not exceed $2\frac{1}{4}$ inches in length.

Remarks. A good deal has been learnt concerning this singular genus since it was described by Hall (1851)¹, whose knowledge of it was derived from incomplete specimens, which consisted only of the siphuncle, found in the Clinton Formation at Ontario and Lockport, in the State of New York. Specimens of the siphuncle had been previously (1822) collected in the Niagara Formation of Drummond Island, Lake Huron, by Dr. Bigsby², who briefly characterized them as "columns usually tapering rapidly, composed of circular discs, with rounded edges, placed one upon the other."

Again, Prof. Hall (1852)³ had occasion to deal with the present

¹ Foster and Whitney's Report on the Geol. of the Lake Superior Land District, p. 222, pl. xxxiv. ff. 2, 3.

² Trans. Geol. Soc. 2nd ser. vol. i. 1824, p. 204, pl. xxx. ff. 3, 4, 6, 7 (*not f.* 5).

³ Pal. of New York, *loc. cit.* I may here take occasion to observe that in the preface to this work the author states that though the printing of the volume was completed in the early part of the year 1850, it was not ready for publication until 1852. This explains how it is that one finds, under Hall's description of *Discosorus conoides* in Foster and Whitney's Report (1851) a reference to the volume of the Palæont. of New York, which was not published till 1852.

genus, but he could add nothing to what he had previously stated respecting its structural characters. Professor Whitfield, however, met with a specimen of *Discosorus* belonging to the Collection of the Geological Survey of Wisconsin, in which septa were preserved in contact with the siphuncle, thus making clear the affinities of the organism.

Added to this are two examples of *Discosorus* in the British Museum, both of which have the septa preserved, and one of them (fig. 26 A) has a considerable part of the shell remaining.

The large proportionate size and nummuloidal character of the siphuncle bring *Discosorus* into close relationship with *Actinoceras*, from which, however, it is differentiated by features which, taken together, are of sufficient importance for generic distinction.

Discosorus would seem to bear the same relationship to *Actinoceras* (perhaps as a brevicone form of it, as suggested by Barrande) that *Piloceras* bears to *Endoceras*.

Both *Discosorus* and *Piloceras* are short, curved forms, having structural affinities with long straight ones.

Horizon. Niagara Group (Wenlock).

Localities. Drummond Island, Lake Huron; Niagara.

Well represented in the Collection by numerous specimens, one of them having formerly belonged to Dr. Mantell's collection, and another having been transferred from the Museum of Practical Geology.

Discosorus conoideus, Hall.

1824. *Columns composed of circular discs &c.*, Bigsby, Trans. Geol. Soc. ser. 2, vol. i. p. 204, pl. xxx. ff. 4, 6, ? 3 (not ff. 5, 7).
1851. *Discosorus conoideus*, Hall, in Report on the Geol. of the Lake Superior Land District, by Foster and Whitney, pt. ii. p. 222, pl. xxxiv. ff. 2, 3¹.
1852. *Discosorus conoideus*, Hall, Pal. of New York, vol. ii. p. 99, pl. xxviii. ff. 13, a, b, c.
1863. *Discosorus (Orthoceras) conoideus*, Billings, Geol. of Canada, p. 335.
1874. *Orthoceras? (Discosorus) conoideus*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. p. 750, pl. cccxxii. ff. 1, 2 (after Bigsby), pl. ccccxxvii. ff. 19-22 (teste Billings), pl. cccclxxiv. ff. 7, 8.
1882. *Discosorus conoideus*, Whitfield, Geol. Surv. of Wisconsin, vol. iv. pt. iii. ; Palæont. p. 299, pl. xx. f. 6.

Sp. Char. These must necessarily be confined mainly to a

¹ I have not seen these figures, as, in the copy of the Report to which I have had access, pl. xxxiv. is wanting.

description of the siphuncle, as very little is known about the shell. Prof. Whitfield thus describes an example of the species belonging to the collection of the Geological Survey of Wisconsin:—"The outer shell . . . tapers very rapidly, resembling in form a species of *Gomphoceras*, but it is too imperfect to permit a description The discs are seen occupying the position of the ordinary siphuncle within the body of an *Orthoceras* [*Actinoceras*], with the true septa and outer shell surrounding it. The discs corresponding in number and position to the septa, and the obliquity of the discs to the axis of the series is seen to correspond to the eccentricity of their position within the *Orthoceras*, as is often the case with the ordinary siphuncle."

The siphuncle is elliptical in section, the ratio of the two diameters in an uncompressed specimen being as 9 : 8. It has a very perceptible curvature, and its rate of increase is a little more than 1 in 3, measured along the convexity. The distance of the septa from each other, as computed by the vertical diameter of the siphuncular discs or segments, varies from 2 to $2\frac{1}{2}$ lines in a specimen measuring $2\frac{1}{4}$ inches along its outer curvature. This same specimen has a transverse fissure (fig. 25 A, f) in several of the discs, situated a little above the median line, and indicating the position of the row of foramina which gave exit to the tubuli proceeding from the endosiphon. The latter is seen in the same figure at *en*.

Horizon. Niagara Group (Wenlock).

Locality. Drummond Island, Lake Huron.

Well represented in the Collection.

***Discosorus remotus*, sp. nov.**

1824. *Columns composed of circular discs &c.*, Bigsby, Trans. Geol. Soc. ser. 2, vol. i. p. 204, pl. xxx. f. 7.

Sp. Char. This species is known only by fragments of the siphuncle, but as these differ in several particulars from the other two species of the genus, it seems advisable that it should be separated from them under a distinctive title. The most marked feature in which the present species differs from *D. conoideus* is in the distance of the siphuncular segments (or, in other words, of the *septa*) from each other. These are in *D. remotus* $2\frac{1}{2}$ lines apart, where the diameter of the siphuncle is 7 lines; in *D. conoideus*, on the other hand, the segments are scarcely 2 lines apart at that diameter. They are also flatter in the present species than they are in *D. conoideus*, and they exhibit the peculiar dual character (one

half of their contour rounded and the other flattened) so noticeable in *Huronia obliqua*. This feature is not existent in *D. conoideus*.

A badly preserved specimen from Niagara (formerly in Dr. Mantell's collection), agreeing essentially with the present species, shows remains of the septa and shell-wall. All the examples, except the last mentioned, are chalcedonized.

Horizon. Niagara Group (Wenlock).

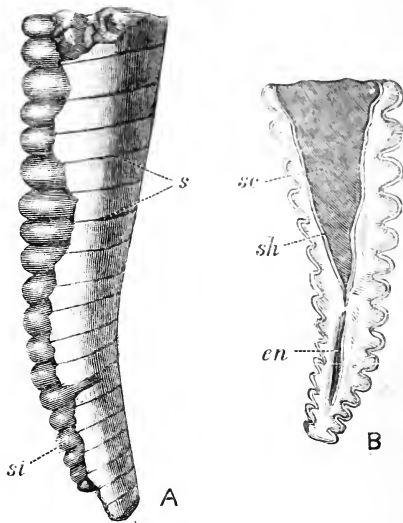
Localities. Drummond Island, Lake Huron; Niagara.

Represented by a few specimens, including one of those figured by Dr. Bigsby. Some were transferred from the Museum of Practical Geology.

Discosorus gracilis, sp. nov.

1877. *Discosorus* — *indéterminé*, Barrande, Syst. Sil. de la Bohême, vol. ii. Supplém. et Série tardive, pl. cccclxxiv. ff. 9, 10.

Fig. 26.



Discosorus gracilis.—A. Fragment of the septate part of the shell, the thin test being broken in a vertical direction, so as to expose the siphuncle to view.

B. Internal view of another specimen cut longitudinally, showing the sheath, *sh*, and the remains of the endosiphon, *en*. Natural size.

Sp. Char. Shell slightly curved. Section probably nearly circular in its normal condition, but compressed in one of the specimens. Rate of increase 1 in 3. Septa 2 lines apart at a diameter of 7 lines; the specimen measured is, however, somewhat compressed,

so as to increase the diameter. The siphuncle is very large in proportion to the size of the shell; the segments of which it is composed are slightly oblique to the axis, and their surfaces flattened along the inner curvature of the shell, as in *D. remotus*. The inner layer of the test must have been extremely thin, as the septa show very distinctly through it. A fragment of the outer layer is preserved, and this presents a perfectly smooth surface.

The endosiphon is seen somewhat obscurely in one of the specimens (fig. 26 B). Judging by the appearance of the sheath in the same example, it is probable that we have here the whole of the septate part of the shell.

Remarks. *Discosorus gracilis* is readily distinguished from *D. conoideus* and *D. remotus* by its more slender proportions and somewhat slower rate of tapering.

Horizon. Niagara Group (Wenlock).

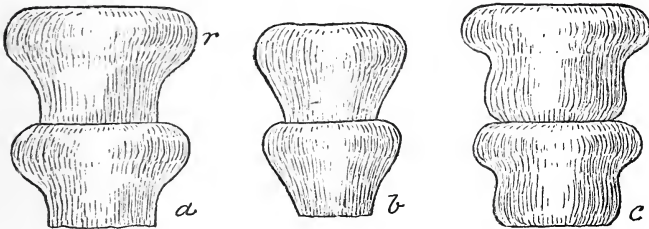
Localities. Drummond Island, Lake Huron; Niagara.

Fairly well represented in the Collection.

Genus **HURONIA**, Stokes¹.

(*Orthocères Longicones*—Group 18, Barrande, 1874².)

Fig. 27.



Gen. Char. This genus is distinguished from *Actinoceras* by the form of the siphuncular segments, which are swollen above into a more or less prominent, inflated rim (fig. 27 *a*, *r*), occupying from about one third to two thirds of the segment, while the latter may be either concave (fig. 27 *a*) or convex below (fig. 27 *c*). Sometimes the segments are of a subturbinate form (fig. 27 *b*); or, again, a curious

¹ Trans. Geol. Soc. ser. 2, vol. i. pt. ii., 1824; explanation of plate xxviii.

² Syst. Sil. de la Bohême, vol. ii. Texte iii. p. 665, 1874; and Texte v. p. 1414 1877.

inequality of development may be produced, by which each segment is almost evenly rounded in the lower half, while in the upper half its outline forms a sigmoid curve, as in fig. 28, *u*¹. In no case are the

Fig. 28.

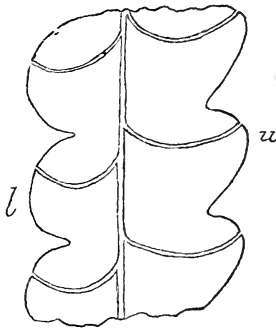


Fig. 29.

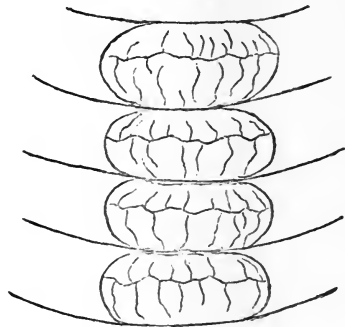


Fig. 28. Lateral view of three siphuncular segments of *Huronia obliqua*, Stokes, showing *l*, the convex outline of the lower half of the segment, and *u* the sigmoid outline of the upper half. Nat. size.

Fig. 29. Four siphuncular segments of *Actinoceras Clouti*, Barrande, showing their evenly rounded contour. Nat. size.

elements of the siphuncle evenly rounded throughout the whole of their contour, as in *Actinoceras* (fig. 29), their habit being always to increase in diameter towards the top.

As it often happens in *Huronia* that the vertical diameter of the siphuncular segments exceeds the transverse, it results from this that the septa are usually more distant from each other than they are in *Actinoceras*². Their very rare preservation is probably due to their extreme thinness and fragility, which led Dr. S. P. Woodward³ to surmise that they may have been membranous or horny. If that was the case, the great strength and solidity of the siphuncle compensated for the weakness of the shell and septa.

¹ It is difficult to find an explanation for this abnormal mode of growth, but it may be connected in some manner with the oblique position of the siphuncle in the shell, by which its development on one side has been retarded, or, again, it may have a pathological origin. I have only observed this peculiar malformation in one species of *Huronia* (*H. obliqua*, infra, p. 205), but it is met with also in *Discosorus* as already stated (*ante*; p. 195).

² *H. minuens*, Barrande, forms an exception to this rule, for in it the transverse diameter of the siphuncular segments greatly exceeds the vertical.

³ Manual of the Mollusca, 3rd ed. 1875, p. 191.

Remarks. I cannot pass by without comment the views of such a competent authority as Billings, upon the affinities of *Huronia*¹. He denied that the characters relied upon to separate *Huronia* from *Orthoceras* had any generic or even specific value, because he observed specimens in the Collection of the Geological Survey of Canada, which exhibited, as he conceived, "both turbinate and nummuloidal joints in the same individual." Now I think there can be no doubt that Billings encountered the same structure as that which is illustrated in fig. 28, but he failed to recognize that the two forms (the turbinate and the nummuloidal) do not exist apart, *i. e.* in different individual segments, but are combined in one and the same segment, as I have already described. The mistake probably arose from the study of specimens in which the dual character of the segments was not clearly shown.

Huronia was first described by Stokes (*loc. cit.*) as a Coral, and in this view of its affinities Dr. Bigsby shared; but upon further examination and comparison this impression was removed, when it was found how closely *Huronia* agreed in structure with *Actinoceras*.

We learn from Dr. S. P. Woodward (*loc. cit.* p. 192) that out of the numerous examples of *Huronia* collected on Drummond Island, only two showed any trace of septa or shell; the rest consisting of the siphuncle only. He adds that "some of those seen by Dr. Bigsby in the limestone cliffs were 6 feet in length."

Huronia had a comparatively brief duration in geological time, having been confined, so far as is known, to the Niagara epoch of the Silurian. It was limited in geographical range to the rocks of the Niagara Group in North America.

***Huronia Bigsbyi*, Stokes.**

1824. *Huronia Bigsbyi*, Stokes, Trans. Geol. Soc. ser. 2, vol. i. pt. ii. "Explanation of Plates," pl. xxviii. f. 1; and p. 203, Species ii. of Bigsby.
1851. *Huronia annulata*, Hall, in Rep. on the Geol. of the Lake Superior Land District, by Foster and Whitney, pt. ii. p. 221, pl. xxxiv. f. 4.
1870. *Huronia Bigsbyi*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, pp. 743, 757, pl. cccxxxvi. ff. 1-3.
1877. *Huronia Bigsbyi*, Barrande, *ibid.* vol. ii. Supplém. et Sér. tardive, pl. cccclxxiv. ff. 2-4.

Sp. Char. The only characters available for distinguishing the species of *Huronia* (except perhaps in one instance) are those which

¹ Geol. Surv. of Canada, Rep. of Progress, 1853-56, p. 323 *et seq.*

appertain to the shape and proportions of the siphuncular segments, nothing but fragments of the shell being known.

In the present species the lower two thirds of each segment is of a cylindrical form, slowly increasing in diameter and forming a more or less inflated rim at the top.

The latter occupies about $\frac{1}{3}$ of the height of the segment, and the ratio of the vertical to the transverse diameter is about as 17 : 19. As the specimens are all more or less imbedded in the matrix, it is very difficult to obtain accurate measurements. At the base of each segment there is a constriction which indicates the place of insertion of the septa, remains of which are here seen, and they are observed to be extremely thin and fragile. About six of the siphuncular segments are preserved in the specimen figured by Stokes. The measurements of the largest of these are:—vertical diameter 1 inch 8 lines; transverse diameter 1 inch 7 lines.

Remarks. In the specimens of this, and in fact of all the examples of *Huronia*, the shelly structures have been replaced by orbicular chalcedony ("beekite"), and the interspaces between the endosiphon and the walls of the siphuncle are often filled with chalcedony of the ordinary amorphous kind. This process of silicification has extended to all the fossils of the Niagara Group of Drummond Island, and generally throughout the Lake Huron region, and they have thus been preserved from the usual solvent agencies. The frequent absence of the shell and septa in *Huronia* can therefore only be accounted for on the supposition that those parts were broken to pieces immediately after the death of the animal, being too fragile to withstand the concussions to which dead shells are subjected on the sea-bottom.

Horizon. Niagara Group (Wenlock).

Locality. Drummond Island, Lake Huron.

Represented by a fine series of specimens, some of which were presented by Dr. J. J. Bigsby, F.R.S.

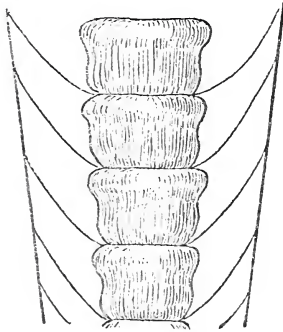
Huronia vertebralis, Stokes.

1824. *Huronia vertebralis*, Stokes, Trans. Geol. Soc. ser. 2, vol. i. pt. ii. "Explanation of Plates," pl. xxviii. ff. 2 & 6, and p. 202, Species i. of Bigsby.
1851. *Huronia vertebralis*, Hall, in Rep. on the Geol. of the Lake Superior Land District, by Foster and Whitney, pt. ii. p. 221, pl. xxxiv. f. 1.
1857. *Orthoceras Canadense*, Billings, Geol. Surv. of Canada, Rep. of Progress for the years 1853-56, p. 321.

1874. *Huronia vertebralis*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. p. 746, pl. cccxxi. ff. 6, 7, pl. cccxxxvi. ff. 5-7 (not pl. cccxxxv. ff. 1-3).

1875. *Huronia vertebralis*, Woodward, Manual of the Mollusca, 3rd ed. v. 192, ff. 56, a, b.

Fig. 30.



Huronia vertebralis.—From a specimen in the British Museum presented by Dr. Bigsby. The septa are added from Dr. Bigsby's drawing; they were only indicated in the specimen by "colourless lines on the brown limestone." (After S. P. Woodward¹.)

Sp. Char. The greatest diameter of each siphuncular segment is to the smallest in the ratio of 13 to 9, and they have an obliquity to the long axis of the shell of about 12°. The inflated rim at the top of the segment occupies about one half of the total height. The septa arch upwards very abruptly, as seen in Dr. Bigsby's figure, and the rate of tapering of the shell appears to have been rather rapid.

Remarks. This species differs from *H. Bigsbyi* in the proportions of its siphuncle, and consequently in the distance of its septa, the latter having been much wider apart in *H. Bigsbyi* than in this one. Of the septa nothing but fragments remain in any of the specimens in the National Collection, and these are preserved in the narrow fissures at the junction of the siphuncular elements where they have been protected from injury.

Horizon. Niagara Group (Wenlock).

Locality. Drummond Island, Lake Huron.

Represented by a large series of specimens, some of which were presented by Dr. J. J. Bigsby, F.R.S., and others were transferred from the Museum of Practical Geology.

¹ *Loc. cit.* p. 192, f. 56 a.

Huronia minuens, Barrande.

1870. *Huronia minuens*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 744, pl. cccxxxv. f. 4.

Sp. Char. The salient feature in this species, which distinguishes it from all others, is the great breadth of the siphuncular segments compared with their height, the latter measuring less than half of the former. A specimen in the British Museum gives the following measurements, viz. :—height of the segment (= distance between the septa) 9 lines; greatest breadth, measured at the base, 20 lines. At least two thirds of each segment is occupied by the swollen rim. Nothing remains of the septa.

Horizon. Niagara Group (Wenlock).

Locality. Drummond Island, Lake Huron.

Represented by two specimens, one of which was presented by Dr. J. J. Bigsby, F.R.S.

Huronia persiphonata, Billings, sp.

1857. *Orthoceras persiphonatum*, Billings, Geol. Surv. of Canada, Rep. of Progress for the years 1853–56, p. 329.

Sp. Char. “Elongate, large; siphon of great size, marginal; strongly annulated in the upper half or two thirds of each chamber, and cylindrical or but gradually expanded in the lower third; septa very thin and convex, distant six and a half lines on an average when the siphuncle has a diameter of one inch and a half.

“The annulations of the siphuncle are, in the two specimens examined, a little oblique, the ventral margin being nearest the aperture; a fragment of a siphuncle six inches and a half in length tapers from one inch and a half to one inch and a quarter, or at the rate of about half a line to the inch.

“This species differs from *O. canadense* [= *H. vertebralis*, Stokes] only in its more approximate septa, and appears to have been like that, an extremely long, tapering form, with very thin, fragile, exterior shell and septa.”

Remarks. The specimens representing this species consist of the siphuncle only in a very imperfect condition, but recognizable as belonging to Billings's species.

I am indebted to the kindness of my friend Mr. H. M. Ami, of the Geological Survey of Canada, for a sketch taken from one of the original specimens described by Billings. This has been of great assistance to me, more especially as the species was not figured by its author.

Horizon. Niagara Group (Wenlock).

Locality. Drummond Island, Lake Huron.

Represented by two specimens, one presented by Dr. J. J. Bigsby, F.R.S., the other transferred from the Museum of Practical Geology.

Huronia obliqua, Stokes.

1824. *Huronia obliqua*, Stokes, Trans. Geol. Soc. ser. 2, vol. i. pt. ii. explanation of pl. xxviii. f. 4; and p. 203, Species iv. of Bigsby.

1840. *Huronia*, sp., Stokes, Trans. Geol. Soc. ser. 2, vol. v. pt. iii. p. 710, pl. lx. f. 3.

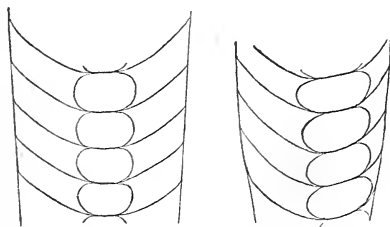
1866. *Orthoceras (Huronia)*, sp., Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 743, pl. cxxxii. f. 3 (after Stokes, *loc. cit.*).

Sp. Char. Of this species the siphuncle only is known, though in several examples fragments of the septa are attached to it, and infold each segment up to the point where the most inflated part begins, from whence they arched upwards to the shell-wall.

The most marked feature in this species is the obliquity of the siphuncular segments to the vertical axis¹. A very peculiar structure, to which attention has already been directed, is also observable in the segments, viz. for about half their contour they have a subturbinate form, which viewed in profile may be aptly compared with the figure known in architecture as an ogee, or sigmoid moulding; but in the other half they have a subglobular form. This singular asymmetry is best seen in a vertical section passing exactly through the centre of each of the two components of the segment, and the difference in their outline is then very plainly demonstrated. (Fig. 28.)

¹ This is seen also in *Actinoceras*, and is plainly attributable to the eccentric position of the siphuncle, whose elements, lying between the septa where these

Fig. 31.



slope upwards to the shell-wall, are thus deflected from the horizontal position. The accompanying figures illustrate these two positions of the siphuncle.

Remarks. The specimen that best represents this species in the Collection (Stokes's type) consists of about seven segments of the siphuncle, varying but little in vertical diameter, and thus indicating a correspondingly slow increase in the distance of the septa from each other. The segment at the smaller extremity has a vertical diameter of about six lines, while the greatest transverse diameter is about thirteen. The rate of tapering is slow; it may be roughly estimated at about 1 in 18. About two thirds of the specimen is imbedded in the limestone matrix, that part of the segments exposed being of a subturbinate form, expanding very rapidly and regularly from the base, the diameter of the latter not exceeding 8 lines, while that of the expanded portion above measures 13 lines. The endosiphon is well seen in the vertical section, fig. 28. All the specimens are silicified.

Horizon. Niagara Group (Wenlock).

Locality. Drummond Island, Lake Huron.

Represented in the Collection by two specimens figured by Stokes, including the type of the species, besides several other examples, one of which was presented by the late Sir W. E. Logan, F.R.S.

Huronia turbinata, Stokes.

1824. *Huronia turbinata*, Stokes, Trans. Geol. Soc. ser. 2, vol. i. pt. ii. explanation of pl. xxviii. f. 3; and p. 203, Species iii. of Bigsby.

1874. *Huronia Romingeri*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. p. 758, and Suppl. 1877, pl. cccclxxiv. ff. 5, 6.

Sp. Char. Bigsby's description, though brief, expresses the salient features of the species, which is only represented by about six segments of the siphuncle. It runs thus:—"In this species, which is the smallest I have met with, the column tapers more rapidly, the upper part of each joint is more enlarged, and is greater in proportion to the rest of the joint, than in the two foregoing species" [*H. Bigsbyi* and *H. vertebralis*].

The rate of tapering cannot be accurately determined, owing to the greater part of the specimen being imbedded in the rock, but it may be taken at about 1 in 8.

Remarks. Barrande has figured a specimen under the name of *Huronia Romingeri*¹, which I am unable to separate from the present species. It consists of a fragment composed of two of the segments of the siphuncle, one of which only is perfect. This is described by Barrande as showing a small longitudinal canal (the endosiphon)

¹ After Dr. Carl Rominger, the State Geologist of Michigan.

and traces of a plicated membrane in the interior. The fragment was collected at Point Detour, Michigan, upon the horizon of the Niagara Formation.

Horizon. Niagara Group (Wenlock).

Locality. Drummond Island, Lake Huron.

Represented by the type specimen figured by Stokes, which was transferred to the National Collection from the Museum of Practical Geology.

Huronia distincta, Barrande.

1840. *Huronia*, sp., Stokes, Trans. Geol. Soc. ser. 2, vol. v. p. 710, pl. lx. f. 2.

1866. *Huronia distincta*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 745, pl. ccxxxi. f. 2 (after Stokes).

Sp. Char. This species was described by Barrande from Stokes's figure. The type specimen consists of four complete siphuncular segments and part of another; these have been cut longitudinally. The centre is partly filled with chalcedony which has interfered very much with the structure, though the endosiphon and some of its canals can be obscurely made out. The rate of increase of this fragment is only 1 in 24. *H. distincta* differs from *H. vertebralis*, its nearest ally, in the greater breadth of the siphuncular segments in proportion to their height. Their inflated rims are also less prominent than those of *H. vertebralis*.

Horizon. Niagara Group (Wenlock).

Locality. Drummond Island, Lake Huron.

The Collection contains the type specimen figured by Stokes.

Genus **SACTOCERAS**, Hyatt¹.

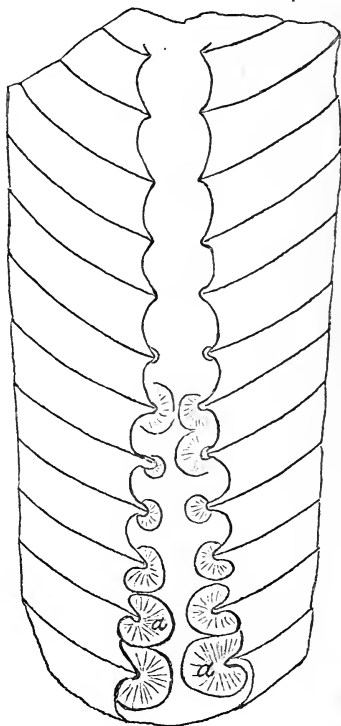
Gen. Char. The peculiar character of this genus consists in the changes which the siphuncle passes through during the growth of the shell. Commencing with a nummuloidal siphuncle, like that of *Actinoceras*, it gradually loses this character and becomes cylindrical, or only very slightly inflated, and comparatively narrow. Nor is this all, for the deposits upon the necks of the septa (anneaux obstrueteurs of Barrande, — *a, a*, in the figure), which are so completely developed in the earlier portions of the shell as to meet in the centre of the siphuncle, die out, leaving the siphuncular cavity empty. This remarkable diminution in the size of the siphuncle in *Sactoceras* is regarded by Prof. Hyatt (*loc. cit.* p. 274) as “a

¹ Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 273.

degradational senile shrinkage"; Barrande, on the other hand, considered it as indicating a reversion to the more simple, cylindrical structure of the siphuncle in the Orthoceratidæ.

The species selected by Hyatt as the type of his genus is the *Orthoceras Richteri* of Barrande¹.

Fig. 32.



Longitudinal section of *Sactoceras docens*, Barrande, sp. (Bull. Soc. Géol. de France, sér. 2, tom. xii. p. 453, pl. xii. A. f. 2).

Sactoceras docens, Barrande, sp.

1855. *Orthoceras docens*, Barrande, Bull. Soc. Géol. de France, sér. 2, tom. xii. p. 453, pl. xii. A. ff. 2, 3.

1868. *Orthoceras docens*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 632, pl. ccl.

¹ Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 570, pl. cccxviii., pl. cccxxii., pl. cccxxiii., pl. cccxlix.

Sp. Char. Shell straight. Section slightly elliptical. Rate of increase about 1 in 8. Septa not very wide apart, being about 4 lines distant from each other where the shell has a diameter of 2 inches.

In a specimen having the following measurements, viz. length $3\frac{1}{2}$ inches, least diameter $1\frac{1}{2}$ inch, and greatest $1\frac{5}{8}$ inch, the diameter of the siphuncle (at the necks of the septa) is 5 lines at the smaller end of the shell, and 3 lines at the larger end.

The deposits around the necks (*anneaux obstrucateurs*), which are at first strongly developed, gradually die out towards the body-chamber (see fig. 32).

The surface of the shell appears to have been destitute of ornamentation according to M. Barrande's observations, but he surmises that the shell he examined may have lost its external layer.

Remarks. "The form of the elements of the siphuncle is very remarkable, for it exhibits a considerable diminution in their diameter, up to a certain height, corresponding to a certain period in the life of the animal, and to a height in the shell of about 40 mm. They are at first nummuloidal and considerably flattened at the smaller end, whilst they appear to be almost cylindrical at the larger extremity. This modification is not accidental, nor is it the result of disease, for we find it persistent in about ten specimens, of which we have the longitudinal sections before us. The fact of this decrease in the siphuncle, inversely to the growth of the shell, is therefore well established in *Orthoceras docens*. As we have just stated, at the smaller end of our examples the elements of the siphuncle are nummuloidal and flattened. Their breadth is to their height as 7 : 2, which indicates a considerable flattening. From this maximum of breadth a gradual reduction takes place from below upwards in the space of from five to six air-chambers, constituting the region of decrease which we have just described. Here the siphuncle is reduced to a mean width of about 9 mm. (observed in all the specimens), representing a little less than half the maximum width, which amounts to 20 mm.

"In consequence of this diminution the siphuncle presents a conical appearance in the region under description. Above this the elements of the siphuncle still retain a slightly inflated form and resemble slightly flattened spheroids, of which the width scarcely exceeds the height. They otherwise preserve about the same dimensions, in ascending towards the larger end of our specimens, where probably the limits of the air-chambers are reached.

"The maximum width of the siphuncle, 20 mm., represents half of that of the shell at the smaller end of our fossils. On the other hand, at the larger extremity the reduced siphuncle does not occupy more than $\frac{1}{6}$ of the corresponding diameter, which reaches 54 mm." (*Barrande.*)

In his list of synonymy of *S. docens*, M. Barrande places *A. nummularium*, Sow., sp., at the same time, however, expressing the opinion that in the absence of any evidence of a decrease in the diameter of the siphuncle of the latter it would be injudicious to unite the two species.

Horizon. Étage E, bande e 2 (= Salopian).

Locality. Dworetz, Bohemia.

Well represented in the Collection, which includes one of the specimens (fig. 3) figured by Barrande in the 'Bull. Soc. Géol. de France,' cited above.

Family GOMPHOCERATIDÆ.

[EQUILOBATES¹.]

Genus **GOMPHOCERAS**, J. de Carle Sowerby², emend. Hyatt³.

(*Phragmoceras*, J. de C. Sowerby, 1839⁴ (partim); *Dimorion*, Barrande, 1867⁵; *Dimeres*, Barrande, 1867⁶.)

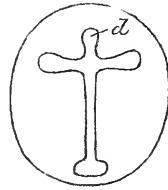
Gen. Char. The shell ranges from an approximately straight form, in relation to the main axis, through varying degrees of cur-

¹ Hyatt (Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 277) has divided the *Gomphoceratidæ* into two groups, viz. :—EQUILOBATES and INEQUILOBATES; in the former the dorsal orifice of the aperture has a median saddle, and therefore an equal number of lateral lobes, while in the latter, instead of the median saddle, there is an unpaired dorsal sinus. The accompanying figures will make this clear :—

Fig. 33.



Equilobates type.
m. Median saddle.



Inequilobates type.
d. Dorsal sinus.

² Murchison's Sil. Syst. pt. ii. 1839, p. 620.

The following names have been applied by various authors to fossils belonging to the genera *Gomphoceras* and *Phragmoceras*, as originally constituted :—*Orthocera*, Sowerby (Min. Conch. vol. iii. 1821, p. 85, tab. cexlvii.); *Campulites*, Deshayes (partim), (Encyclop. Méthodique, tom. iii. 1832, p. 675); *Nautilus*?, Hisinger (Lethæa Svecica, 1837, p. 27, pl. vii. f. 1); *Orthoceratites*, Münster (Beiträge zur Petrefactenkunde, 1840, Heft iii. p. 103, Taf. xx. f. 10); *Bolboceras*, *Apioceras*, Fischer (Bull. Soc. Imp. des Nat. de Moscou, tom. xvii. no. 3, p. 779); *Orthoceratites Inflat*i, Quenstedt (Petrefactenkunde Deutschlands, 1849, Abth. i. Band i. Die Ceph. p. 45); *Sycoceras*, Pictet (partim) (Traité de Paléont. 2nd ed. 1854, tom. ii. p. 645).

³ Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 277.

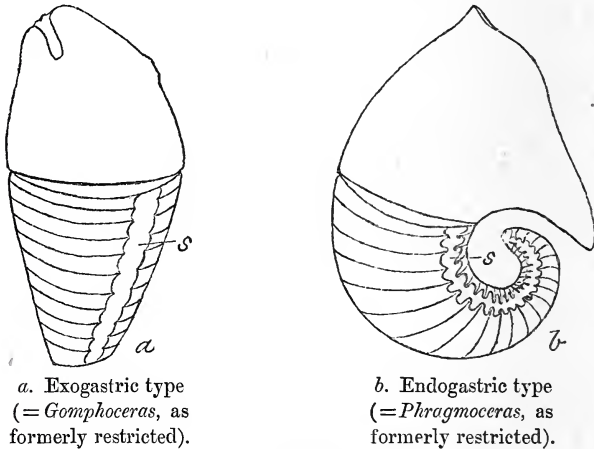
⁴ Murchison's Sil. Syst. pt. ii. 1839, p. 621.

⁵ Syst. Sil. de la Bohême, vol. ii. pt. i. p. 265.

⁶ Ibid. p. 203.

vature, to one in which a complete whorl is attained. The curved forms are those which were formerly set apart to constitute the genus *Phragmoceras*. In the straighter forms the ventral side, or that upon which the siphuncle is situated (corresponding with the smaller apertural orifice), is always more convex than the dorsal. In the curved forms, on the other hand, the dorsal side (corresponding with the larger apertural orifice) is convex, the curvature in fact being reversed in the two cases, as may be seen in the diagrams *a*, *b*, fig. 34.

Fig. 34.



a. Exogastric type
(= *Gomphoceras*, as
formerly restricted).

b. Endogastric type
(= *Phragmoceras*, as
formerly restricted).

Siphuncle.

For these two types the terms "exogastric" and "endogastric," proposed by Saemann¹ will be useful. The former implies that the siphuncle lies near the convex side of the shell, and the latter that it is near the concave side. The straighter (exogastric) forms vary considerably in their outline, according as they are more or less inflated; so that they may be pear-shaped, amphora-shaped, or barrel-shaped, *i. e.* as viewed ventrally or dorsally, because the lateral outline is modified by the greater convexity of the one side in comparison with the other.

In the more curved (endogastric) forms the increase in diameter is more rapid, though there is always a slight diminution towards the aperture. The shell commences with a pointed, more or less attenuated apex, and the initial point is described by Barrande

¹ Palæontographica, 1854, Band iii. p. 139; also Barrande, *loc. cit.* p. 262.

(*loc. cit.* p. 198, pl. ccxlv. ff. 6-12) as being rounded, and covered with a cap (*calotte*), which is sometimes smooth, as in *Gomphoceras* [*Phragm.*] *Broderipi* (pls. lvii., lix.) and *Gomphoceras* [*Phragm.*] *perversum* (pl. c.), and sometimes ornamented with fine concentric striæ, as in *Gomphoceras* [*Phragm.*] *imbricatum* (pl. ccxlv.). In the last two species there is a small cicatrix at the apex, where the siphuncle appears to terminate.

The T-shaped aperture may have its larger orifice widely expanded (*Gomphoceras ferum*, Barr., *loc. cit.* pl. lxxx. f. 21), or it may be contracted in the middle and expanded at both ends (*Gomphoceras tumescens*, Barr., pl. lxxxi.).

The channel connecting this orifice with the smaller (ventral) one varies considerably in length in different species, and may be reduced almost to zero. The smaller orifice, which is supposed to have given vent to the respiratory funnel, is sometimes merely an ovate expansion of the channel, or it may be distinctly bilobed, thus repeating on a smaller scale the shape of the larger orifice.

The body-chamber is large in comparison with the septate part of the shell; it is frequently crenulated at the base. The siphuncle varies from a submarginal to a nearly central position, and is often inflated between the septa. In the endogastric forms it is often filled with radiating calcareous deposits, the centre being sometimes found to be occupied by a canal (? endosiphon) which is filled with the matrix in which the fossil was imbedded¹. The septa are approximate and direct.

Remarks. The great development of the *Gomphoceratidæ* in the Bohemian Basin enabled Barrande to observe the very considerable range of variation which the group passes through, and which could hardly have been suspected from its comparatively meagre representation in the British rocks.

Finding it convenient to subdivide the many species coming under his notice, Barrande selected as the basis for his subdivisions the characters of the aperture, and still retaining the old groups *Gomphoceras* and *Phragmoceras*, he constructed a table under each of these, in which the species are grouped according to the number of lobes in the aperture, the names chosen for them indicating these numbers, such as, *e. g.*, Dimorion, Dimeres, Tetramorion, Tetrameris, &c. &c. These groups he regarded as of subgeneric rank, but Hyatt² has erected some of them into genera, slightly altering the terminations of Barrande's names to suit their extended

¹ Barrande, *loc. cit.* pl. liv. f. 9, pl. lxxxiii. ff. 12, 140.

² *Loc. cit.*

significance. I have adopted Hyatt's genera, because I believe that the characters of the aperture are of much higher importance in classification than the amount, or even the direction, of the curvature of the shell.

The following observations by Barrande regarding the contraction of the aperture met with in *Gomphoceras* and other genera (such as *Hercoceras* [*Gyroceras*] *alatum*, Barr., sp., and *Hercoceras* [*Trochoceras*] *flexum*, Barr., sp.) are so interesting and suggestive that I give here a translation of them:—"The appearance," he says, "of the contraction of the aperture in *Phragmoceras*, *Gomphoceras*, and some other genera, makes it difficult, at first sight, to imagine how the mollusk could have constructed its shell. It seems to us that this difficulty vanishes on studying the figures on our Plate 241, showing sections of different individuals of *Hercoceras mirum*. These sections show clear marks of the reconstruction of the external (ventral) area of the test, and of the absorption of the internal (dorsal) area, so that the mollusk, though apparently walled into its shell by a transverse diagram, could, nevertheless, gradually develop itself and lengthen its spire, like those Nautilids in which the aperture is quite open.

"By the application of the same process of reconstruction and absorption of the test, the shells of *Phragmoceras*, *Gomphoceras*, &c. &c., may have been constructed and successively augmented at the larger extremity, during the growth of the mollusk. It would therefore be needless to refer to the views of certain observers, who have supposed that the shells of *Phragmoceras* and other analogous types had a simple and widely expanded aperture, during the whole of the period of growth of each individual, and that the aperture became contracted only at the adult age. It should also be noted that in every species we find individuals of very different size, but all presenting an equally contracted aperture, conforming to the structure proper to each specific type."

Remarks. This genus is recorded as having a range extending from the Ordovician to the Carboniferous; but the species occurring in the rocks below the Silurian, owing to their imperfect condition, must be looked upon with great suspicion, while those above that horizon belong apparently to other genera.

Beginning with the Ordovician, we find that Dr. Ferdinand Roemer¹ has described and figured a curved and rapidly expanding

¹ Die Foss. Fauna der Silur. Diluvial-Gesch. von Sadewitz, 1861, p. 61, Taf. vi. ff. 4, a, b.

shell under the name of *Phragmoceras rectiseptatum*, of which only the septate part of the shell (with the siphuncle) is known, neither body-chamber nor test being preserved. There is therefore nothing to show that this species has any affinities with the present genus. Blake has more recently described a species under the name of *Phragmoceras prius*, from the Bala Beds of Rhiwlas, Bala. The type specimen of this species is contained in the Museum of Practical Geology; and I am indebted to the kindness of Mr. E. T. Newton, F.G.S., for the opportunity of thoroughly examining it. The specimen is a cast of the body-chamber with several of the septa attached. The surface is much worn and pitted, and a small mass of rock almost entirely covers the region of the aperture, so that the latter cannot with any degree of certainty be made out. There is an obscure groove of a rudely rounded form in the situation in which in an endogastric form of *Gomphoceras* the larger apertural orifice would be found, and this is the only character from which the generic affinities of the fossil might be deduced. It appears to me therefore that conclusive evidence is yet wanting of the occurrence of the present genus *below* the Silurian. *Above*, that is to say in the Devonian, the following species have been described, viz.:—*Phragmoceras Brateri*, Münst.¹, *Orthoceratites* (*Gomphoceras*?) *subfusiformis*, Münst.², *O. (G.?) subpyriformis*, Münst.³, *G. sulcatulum*, Murch., de Vern., and de Keyserl.⁴ In none of these species does the aperture appear to be known, hence their affinities can only be conjectured. Their general form, however, would lead to the supposition that they belong to the genus *Poterioceras*. The species named by Saemann *Apioceras olla* has been taken by Hyatt as the type of his new genus *Acleistoceras*⁵ (Fam. Gomphoceratidæ); and *Phragmoceratites subventricosus*, d'Archiac and de Vern., is placed by Hyatt in his genus *Ooceras* (Fam. Cyrtoceratidæ). The Carboniferous species (such as *Orthoceras fusiforme*, Sow., *O. cordiforme*, Sow.⁶) hitherto referred to *Gomphoceras* (or to *Phragmoceras*) will now fall into *Poterioceras*.

The genus *Gomphoceras* may thus be regarded, according to our present knowledge of it, as restricted to the Silurian epoch.

¹ Beiträge zur Petrefactenkunde, Heft iii. 1840, p. 105, Taf. i. ff. 10, a, b, c.

² *Loc. cit.* p. 103, Taf. xx. ff. 6, 7.

³ *Loc. cit.* p. 103, Taf. xx. f. 10.

⁴ Géol. de la Russie d'Europe, vol. ii. Paléont. p. 357, pl. xxv. f. 6.

⁵ *Loc. cit.* p. 277.

⁶ Min. Conch. vol. iii. tab. cexlvii., vol. vi. tab. dlxxxviii. f. 1 (not f. 2).

SILURIAN SPECIES.

a. *Exogastric*.**Gomphoceras cinctum**, Blake.

1882. *Gomphoceras cinctum*, Blake, British Foss. Ceph. pt. i. p. 197, pl. xxiii. ff. 5, 5 a.

Sp. Char. "Section elliptic; diameters in the ratio of 16 to 13. General outline straight with little convexity, like two cones with their bases opposed. The septate portion increases in its long diameter at the rate of 1 in 2. The greatest thickness is at the last septum, from which the body-chamber contracts again at the rate of 2 in 3. There is a constriction at the base of the body-chamber and another round the aperture, which is not well shown, but the dorsal opening of which appears to have a simple elliptic outline. Septal characters not seen." (*Blake*.)

Remarks. The above description is that of the type specimen, which, as may be seen, is in a very imperfect condition. Other specimens show that the septa are but slightly convex and are distant from each other $\frac{1}{4}$ the greatest diameter of the shell. The siphuncle is not more than $\frac{1}{4}$ the diameter from the ventral side. Prof. Blake considers that this species "approaches *G. microstoma*, Barrande, but there is no reason to believe that the ellipticity of our species is due to compression, as they are found with the same characters in different localities."

Horizon. Lower Ludlow.

Locality. Ludlow, Shropshire.

Represented by the type specimen, figured by Blake.

Gomphoceras crater, Blake.

1882. *Gomphoceras crater*, Blake, British Foss. Ceph. pt. i. p. 189, pl. xxiii. ff. 4, 4 a, 4 b, 8, 8 a.

Sp. Char. "Section circular; the general direction of the shell straight. The body-chamber, which alone is preserved, has straight sides, so that it forms a cone. Its length is $\frac{2}{3}$ the basal diameter. The aperture has the dorsal opening on the apex, which is transversely elliptic, with axes in the ratio of 3 to 2. The passage and ventral opening are not distinct, but form, as it were, a long lobe, which slopes down the ventral side. The whole is separated from

the body-chamber by a constriction. The septa have a considerable convexity, $\frac{1}{4}$ the diameter. The sutures are direct, and the siphuncle $\frac{1}{4}$ the diameter from the ventral edge." . . . (*Blake.*)

Remarks. The above is the description of the type specimen, and to this may be added the following particulars:—"The section is very often elliptic; but it is presumed that this is due to compression, as the inequality of the axes is never very great, and the longer one is always in the plane of symmetry. The body-chamber is the only part that has been preserved in any examples. . . . The shell was thick, and had rough transverse annulations and lines of growth. The septa are very convex, up to $\frac{4}{15}$ of the diameter. The siphuncle is $\frac{1}{4}$ of the diameter from the edge, and is bulbous. The type is as large as any that are found." (*Blake.*)

Remarks. Blake compares *G. crater* with *G. decurtatum*, and *G. microstoma* of Barrande, but he observes that these differ from his species "in the details of the aperture and the less convexity of the septa."

Horizon. Wenlock.

Locality. Dudley, Worcestershire.

Represented by two very imperfect specimens.

Gomphoceras ellipticum, M'Coy, sp.

1839. *Orthoceras pyriforme*, J. de C. Sowerby, in Murchison's 'Silurian System,' pt. ii. p. 620, pl. viii. ff. 19 (lower fig. only), 20.
- ? 1847. *Gomphoceras ovum*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. d. Naturwiss. in Wien, Band iii. p. 269.
1851. *Poterioceras ellipticum*, M'Coy, Ann. Mag. Nat. Hist. ser. 2, vol. vii. p. 45.
1852. *Orthoceras (Poterioceras) ellipticum*, M'Coy, British Pal. Foss. fasc. ii. p. 321.
1854. *Phragmoceras pyriforme*, Morris, Cat. of British Foss. 2nd ed. p. 312.
- ? 1867. *Gomphoceras ovum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 295, pl. lxxv. ff. 10-12, pl. lxxxiv., pl. cv. ff. 12-14.
1867. *Gomphoceras pyriforme*, Dixon, 'Woolhope Nat. Field Club,' Fossil Sketches, No. 1, f. 4, p. 136.
1882. *Gomphoceras ellipticum*, Blake, British Foss. Ceph. pt. i. p. 190, pl. xxii. ff. 1, 1 a, 4.

Sp. Char. "Elliptical, last chamber conoidal; greatest width at last septum, from whence the chambered and unchambered portions taper elliptically to the contracted mouth and attenuated extremity; septa nearly horizontal, the last three or four about two lines and a

half apart: greatest width of last chamber (at septum) two inches three lines, length of last chamber two inches four and a half lines.

“There are clearly two species confounded by Sowerby in the Sil. Syst. under the name *Orthoceras pyriforme*; the difference in form he supposed to be produced by the direction of pressure, but I find it to be constant in perfectly uncrushed specimens. To that represented by his upper figure I would restrict his specific name *pyriforme*.” (*M' Coy.*)

Remarks. To the present species I have referred an imperfect specimen in which the larger orifice is remarkably short transversely, agreeing in this and in other respects with Sowerby's type, as figured by Blake.

Horizon. Lower Ludlow. Étage E (=Salopian).

Localities. *British.* Herefordshire.—*Foreign.* Lochkow, Kosorž, Wiskočilka, Bohemia.

Represented by a single British example and a few Bohemian ones.

Gomphoceras Agassizi, Barrande.

1847. *Gomphoceras Agassizi*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. d. Naturwiss. in Wien, Band iii. p. 269.

1867. *Gomphoceras Agassizi*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 269, pl. lxxxviii. ff. 1-8.

Sp. Char. The shell presents the usual convexity on the ventral side, while on the dorsal it is nearly straight. The transverse section is almost circular, in specimens which have not been subjected to compression. The body-chamber is flattened in a direction parallel to the longer diameter of the large orifice of the aperture. This flattening gives a very distinctly subtriangular form to this region. The body-chamber occupies at least half of the total length of the shell, and its capacity exceeds that of the septate part of the latter. The aperture is nearly parallel to the plane of the last septum; the larger orifice is very wide and has the form of an ellipse of which the two axes are in the ratio of 1 : 2. Its greatest width equals $\frac{3}{4}$ of the diameter of the body-chamber; its dorsal border is almost straight or but very slightly sinuous in the centre. The channel uniting the larger with the smaller orifice is extremely short; the latter is circular, and its borders project slightly above the surface of the body-chamber. The distance between the septa does not exceed $\frac{1}{8}$ the diameter of the shell. Their convexity amounts to $\frac{1}{6}$ of that diameter. The siphuncle is situated in the median line about midway between the dorsal margin and the

centre; its elements appear to be nummuloidal or flattened. The surface of the shell is ornamented with prominent transverse plications or rings, which are only developed in the upper two thirds of the shell; three of them are much stronger and more prominent than the rest; these may be situated either at the base of the body-chamber, or near to it in the septate portion of the shell. The whole of the test, including the plications, is covered with fine lines which run parallel with the coarser ornaments. It should be observed that in this species, contrary to the general rule, the sinus of the ornaments is situated on the side farthest from the siphuncle.

Remarks. The three large plications, the large size of the principal orifice of the aperture, and the position of the siphuncle are the characters which distinguish this species. M. Barrande observes that *G. Agassizi* is a rare species.

Horizon. Étage E (=Salopian).

Locality. Dvoretz, Bohemia.

Represented in the Collection by a few imperfect examples.

Gomphoceras amphora, Barrande.

1847. *Gomphoceras amphora*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. d. Naturwiss. in Wien, Band iii. p. 269.

1867. *Gomphoceras amphora*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 272, pl. lxxviii. ff. 10-15, pl. civ. ff. 15-17.

Sp. Char. This species is distinguished by the inflated form of the body-chamber. The outline of the ventral side is strongly convex, while that of the dorsal is only very slightly so. The transverse section is nearly circular, though there is a slight difference between the two diameters in some specimens, the ventro-dorsal being in such cases in the ratio of 20 : 21 to the transverse diameter. The body-chamber occupies at least $\frac{1}{3}$ of the total length of the shell, and exceeds the septate part in bulk. The aperture is characterized by its great length, by reason of which the larger orifice opens upon the dorsal aspect of the body-chamber, instead of upon its apex. This feature is not so strongly developed in young examples. The smaller orifice is united by a very narrow channel with the larger one, and extends nearly halfway down the ventral (convex) side of the body-chamber. The distance between the septa, near the body-chamber, amounts to about $\frac{1}{10}$ of the diameter of the shell; their convexity equals $\frac{1}{7}$ that diameter. The siphuncle is situated midway between the ventral margin and the centre; its elements are nummuloidal, their transverse diameter is to their vertical as 5 : 2, their maximum width representing $\frac{1}{7}$ the corre-

sponding diameter. The surface of the test bears only striæ of growth, which appear to be lamellose.

Horizon. Étage E (=Salopian).

Locality. Lochkow, Bohemia.

Fairly well represented in the Collection.

Gomphoceras amygdala, Barrande.

1847. *Gomphoceras amygdala*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. d. Naturwiss. in Wien, Band iii. p. 269.

1867. *Gomphoceras amygdala*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 273, pl. lxxvii. ff. 23-26, pl. lxxx. ff. 1-17.

1882. *Gomphoceras amygdala*, Blake, British Foss. Ceph. pt. i. p. 198, pl. xxv. ff. 4, 4 a, 4 b, ? pl. xxiii. ff. 7, 7 a.

Sp. Char. In all the specimens of this species one notices at once a very marked difference between the dorsal and ventral borders, the former being nearly straight, while the latter has a very considerable degree of convexity. This curvature in the outline extends to the body-chamber. The transverse section is an ellipse, the ratio of the two diameters of which is as 5 : 6. In some examples the section approaches a little more to a circular form, especially towards the smaller extremity of the fossil. The body-chamber occupies about $\frac{1}{3}$ of the total length of the shell, and in bulk it exceeds by more than one half the septate part of the latter. The larger orifice of the aperture (whose longer diameter corresponds with that of the shell) is contracted by the raised dorsal border, but it is not recurved; its breadth is equal to about $\frac{2}{3}$ of the transverse diameter. The small orifice is circular and is situated at a slightly lower level than the larger one; it does not project at all beyond the ventral side. The distance between the septa is somewhat variable in different examples, ranging from $\frac{1}{5}$ to $\frac{1}{1\frac{1}{2}}$ of the diameter of the shell. The siphuncle is situated near the ventral border, about $\frac{1}{5}$ the distance across the ventro-dorsal diameter; its elements are slightly inflated. The surface of the test has irregular striæ of growth upon it.

Remarks. Prof. Blake has identified this species from the Lower Ludlow of Ledbury, but he observes that "there is not an absolute agreement between our forms and the Bohemian, but the differences appear to be within the range of what may be called varietal."

Horizon. Étage E (=Salopian).

Locality. Karlstein, Bohemia.

Fairly well represented in the Collection.

Gomphoceras cylindricum, Barrande.

1847. *Gomphoceras cylindricum*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. d. Naturwiss. in Wien, Band iii. p. 269.

1867. *Gomphoceras cylindricum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 309, pl. lxxix.

Sp. Char. This species is small. The transverse section is generally circular in the septate part of the shell, but flattened a little in the body-chamber, in some specimens. The body-chamber occupies in some examples $\frac{1}{3}$, in others $\frac{2}{5}$ of the total length of the shell. The aperture, which is very distinctly T-shaped, is a little inclined towards the ventral side. The larger orifice is very narrow and curved in conformity with the contour of the shell; it is scarcely perceptibly lobed. The channel connecting it with the smaller orifice is long and very narrow. The greatest distance between the septa equals about $\frac{1}{7}$ of the shell-diameter; they are perfectly horizontal. The siphuncle is situated about midway between the ventral margin and the centre; its elements are cylindrical, and the width is to the height as 2:3. The test is covered with very fine, close-set, somewhat irregular striæ of growth, which have a slight concave inflexion at the extremity of the smaller orifice, caused by the projecting lobe of the latter.

Remarks. This species may be recognized by its small size, cylindrical form, and extremely contracted aperture.

Horizon. Étage E (=Salopian).

Locality. Dlauha Hora, Lochkow, Bohemia.

Well represented in the Collection.

Gomphoceras incola, Barrande.

1867. *Gomphoceras incola*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 313, pl. lxxviii. ff. 9-19, pl. lxxxi. ff. 7, 8, ? pl. xcii. f. 15.

Sp. Char. The shell in this species has a very distinct curvature on the ventral side, while upon the dorsal it is only very slightly convex, and often appears quite straight. The transverse section is circular, but it is noticeable that in this species, as also in the greater part of its congeners, the dorsal side is flattened at the aperture, although the section in the septate part of the shell may be circular. The body-chamber appears to occupy about $\frac{1}{3}$ or $\frac{2}{5}$ of the length and more than half of the total bulk of the shell. The aperture is a little inclined in relation to the vertical axis, and its larger orifice is much elevated and extended laterally. Both this

and the smaller orifice, together with the channel connecting them, are greatly contracted. The larger orifice is slightly arcuate, and the lobes at either extremity of it are but very little expanded. The distance between the septa does not exceed $\frac{1}{3}$ of the diameter of the shell; they are, however, very strongly convex, particularly in specimens which have not attained adult age; the convexity equals sometimes $\frac{1}{3}$ the diameter of the shell. The siphuncle is situated in the median line between the ventral margin and the centre, a little nearer to the former than to the latter. It is for the most part cylindrical, but tends to become inflated in the vicinity of the body-chamber. The test has no other ornamentation than lines of growth, more or less distinct, but somewhat irregularly spaced.

Horizon. Étage E (=Salopian).

Localities. Kosořz, Lochkow, Bohemia.

Fairly well represented in the Collection.

Gomphoceras perversum, Barrande, sp.

1854. *Phragmoceras perversum*, Barrande, Leonhard and Bronn's Jahrb. Heft i. p. 10.

1867. *Phragmoceras perversum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 241, pl. liii. ff. 1-33 (pl. c., vars. *subrecta* and *falciformis*).

Sp. Char. This small species varies much in the degree of its curvature, some examples being very strongly curved, whilst others are scarcely bent at all. Barrande has separated two varieties from the species, under the names of

Var. *subrecta* slightly curved.

Var. *falciformis* much curved.

The transverse section is oval or suboval, the ratio of the two diameters being as 7:6. The rate of increase, computed from one of the straighter examples, is 1 in $4\frac{1}{2}$. The body-chamber varies very much in its relative size, being sometimes $\frac{3}{5}$, sometimes only $\frac{2}{5}$ of the total length of the shell. The aperture presents a great diversity of form, the larger orifice sometimes projecting to such an extent as to overhang considerably the shell-border, or it may scarcely project at all. The whole of the aperture, including the two orifices with the channel connecting them, is raised considerably above the surface of the shell. The larger orifice is semicircular, and connected by a narrow channel with the smaller one, which is formed by a very slight expansion of the channel. The septa are very close together, their mean distance amounting to about $\frac{1}{8}$ the ventro-dorsal diameter. The siphuncle is situated very near to the ventral

border, but without coming in contact with the test. The latter is ornamented with fine transverse lines which conform to the curvature of the shell, and these are crossed by very fine longitudinal lines.

Remarks. Barrande observes that this species is remarkable amongst the Bohemian Cephalopods for the variations which it exhibits in almost all the elements of its shell—in the curvature, length of body-chamber, form of aperture, form of the elements of the siphuncle, &c.

Horizon. Étage E (=Salopian).

Localities. Hinter Kopanina, Kosořz, Lochkow, Bohemia.

Represented in the Collection by three examples.

Gomphoceras rigidum, Barrande.

1847. *Gomphoceras rigidum*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. d. Naturwiss. in Wien, Band iii. p. 269.

1867. *Gomphoceras rigidum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 326, pl. lxxxiii. ff. 10-14.

1877. *Gomphoceras rigidum*, Barrande, *ibid.* Suppl. p. 193, pl. dxv. ff. 24-27.

Sp. Char. Shell straight, excepting that there is a slight inflation in the body-chamber in the region of the smaller orifice. The transverse section is circular. The rate of increase in the septate part of the shell is variable; in one specimen measured it is 2 in 3, in another 1 in 3. The body-chamber is of medium size, and may be computed to have occupied about $\frac{1}{4}$ of the total length of the shell. The aperture is T-shaped; the small orifice is oval and leads by a very short channel into the larger orifice, which is of a sub-elliptical form; the whole aperture is distinctly raised above the surface of the body-chamber. The distance between the septa is somewhat irregular; but it amounts on an average to about $\frac{1}{7}$ the diameter of the shell. The siphuncle is situated at a little distance from the centre, towards the ventral or convex margin; its elements are spheroids, of which the width is to the height as 5:3. A narrow longitudinal canal or tube is observed in the interior of the siphuncle, which, according to Barrande, represents the fleshy part of the siphuncle (*cordon charnu*), compressed and shrunken (pl. lxxxiii. ff. 12, 14, *loc. cit.*). The test is not preserved.

Horizon. Étage E (=Salopian).

Locality. Lochkow, Bohemia.

Represented in the Collection by a single example.

Gomphoceras tumescens, Barrande.

1867. *Gomphoceras tumescens*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 316, pl. lxxxii. ff. 18-30.

Sp. Char. Shell having a distinct and uniform curvature on the ventral side, but almost straight on the dorsal. Circular in transverse section. The rate of increase in the septal part of the shell is about 1 in 2. The body-chamber occupies about $\frac{1}{3}$ of the total length, and it is about equal in capacity to the septate portion of the shell. The aperture is T-shaped, and, taken as a whole, is strongly inclined towards the ventral side, forming an angle of about 30° with the vertical axis of the shell. The larger orifice is considerably dilated in the middle and is lobed at either extremity; a moderately short channel leads into the smaller orifice, which is oval in shape and does not project beyond the ventral margin. The septa are separated from each other by a space equal to about $\frac{1}{7}$ the diameter of the shell; their convexity equals about $\frac{1}{4}$ of the same. The siphuncle varies in position according to the age of the individual. In the young it is midway between the centre and the ventral border; in older individuals it is only the width of its own diameter removed from the centre; its elements are probably cylindrical, but they are not completely known.

The test is ornamented with fine, subregular, transverse striae which form a sinus upon the ventral side. Very close-set longitudinal striae are visible on some specimens with the aid of a lens, and there are on the body-chamber a series of faint longitudinal impressions, which, however, are not always present. This species is distinguished from its nearest allies by the globular form of its body-chamber, as well as by the position of the siphuncle and the longitudinal markings on the test. The species nearest to it is *G. amphora*, which, however, has a smooth test and much less developed body-chamber.

Horizon. Étage E (=Salopian).

Locality. Karlstein, Bohemia.

Represented in the Collection by two examples.

Gomphoceras scrinium?, Hall.

1864. *Gomphoceras scrinium*, Hall, 18th Reg. Rep. on the New York State Cabinet of Nat. Hist. p. 350, pl. xviii. ff. 1-3.

1866. *Gomphoceras Marcyæ*, Winchell and Marcy, Mem. Boston Soc. Nat. Hist. vol. i. pt. i. p. 101, pl. iii. f. 8.

1879. *Gomphoceras scrinium*, Hall, Pal. of New York, vol. v. pt. ii. p. 318.

1882. *Gomphoceras scrinium*, Whitfield, Geol. of Wisconsin, pt. iii. Palæont. p. 360.

Sp. Char. "A specimen consisting of the outer chamber and last septum, is of moderate size, transversely subcircular, with a very slight angularity on the ventral side. Outer chamber rapidly contracting from near the last septum to the aperture, giving it a somewhat conical form, the length being less than the transverse diameter of the septum. Aperture trilobed, the ventral opening small; dorsal opening moderately large and subtriangular: the proportions of the transverse and axial diameters are as three to four. Septa moderately deep, with a very regular convexity. Siphuncle situated at one third the distance from the ventral margin to the centre. Surface marked only by irregular lines of growth." (*Hall.*)

Remarks. The specimen which I have doubtfully referred to *G. scriinium* is characterized by the remoteness of its septa, and by its elliptical form, in both of which features it offers a considerable resemblance to *G. ellipticum*, M^cCoy. The present form may possibly be undescribed; but without better material, it would not be advisable to found a new species for it.

Horizon. Niagara Group (Wenlock).

Locality. Wabash County, Indiana.

Represented by a single imperfect example.

b. *Endogastric.*

Gomphoceras arcuatum, Sowerby, sp.

1839. *Phragmoceras arcuatum*, Sowerby, in Murchison's Sil. Syst. pl. x. f. 1.

1854. *Phragmoceras arcuatum*, Morris, Cat. British Foss. 2nd ed. p. 312.

1882. *Phragmoceras arcuatum*, Blake, British Foss. Ceph. pt. i. p. 204, pl. xxv. f. 1, pl. xxvi. ff. 1, 2, 2 a.

1885. *Phragmoceras arcuatum* (?), F. Roemer, Palæont. Abhandl. Band ii. Heft v. p. 127, Taf. x. f. 2.

Sp. Char. Shell curved to an extent equalling half a whorl. Section oval, the longer axis in the plane of curvature, the ratio of the two diameters being as 11 : 8, when the shell is not compressed. The length of the body-chamber equals, if it does not exceed, that of its basal diameter. The aperture slopes at an angle of about 45° to the plane of the last septum; its larger orifice is remarkably prominent, and uniformly expanded transversely; the channel connecting it with the smaller orifice is nearly closed for the greater part of its length, but gradually opens out as it approaches the latter, and forms an elongated oval opening. The smaller orifice,

produced beyond the shell border, gives a beak-like termination to this part of the aperture, a feature which was noticed by Sowerby. The septa are direct and but slightly concave, they are distant from each other from $\frac{1}{7}$ to $\frac{1}{5}$ the long diameter of the shell. The siphuncle is close to the ventral border and its elements are nummuloidal. The shell ornaments are described by Blake from the type specimen as consisting of "rough risings of growth which are easily lost, are not very regular, but which curve back very much towards the convex side, cutting the septa at an angle of 60° . On the base of the body-chamber in all specimens seen is a crenulated band, which is more or less feebly continued upon the lower part of the body-chamber. As a rule, I am not inclined to consider these marks as a specific character, for they may be absent or present; but in this species their presence seems always accompanied by the other distinctive characters." The type of this species is missing.

Blake regards the species as represented in the Bohemian rocks by *G. [Phragm.] comes*, Barr., in which, however, the shell is more inflated, and shows no crenulations at the base of the body-chamber. From *Gomph. [Phragm.] imbricatum*, *G. arcuatum* differs in the character of its ornamentation, but it resembles that species in other respects, as, for example, in the beak-like projection of the lesser orifice and in the general form of the shell.

Horizon. Wenlock; Lower Ludlow.

Localities. Dudley?, Worcestershire; Leintwardine, Herefordshire.

Represented by two imperfect examples.

Gomphoceras ventricosum, Sowerby, sp.

1839. *Phragmoceras ventricosum*, Sowerby, in Murchison's Sil. Syst. p. 621, pl. x. ff. 4, 5, 6.

1852. *Phragmoceras ventricosum*, M'Coy, British Pal. Foss. fasc. ii. p. 322.

1854. *Phragmoceras ventricosum*, Morris, Cat. British Foss. 2nd ed. p. 312.

1832. *Phragmoceras ventricosum*, Blake, British Foss. Ceph. pt. i. p. 200, pl. xxiv. ff. 1, 1 a, 2, 2 a, 3.

Sp. Char. Shell curved, but not sufficiently so to form a complete whorl; the apical portion unknown. Section elliptical, the ratio of the two diameters, in an uncompressed example, being about as 20:27. The septa form a very open sigmoid curve in passing across the shell; they are rather widely separated, being about $\frac{1}{5}$ the diameter distant from each other, as measured in the middle of the side

of the shell. "The siphuncle is seen in several to be internal; it is elliptic in section, the long diameter in the plane of curvature reaching $\frac{1}{5}$ that of the septum" (*Blake*). The ornamentation, which is a very marked feature in the species, consists of upwardly imbricating striæ, which make a bold curve on the sides of the shell, forming on the convex (dorsal) margin a broad sinus, and upon the concave (ventral) margin a tongue-like lobe, pointing away from the aperture. The larger apertural orifice forms a broad transverse opening, raised above the general level, the channel uniting it with the smaller orifice being partly closed.

Remarks. The species most closely allied to the present one is *G. [Phragm.] imbricatum*, Barrande, sp., but this has a stronger curvature, and the striæ upon the surface of the test are more irregular than they are in the present species. Added to this, *P. imbricatum* increases more rapidly in diameter than does *G. ventricosum*. The latter has undoubted affinities also with *G. [Phragm.] Broderipi*, Barr., as Blake has pointed out (*loc. cit.* p. 201); but from a comparison of the British and Bohemian species, I find that the ornamentation in *Broderipi* is of a much coarser character than that of *ventricosum*, and this alone would be quite sufficient to distinguish these two species.

Horizon. Wenlock; Lower Ludlow.

Localities. Dudley, Worcestershire; near Ludlow, Shropshire; Garcoed, near Usk, Monmouthshire.

Represented in the Collection by several remarkably fine specimens; those from Garcoed and Ludlow presented by J. E. Lee, Esq., F.S.A.

Gomphoceras Broderipi, Barrande, sp.

1847. *Phragmoceras Broderipi*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. d. Naturwiss. in Wien, Band iii. p. 269.

1867. *Phragmoceras Broderipi*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 207, pl. lvi., pl. lvii., pl. lviii., pl. lxxv. f. 3, pl. xcvi. ff. 1-4, pl. xcix. ff. 1-7.

Sp. Char. Shell strongly curved, so as to form a complete whorl. The apical extremity of the shell is blunt, and terminates in a spherical cap (*calotte*)¹. The transverse section is of an oval form, of which the narrowest end corresponds with the concave or ventral side of the shell. The ventro-dorsal axis is to the transverse as 5:4. The increase in diameter is very rapid, being in the ratio of 1:10. The body-chamber occupies about half the length

¹ Figured by Barrande (*loc. cit.*) in plates lvi., lvii., lviii., xcix.

of the shell, and its bulk is at least double that of the whole of the septate portion. The apertural surface makes an angle of about 45° with the first septum. The larger orifice is a little inclined towards the convex border of the shell; it is nearly circular in contour, and is connected by a long channel with the smaller orifice. The latter is oval in outline, and projects a little beyond the concave border of the shell. The septa are approximate, and bend sharply upwards towards the shell-wall. The siphuncle is situated at a little distance from the ventral border; its elements are nummuloid and flattened. In some examples obstruction-rings ("anneaux obstruc-teurs") are formed upon the necks of the septa. The test is somewhat thick, especially around the orifices; its surface is ornamented with numerous small plications which have a direct imbrication. In the upper part of the shell they conform to the shape of the aperture, and form a shallow sinus on the convex border, while on the concave border they present a deep and narrow sinus.

Remarks. The affinities of this species have already been dwelt upon under *G. ventricosum*. The specimens from Sweden and Norway which I have referred to this species are very imperfect, and apparently immature, so that I am in some doubt as to the correctness of my determination.

Horizon. Étage E (=Salopian), Bohemia; Bed 7a (=Wenlock), Norway; Upper Ludlow, Sweden.

Localities. Konieprus, Bohemia; Norway; Island of Gothland, Sweden.

Fairly well represented in the Collection. The specimen from Norway was transferred from the Museum of Practical Geology.

Gomphoceras imbricatum, Barrande, sp.

1847. *Phragmoceras imbricatum*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. d. Naturwiss. in Wien, Band iii. p. 269.

1848. *Cyrtoceras Vollborthi*, Barrande, *ibid.* Band iv. p. 208 (*vide* Barrande).

1867. *Phragmoceras imbricatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 212, pl. xlvi., pl. clxxv. ff. 1-15, pl. ccxlv. ff. 6-12.

1882. *Phragmoceras imbricatum*, Blake, British Foss. Ceph. pt. i. p. 202, pl. xxv. ff. 2, 2a.

Sp. Char. The shell is curved so as to form nearly half a whorl; its initial point is rounded, and the extremity bears a well-marked cicatrix in the centre, and is ornamented with fine concentric striæ. The transverse section varies a little in different parts of the shell, but its form is always either elliptical or oval. The ventro-dorsal

axis at the last septum is to the transverse as 4:3. These proportions vary a little in different parts of the body-chamber. The latter occupies about one half of the total length of the shell. The plane of the apertural surface is inclined at a considerable angle to that of the last septum. There is a slight swelling in the body-chamber just below the ventral (smaller) orifice. The larger orifice is of a broadly elliptical form, of which the diameters are in the ratio of 4:3; the channel connecting the larger with the smaller orifice is narrow, and, in fact, it is closed at a point near the larger orifice, after which it gradually widens to form the smaller orifice. The borders of the latter are very prominent, and form a recurved beak-like process. The septa are rather wide apart, their mean distance from each other being equal to about $\frac{1}{7}$ of the ventro-dorsal diameter. The siphuncle is situated very near the ventral border, and its elements are nummuloidal. The test is thin in the septate portion of the shell, but thicker at the body-chamber and around the aperture; its surface is composed of thin superimposed lamellæ, which have a direct upward imbrication. The striæ of growth corresponding with this structure of the test are irregularly spaced; they cross the sides of the shell in a broad curve, forming a shallow sinus on the dorsal margin and a narrow tongue-like lobe (concave towards the aperture) in the median line of the ventral border.

Remarks. Among British species *G. imbricatum* finds its nearest ally in *G. arcuatum*, from which it may be distinguished chiefly by the character of its ornamentation, which separates it also from *G. Broderipi*, *G. rex*, and other Bohemian species of a similar habit.

Horizon. Étage E (=Salopian).

Localities. Butowitz, Prague, Bohemia.

Fairly well represented in the Collection.

Gomphoceras longum, Barrande, sp.

1847. *Phragmoceras longum*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. d. Naturwiss. in Wien, Band iii. p. 269.

1867. *Phragmoceras longum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 213, pl. lix.

Sp. Char. This species is strongly curved, though the apex is at a considerable distance from the body-chamber. The section is oval, the smaller extremity corresponding with the concave border of the shell. The ventro-dorsal is to the transverse axis as 3:2. The increase is in the ratio of 1:4 upon a length of 40 millim. of the septate part of the shell. The body-chamber is not very largely

developed. The aperture is very oblique, making an angle of 50° with the plane of the last septum. The larger orifice is circular, and its diameter equals $\frac{2}{3}$ of the thickness of the fossil. The smaller orifice projects slightly beyond the concave border of the shell. The channel connecting the two orifices is narrow. The distance between the septa equals $\frac{1}{9}$ the corresponding ventro-dorsal diameter. The siphuncle is near the ventral border; the form of its elements has not been seen. The test is ornamented with fine, slightly projecting striæ, having a direct imbrication. They are less distinct and less regular than those of the allied species *G. Broderipi*; the very oblique direction they take in crossing the shell causes them to be nearly at right angles with the septa; they form a very distinct sinus on the concave border of the shell, and a large undulation upon the convex side.

Remarks. This species has for its nearest ally *G. Broderipi*, which, however, has a much greater curvature and a more rapidly expanding shell, while the aperture is relatively shorter than that of *G. longum*.

Horizon. Étage E (=Salopian).

Localities. Lochkow, Dworetz, Bohemia.

Fairly well represented in the Collection.

Gomphoceras pusillum, Barrande, sp.

1847. *Phragmoceras pusillum*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. d. Naturwiss. in Wien, Band iii. p. 269.

1867. *Phragmoceras pusillum*, Barrande Syst. Sil. de le Bohême, vol. ii. pt. i. p. 220, pl. lii.

Sp. Char. Shell rather small, slightly curved, the dorsal border strongly arched, the ventral correspondingly incurved till near the region of the aperture, where the shell becomes considerably inflated, so that, upon the whole, it has a pyriform aspect. The aperture is almost Y-shaped, owing to the very deep median saddle between the two lobes, which constitute the larger orifice; the smaller orifice, which forms only a slightly expanded termination to the straight channel, projects a little beyond the ventral border of the shell. The transverse section of the shell is oval, the two diameters being in the ratio of 4 to 3. The ventro-dorsal diameter increases very rapidly at the upper part of the septate portion of the shell, so that the latter is very short. The body-chamber occupies about one half of the total length of the shell, while its capacity is more than two thirds of that of the entire shell. The aperture makes an angle of about 60° with the plane of the last septum. The septa are very close together, their average distance in the

middle of the dorsal surface equals about $\frac{1}{5}$ of the ventro-dorsal diameter. The siphuncle is generally situated very near the ventral border, but it varies a little in position in different specimens; it is filled with radiating deposits. The test is marked only with striæ of growth.

Horizon. Étage E (=Salopian).

Locality. Kosořz, Bohemia.

Represented in the Collection by a single example.

Gomphoceras rex, Barrande, sp.

1867. *Phragmoceras rex*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 215, pl. lxi., pl. lxii., pl. ci. ff. 1-5.

[Not 1858. *Gomphoceras rex*, Pacht, in G. von Helmersen and R. Pacht's Geogn. Untersuch. in den mittl. Gouvern. Russlands, p. 78, tab. i. ff. 1-4.]

Sp. Char. Shell large and of robust habit, strongly curved; the apical portion of the shell unknown. Section oval, the ventro-dorsal diameter is to the transverse as 11 : 7. The increase in the septate part of the shell is in the ratio of 1 : 3 in a length of 50 millim. The body-chamber is highly developed, and appears to occupy at least one half of the total length of the shell; it is remarkable for the great elevation of the concave side as compared with the convex, which is quite the reverse of what is met with in other allied species. Hence the angle formed by the plane of the aperture with that of the last septum falls beyond the convex side of the shell instead of the concave side, as is usually the case. The ventral border of the body-chamber is nearly straight, but always a little convex in outline. The larger apertural orifice is elliptical or reniform, of which the greater diameter is to the lesser as 5 : 2. The smaller orifice forms an ovate expansion at the termination of the channel. The distance between the septa increases regularly, and equals $\frac{1}{7}$ of the ventro-dorsal diameter. The siphuncle is situated close to the concave border of the shell, its elements are nummuloidal, and it is so large as to occupy $\frac{1}{4}$ of the ventro-dorsal diameter; it is filled with radiating deposits. The test has been completely removed by solvent action. The general form of the shell, the relative height of the body-chamber upon the ventral side, and the great size of the siphuncle, serve to distinguish this species.

Horizon. Étage G (=Downtonian).

Locality. Hlubočep, Bohemia.

Represented by a single very imperfect example.

Gomphoceras comes, Barrande, sp.

1867. *Phragmoceras comes*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 208, pl. lxiii., pl. cexliv. f. 13.

Sp. Char. The curvature of the shell is very slight. The section is suboval, of which the narrow extremity corresponds with the inner or ventral border. The ventro-dorsal is to the transverse axis as 10 : 9, measured near the middle of the septate portion of an adult specimen. In the young these axes are nearly equal. The rate of increase in the septate part of the shell is in the ratio of 1 : 3 in a length of 80 millim. The body-chamber occupies about $\frac{1}{3}$ of the total length of the shell; it is slightly oblique in relation to the last septum. In its upper part, just below the larger orifice, there is a swelling which, however, dies away at the sides. Barrande states that he has only seen it in one individual (*loc. cit.* pl. lxiii. ff. 1, 2). The larger orifice of the aperture is uniformly expanded transversely, and leads by a somewhat broad channel to the smaller orifice, which is of a broadly oval form. The distance between the septa amounts to about $\frac{1}{6}$ of the ventro-dorsal diameter; they are nearly direct on the lateral and concave borders of the shell, but are broadly arched upon the dorsal aspect. The siphuncle is placed close to the concave border of the shell; its elements are nummuloidal, the width representing about $\frac{1}{6}$ of the transverse diameter of the shell; their interior is filled with radiating deposits. The test is unknown, all the examples seen being casts.

Horizon. Étage G, bande g 3 (= Downtonian).

Locality. Hlubočep, Bohemia.

Represented in the Collection by one example.

Gomphoceras Nestor, Hall, sp.

1864. *Phragmoceras Nestor*, Hall, 18th Reg. Rep. on the New York State Cabinet of Nat. Hist. p. 347, ff. 7, 8.

1882. *Phragmoceras Nestor*, Whitfield, Geol. of Wisconsin, pt. iii. Palæont. p. 301.

Sp. Char. "A fragment preserving the outer chamber and several of the septa is ventricose, broadly expanded in the dorso-ventral direction, and measuring from the extreme limits of the apertures, which are marginal, more than two and a half inches, the length of the narrow constriction between them being one inch and a quarter. Both the dorsal and ventral apertures are marginal and expanded. The length of the outer chamber along the middle is an inch and three fourths, and the dorso-ventral diameter in the middle of the length is two and a quarter inches. The septate portion

has been abruptly arcuate, the length of the remaining part being four times as great on the outer as on the inner side of the curve. The greater and lesser diameters of the septa are about as 7 to 10. The siphuncle is submarginal. The cast of the outer chamber is marked by what appear to be regular vascular impressions, extending outwards from the first septum.

“This species differs from the *P. Hector*, Billings¹, of the Guelph Limestone of Canada, in being more narrowly elliptical in section and much more expanded in the dorso-ventral direction at the aperture as well as in the greater length and more extreme constriction of the intermediate portion of the aperture.”

Remarks. Comparing *G. Nestor* with European species, it is found to be nearest to *G. rex*, Barr., but is differentiated therefrom by the fact that the convex side of the body-chamber is much more elevated than the concave side; the reverse of this is the case in *G. rex*. The two species have, however, a strong resemblance to each other in their robust habit, distance of septa, curvature, &c.

Horizon. Niagara Group (Wenlock).

Locality. Wabash, Indiana.

Represented by a single example.

DEVONIAN SPECIES.

Gomphoceras ?

[Cf. *Gomphoceras ficus*, Roemer, Palæontographica, 1854, Band iii. p. 38, tab. vi. ff. 1, a, b.]

This is represented by a cast of the body-chamber and most of the septate part of the shell. The latter is small and fusiform, the greatest length being 1 inch 9 lines, the greatest diameter, which is at about the mid-length, is 11 lines. The septa are direct and distant from each other a little more than one line. The aperture is not seen. The label accompanying the specimen gives the horizon and locality as “Up. Devonian, Nismes;” and as the appearance of the fossil resembles that of other specimens from the same locality, there is every probability that the statement is correct.

Gomphoceras (?) subfusiforme, Münster, sp.

1840. *Orthoceratites (Gomphoceras ?) subfusiformis*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 103, Taf. xx. f. 8 (not ff. 6, 7, 9).

¹ Palæoz. Foss. 1862, vol. i. p. 163, ff. 147 a, b.

[Not 1842. *Gomphoceras subfusiforme*, Eichwald, Die Urwelt Russlands, Heft ii. p. 70, tab. iii. ff. 7, 8.—1843. *Gomphoceras subfusiforme*?, Portlock, Rep. on the Geol. of Londonderry, p. 381, pl. xxiv. f. 5.]

Sp. Char. The crucial characters of this fossil, viz. those of the aperture, are wanting, and therefore we have only the general form to serve as a guide to its affinities. The fusiform shell, one side a little inflated, the other nearly straight, presents very much the aspect of a *Gomphoceras*, or at least a closely allied genus. The subject of the present description is a compressed (?) fragment, consisting of part of the septate portion of the shell and an equal amount of the body-chamber, the whole measuring nearly two inches in length. The section is elliptical, the ratio of the two diameters in the most inflated part of the shell being as 11 : 13. The septa are approximate, the most distant not being more than one line apart. A portion of the test is preserved, and is seen to be ornamented with lines of growth of varying degrees of fineness. The siphuncle is not seen.

Remarks. Münster appears to have included more than one species under the name of *subfusiforme*, his figures 7 and 9 (*loc. cit.*) illustrating a shell having much more widely spaced septa than are those of fig. 8, to which I have referred the specimen in the National Collection. The same dissimilarity exists between the latter and the fossil figured by Portlock. Eichwald¹ makes Münster's species (restricted to figs. 7 and 8 of that author) synonymous with *Gomphoceras Eichwaldi*, de Vern.; but de Verneuil² affirms that his species is clearly distinguished from Münster's by the great size of its siphuncle, which occupies nearly $\frac{1}{4}$ of the diameter of the shell.

Horizon. Devonian.

Locality. Bavaria.

Gomphoceras ?

[Cf. *Gomphoceras rev.*, Pacht, in Helmersen & Pacht's Geogn. Untersuch. in den mittl. Gouvernem. Russlands, 1858, p. 78, tab. i. ff. 1-4.]

This is a fragment consisting of the upper part of the septate portion and the lower part of the body-chamber of a shell whose general form strongly suggests affinities with *Gomphoceras*. The fossil, though crushed, is considerably inflated in the middle and tapers at both ends. The septa are crowded together near the

¹ Lethæa Rossica, 1860, vol. i. p. 1265.

² Géol. de la Russie d'Europe, vol. ii. pt. iii. p. 357, pl. xxiv. f. 8.

aperture, but below this they are at a greater distance from each other, that is about 3 lines apart where the diameter of the shell is $2\frac{1}{2}$ inches. Nothing of the test remains, but the base of the body-chamber is marked with crenulations, and these extend to some of the septa contiguous thereto. The dimensions of the specimen are :—Greatest length $3\frac{1}{4}$ inches ; greatest breadth, measured in the plane of the longer diameter, $2\frac{3}{4}$ inches. The siphuncle is not preserved. The specimen figured by Pacht appears to have been distorted, as it is, if a *Gomphoceras*, of very abnormal shape, the septate part narrowing towards the body-chamber instead of becoming wider, the body-chamber being apparently of a cylindrical form. The resemblance is by no means remote between the present specimen and *Gomphoceras compressum*, Roemer¹, but in the latter the septa are much closer together.

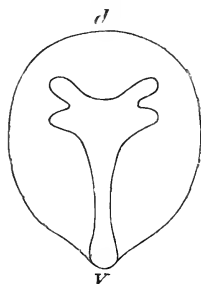
Horizon. Devonian.

Locality. Jelez, Russia.

Genus **TETRAMEROCERAS**, Hyatt².

(*Tetrameres*, *Tetramorion*, Barrande, 1867³.)

Fig. 35.



Outline of the aperture of *Tetrameroceras*, showing the two pairs of lobes in the larger orifice. Reduced from Barrande's figure, plate li. f. 3. *d*, dorsal margin ; *v*, ventral.

Gen. Char. This genus differs from *Gomphoceras* solely in possessing two pairs of lobes in the larger orifice of the aperture, instead of one pair. Its stratigraphical range is limited, so far as is known, to the Silurian epoch. Type, *Tetrameroceras* [*Phragm.*] *bicinctum*, Barr. (pl. li.).

¹ Palæontographica, Band iii. 1854, p. 4, tab. i. ff. 7 a, b.

² Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 277.

³ Syst. Sil. de la Bohême, vol. ii. pt. i. pp. 203 & 265.

Tetrameroceras obovatum¹, Blake, sp.

1882. *Gomphoceras obovatum*, Blake, British Foss. Ceph. pt. i. p. 193, pl. xxii. ff. 3, 3 a.

Sp. Char. "The section at the base of the body-chamber is uniformly elliptical, the axes being as 32 to 27, and the longer diameter is in the plane of symmetry. On the dorsal side the curvature is nearly uniform from the aperture to the earliest part preserved, with a mean radius of three inches; on the ventral side the septal portion is nearly straight, but the body-chamber rapidly bulges out so as to have a radius of curvature of only 14 lines. The mean rate of increase on the septal portion is 3 in 4. The body-chamber is $\frac{4}{5}$ the length of its greatest diameter at the base. The general slope of the aperture is 27° , and the total space occupied is equal to the length of the body-chamber. The ventral opening is elliptic, with diameters of 4 and 10 lines, the longest in the plane of symmetry. The dorsal aperture is fourfold; each lobe is rounded, the most dorsal pair the largest. The greatest transverse diameter of this aperture is 16 lines to a ventro-dorsal of 7 lines. The passage has a length of 14 lines and is narrow. The highest point of the shell lies near the centre of the dorsal aperture. There are no ornaments remaining on the surface, but the last chamber has a series of crenulations of the usual character. The septa have very little convexity. They are $\frac{1}{3}$ the largest diameter apart, but the last is of half the usual size. The sutures have a very slight obliquity, rising to the dorsal side. The siphuncle is not accurately seen: probably it is central; but if not, it must be towards the ventral side." . . . (*Blake.*)

Remarks. Blake compares the present species with *Tetrameroceras discrepans*, Barrande, sp.², remarking that it is distinguished from the latter by the greater breadth of the body-chamber, and by the much greater convexity of the ventral side. He adds that the name *obovatum* had been placed by Salter on the type specimen in the Ludlow Museum.

Horizon. Lower Ludlow.

Locality. Mocktree Hill, Herefordshire.

Represented by a single example.

Tetrameroceras Deshayesi, Barrande, sp.

1867. *Gomphoceras Deshayesi*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 332, pl. lxxiii. ff. 12-19, pl. ci. ff. 6-14.

¹ All the species of *Tetrameroceras* here described are endogastric.

² Syst. Sil. de la Bohême, 1867, vol. ii. pt. i. pl. xlix. &c.

1882. *Gomphoceras eta*, Blake, British Foss. Ceph. pt. i. p. 194, pl. xxii. ff. 5, 5 a.

Sp. Char. Shell pretty strongly curved on the dorsal side, but very slightly so on the ventral. Section circular, though in young individuals the ventro-dorsal is to the transverse diameter as 12:11. The rate of increase is about 2 in 5. The body-chamber appears to occupy a little less than $\frac{1}{3}$ of the total length of the shell, supposing the latter to be complete. Its greatest width is at the base, which also represents the greatest diameter of the shell. The aperture is strongly inclined towards the ventral side. The larger orifice has two pairs of lobes, which are separated from each other by a very slight sinus in the adult shell, but in the young the separation is more marked. The channel proceeding from the larger orifice is of moderate length, and terminates in a rounded lobe which constitutes the smaller orifice. The distance between the septa is equal to about $\frac{1}{9}$ of the diameter of the shell. The siphuncle is situated at first near the ventral border, but gradually recedes to a position nearer the centre as the shell advances; it is filled with radiating deposits. There are only traces left of the test, but these show strong transverse striæ of growth. The base of the body-chamber is marked upon the cast with very distinct crenulations.

Remarks. On comparing the specimens described by Blake under the name of *Gomphoceras eta* with Barrande's species, I can find no character by which it can be separated from the latter. The bilobation on each side of the larger orifice of the aperture in Blake's type, though not very distinct, can, nevertheless, be made out. The failure to observe this feature doubtless led to the mistake as to the affinities of the fossil.

Blake remarks that the "general shape of this species is singularly like that of *G. obovatum*. . ."

Horizon. Lower Ludlow.

Locality. Mocktree, Herefordshire.

Represented by the specimen figured by Blake (*loc. cit.*) under the name of *Gomphoceras eta*.

Tetrameroceras infaustum, Barrande, sp.

1847. *Gomphoceras infaustum*, Barrande, Haidinger, Berichte über die Mittheil. von Freunde der Naturwiss. in Wien, Band iii. p. 269.

1867. *Phragmoceras infaustum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 224, pl. lv.

1877. *Phragmoceras infaustum*, Barrande, *ibid.* Suppl. et Série tardive, p. 80, pl. cccclxxxii. ff. 4, 5.

Sp. Char. Shell curved on the dorsal, but nearly straight on the ventral border. Transverse section oval, the ratio of the ventro-dorsal to the transverse diameter being as 6:5. The rate of increase is very rapid, being 1 in 2 in the septate part of the shell. The body-chamber occupies about $\frac{1}{3}$ of the total length of the shell, while in bulk it nearly equals that of the septate part. The general surface of the aperture is a little oblique to the plane of the last septum. The larger orifice is situated at the most elevated part of the aperture; the two pairs of lobes into which it is divided being distinctly separated from each other, with a broad and shallow median saddle. The longer pair of lobes are inclined towards the dorsal border of the shell, the shorter towards the ventral border. A long channel leads to the smaller orifice, which projects considerably beyond the ventral border in a beak-like fashion. The septa are moderately distant from each other, being on an average about $\frac{1}{11}$ of the shell-diameter apart; they arch strongly upwards on the dorsal side. The siphuncle is situated midway between the centre and the ventral border, though in the young shell it is closer to the margin; its elements are nummuloidal and slightly flattened, the breadth being to the height in the ratio of 8 to 5. The test is ornamented with subregular striæ of growth, which tend to form more or less prominent thread-like lines. In the vicinity of the aperture these lines naturally conform to the outline of the orifices. The cast of the body-chamber exhibits a series of irregular longitudinal impressions very slightly raised above the surface; these have apparently some connection with the crenulations observed at the base of the body-chamber in certain specimens.

Remarks. This species comes very near to *Tetrameroceras* (*Phragm.*) *Lovéni*, Barr., in its general shape, and in the characters of the aperture, but it has a slower rate of tapering and is not so decidedly curved as that species.

Horizon. Étage E (Salopian).

Locality. Lochkow, Bohemia.

Represented in the Collection by a single example.

***Tetrameroceras Lovéni*, Barrande, sp.**

1854. *Phragmoceras Lovéni*, Barrande, Leonhard and Bronn's Neues Jahrb. Heft i. p. 11.

1867. *Phragmoceras Lovéni*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 227, pl. xlvi. ff. 8-11, pl. xlix. ff. 16-19, pl. xcix. ff. 8-11 (young).

Sp. Char. Shell strongly convex on the dorsal side and but slightly concave on the ventral. Transverse section oval, the two

axes being in the ratio of 4 to 3. The increase is very rapid, being in the ratio of 1 : 4 in a length of 30 millim. in the septate part of the shell. The body-chamber is about $\frac{1}{3}$ the total length of the shell in the adult, but it is nearly $\frac{1}{2}$ of the same in the young. The general surface of the aperture makes an angle of about 20° with the plane of the last septum. The lobes of the larger orifice are perfectly symmetrical, the pair on the dorsal side being somewhat longer than the other pair. The median saddle is rather deep, so as considerably to contract the orifice. The smaller orifice forms in adult specimens an oval termination to the narrow channel connecting the two orifices ; it projects slightly beyond the ventral border. The septa are moderately distant from each other ; about $\frac{1}{3}$ the diameter of the shell ; the last two are much nearer together than the rest. The siphuncle is situated near the ventral border for the greater part of its length, but in the earlier stages of the growth of the shell it must be almost touching the test. The width of the siphuncle is equivalent to about $\frac{1}{4}$ the ventro-dorsal diameter of the shell. The test is ornamented with numerous irregular lines of growth, which bend downwards upon the ventral border and form there a narrow sinus. The base of the body-chamber is beautifully creulated in most examples of the species.

Remarks. A species very closely allied to the present one is *Tetrameroceras* (*Phragm.*) *discrepanis*, Barr. (pl. xlix. &c.), but it differs in the position of the siphuncle, which is very nearly central, and in the form and proportions of the lobes of the larger orifice, these being nearly equal in length.

Horizon. Étage E (= Salopian).

Localities. Lochkow, Dlauha Hora, Bohemia.

Represented in the Collection by two examples.

Tetrameroceras vetus, Barrande, sp.

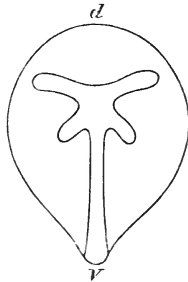
1847. *Gomphoceras vetus*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iii. p. 269.

1867. *Phragmoceras vetus*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 231, pl. liv.

Sp. Char. Shell nearly straight, the dorsal side being, as usual, the more convex. The transverse section is oval, the two axes being in the ratio of 5 to 4. The rate of increase amounts to about 2 in 5, though in some individuals it is still more rapid. The body-chamber occupies about $\frac{1}{3}$ of the total length of the shell, and its capacity is nearly equal to that of the septate part. The plane of the aperture forms an angle of about 40° with that of the last

septum. The pair of lobes in the larger orifice, nearest the dorsal margin, are considerably longer than the other pair, and are separated from them by a very wide sinus. The smaller orifice, which is of an elongate-oval form, is connected with the larger one by a somewhat narrow channel. The whole aperture is like the letter T, with two shorter arms below the longer ones, pointing backwards (see fig. 36).

Fig. 36.



Outline of the aperture of *T. vetus*, Barr. sp. Reduced from Barrande's figure, pl. liv. f. 4. *d*, dorsal margin; *v*, ventral.

The septa are distant about $\frac{1}{11}$ of the ventro-dorsal diameter of the shell. The siphuncle is situated at a distance from the ventral margin equalling about $\frac{1}{2}$ its own diameter, a distance which is maintained pretty constantly throughout the whole length of the shell. Its width does not exceed $\frac{1}{9}$ of the ventro-dorsal diameter; its elements are nummuloidal, and it is filled with radiating deposits.

The test is ornamented with lines of growth which tend to form raised, thread-like lines, and follow the contour of the orifices of the aperture. Besides the transverse lines, there are sometimes very fine longitudinal ones, chiefly upon the sides of the shell; these can only be seen in a good light. The base of the body-chamber is crenulated, and a series of faint longitudinal bands are visible upon the cast. These bands are apparently connected with the crenulations.

Remarks. This species finds its nearest ally in *T. infaustum*, but it differs from this and others of its congeners by the characters of its aperture, in which the lobes of the larger orifice are usually wide apart. *T. vetus* forms one of a group of which the species strongly resemble each other; these are *T. Lovéni*, *T. discrepans*, *T. insolitum*, *T. bicinctum*, and *T. infaustum*.

Horizon. Étage E (=Salopian).

Localities. Kosorž, Lochkow, Bohemia.

Fairly well represented in the Collection.

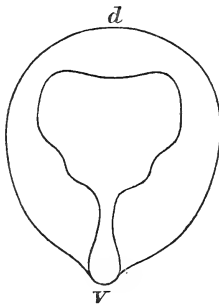
Tetrameroceras Conradi, Barrande, sp.

1847. *Gomphoceras Conradi*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iii. p. 269.

1867. *Phragmoceras Conradi*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 209, pl. xlix. ff. 1-11.

Sp. Char. Shell sometimes straight, sometimes slightly curved. The transverse section is oval, the ratio of the two diameters being nearly as 9 : 7 at the last septum, and as 4 : 3 in the middle of the septate part of the shell ; the fossil is therefore more inflated at the upper part. The body-chamber is of moderate size compared with the entire shell. The general surface of the aperture is nearly parallel with the plane of the last septum. The larger orifice is of

Fig. 37.



Outline of the aperture of *T. Conradi*, Barr. sp. (after Barrande, *loc. cit.* pl. xlix. f. 6). *d*, dorsal margin ; *v*, ventral.

subtriangular form, the lobes being almost effaced, thus making the aperture larger proportionally than in any other species. The channel is very short and leads into the smaller orifice, which is of an oval form, and projects considerably from the ventral margin like a spout. The septa are moderately distant from each other, that is about $\frac{1}{5}$ of the ventro-dorsal diameter. The siphuncle is placed at a little distance from the ventral border as seen at the last septum, but nearer the apex it is almost in contact with the test ; its elements are nummuloidal, and filled with radiating deposits. The surface of the test is ornamented with feebly-marked lines of growth which form a very distinct sinus on the ventral border of the shell, whilst they pass horizontally across the dorsal or convex side. Some specimens show traces of crenulations at the base of the cast of the body-chamber, and also slight longitudinal impressions connected with these.

Remarks. This species is easily distinguished from all others of the genus by the peculiar character of the aperture.

Horizon. Étage E (=Salopian).

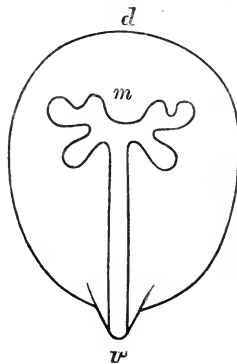
Locality. Hinter Kopanina, Bohemia.

Represented in the Collection by two examples.

Genus **HEXAMEROCERAS**, Hyatt¹.

(*Hexameres*, *Hexamorion*, Barrande, 1867²).

Fig. 38.



Outline of the aperture of rather a young individual of *Hexameroceras*, showing the three pairs of lobes in the larger orifice: *m*, median saddle; *d*, dorsal margin; *v*, ventral. (After Barrande, *loc. cit.* pl. 1. f. 13.)

Gen. Char. In this genus there are three pairs of lobes in the larger orifice of the aperture. Its stratigraphical range is confined to the epoch of the Silurian. Type, *Hexameroceras* (*Phragm.*) *Panderi*, Barr.

Hexameroceras Panderi, Barrande, sp.

1847. *Phragmoceras Panderi*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iii. p. 269.

1867. *Phragmoceras Panderi*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 232, pl. xlvi. ff. 12-15, pl. l. ff. 7-15.

1877. *Phragmoceras Panderi*, Barrande, *ibid.* Suppl. et Série tardive, pp. 80 & 236, pl. ccccxxix. ff. 14-20.

Sp. Char. Shell very slightly curved. The dorsal side is strongly

¹ Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 278.

² Syst. Sil. de la Bohême, vol. ii. pt. i. pp. 203 & 265.

convex, the ventral side is considerably inflated at the body-chamber, but below that it is slightly concave, indicating a distinct curvature in the apical portion of the shell. The transverse section is an oval, of which the ventro-dorsal is to the transverse diameter as 5:4. The body-chamber occupies about $\frac{1}{3}$ of the total length of the shell. Its capacity is a little inferior to that of the chambered part. The general surface of the aperture makes an angle of about 40° with the plane of the last septum. There are three pairs of lobes in the larger orifice; two of these pairs are similar to those met with in *Tetrameroceras*. The third pair, situated nearest to the dorsal border of the shell, seems to be formed by the bifurcation of the two principal lobes, and its development is found to correspond with that of the individual, indications of it occurring even in very young shells. As the third pair of lobes develop, the median saddle (fig. 38, *m*) encroaches more and more upon the orifice. The transverse diameter of the larger orifice is a little more than half of the corresponding diameter of the shell. The smaller orifice projects a little above the surface of the body-chamber, and in young individuals it slightly overhangs the ventral border. The channel connecting the two orifices is narrow, especially in adult shells, in which it is almost closed in the middle of its course. The septa are distant from each other about $\frac{1}{11}$ of the ventro-dorsal diameter; they have a slightly undulating course, rising perceptibly upon the dorsal border. The siphuncle is placed at a distance equalling its own diameter from the ventral border; it is composed of nummuloidal elements of which the height is to the width as 1:2. The test is ornamented with lines of growth, which are for the most part very fine, but at intervals of about one line coarser ones appear. A series of very faint, longitudinal, and parallel impressions are observed upon the cast of the body-chamber, and the base of the latter is often crenulated.

Remarks. This species is distinguished from *Hexameroceras pollens*, Barrande, sp.¹, by the form of the lobes in the larger orifice of the aperture, by its more oval section, and by the much finer markings of the test.

Horizon. Étage E (=Salopian).

Locality. Lochkow, Bohemia.

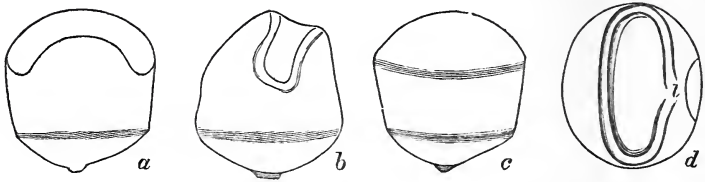
Fairly well represented in the Collection.

¹ Syst. Sil. de la Bohême, vol. ii. pt. i. p. 333.

Genus **MESOCERAS**, Barrande ¹.

(Not represented in the Collection.)

Fig. 39.



Mesoceras Bohemicum, Barr.—*a*, view of the straight side; *b*, lateral view; *c*, view of the convex side; *d*, view of the apertural surface, oriented to correspond with *b*. Reduced from Barrande's figures.

Gen. Char. Shell straight, short; transverse section elliptical. Aperture contracted, forming a large transverse orifice, rounded at both ends, with indications of a median lobe on the ventral (?) side of it (*l*, fig. 39, *d*). Siphuncle central. The body-chamber only is known. Type (the only species known), *M. Bohemicum*, Barr. Silurian of Bohemia (Étage E, bande *e* 2).

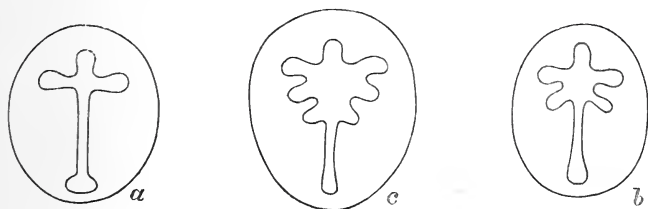
Remarks. The genus *Meosceras* was founded by Barrande upon a fragment, consisting of the body-chamber of a shell resembling *Gomphoceras* in general form, but having a central siphuncle, and only obscure indications of a median lobe in the aperture. Barrande informs us that he kept this fossil in his cabinet twenty-five years before venturing to describe it, waiting in vain for the discovery of other specimens which would throw light upon it. With reference to the form of the aperture, he observes that there is a faint depression or interruption in the middle of the inferior border (*l*, fig. 39, *d*), but that the state of preservation of the specimen (in black slate) does not permit of a conclusion being come to as to whether this depression has a natural or an artificial origin. If the former, it may have served as an exit for the respiratory funnel of the animal, as the smaller orifice in *Gomphoceras* is supposed to have done. An obscure median groove is also present, proceeding from the depression, and there are transverse striæ corresponding with it. All these phenomena, observes Barrande, tend to show that this is the ventral side of the shell. *Mesoceras Bohemicum* is compared by

¹ Syst. Sil. de la Bohême, vol. ii. 1877, Supplém. et Série tardive, p. 198, pl. dviii.; Hyatt, *loc. cit.*

Barrande with *Gomphoceras semiclausum*, Barr.¹, and *Gomphoceras* [*Apioceras*] *olla*, Saemann², in both of which species the smaller apertural orifice is indicated by an obscure sinus, without any intervening channel to separate the two orifices, such as is present in the majority of the *Gomphoceratidæ*.

The following Silurian genera comprising the Division INEQUILOBATES (*ante*, p. 211, footnote) are not represented in the Collection :—*Trimeroceras*, *Pentameroceras*, *Septameroceras*.

Fig. 40.



Outline of the aperture of (a) *Trimeroceras*, (b) *Pentameroceras*, and (c) *Septameroceras*. a and b, after Barrande, b slightly enlarged; c, after Hall.

Genus **TRIMEROCERAS**, Hyatt³.

(*Trimorion*, Barrande, 1867⁴.)

Gen. Char. Shell with three lobes in the larger orifice of the aperture.

Type, *Trimeroceras staurostoma*, Barr. sp. (fig. 40, a).

Genus **PENTAMEROCERAS**, Hyatt³.

(*Pentamorion*, Barrande, 1867⁴.)

Gen. Char. Shell with five lobes in the larger orifice of the aperture.

Type, *Pentameroceras mirum*, Barr. sp. (fig. 40, b).

¹ Pl. lxxxviii. ff. 12-15.

² Palæontographica, Band iii. 1854, p. 163, pl. xix. ff. 1, a, b, c. Hyatt has made this species the type of a new genus (*Acleistoceras*), the name *Apioceras* being preoccupied.

³ Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 278.

⁴ Syst. Sil. de la Bohême, vol. ii. pt. i. p. 265.

Genus **SEPTAMEROCERAS**, Hyatt¹.

Gen. Char. Shell with seven lobes in the larger orifice of the aperture.

Type, *Gomphoceras inflatum*, Billings, sp.²

Family ASCOCERATIDÆ³.Genus **ASCOCERAS**, Barrande⁴.

(*Cryptoceras*, Barrande, 1846⁵, non d'Orbigny.)

Gen. Char. The shell is of a sac-like form, essentially straight, but always more convex on the ventral than on the dorsal side. The apex is unknown, the shell being always truncated. The transverse section may be elliptical or circular. The body-chamber occupies nearly the whole length of the shell on the ventral side, and contracts into a neck-like prolongation towards the aperture, which is simple. The last few septa are abnormal; they have the usual shape and position on the ventral side of the shell, but on the dorsal side they coalesce, and sweeping upwards in a sigmoid curve (as seen in section, fig. 41, *a*) form a series of vaulted chambers convex towards the aperture, and encroaching considerably upon the body-chamber. This extraordinary conformation of the septa on the dorsal side was doubtless caused by the shrinking of the animal in its shell on that side, whereby a cavity was created between the shell-wall and the mollusk, and then partitioned in the manner above described. The short siphuncle is submarginal and near the ventral or concave border of the shell; it diminishes rapidly in size towards the body-chamber. The test is relatively thick considering the size

¹ Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 278.

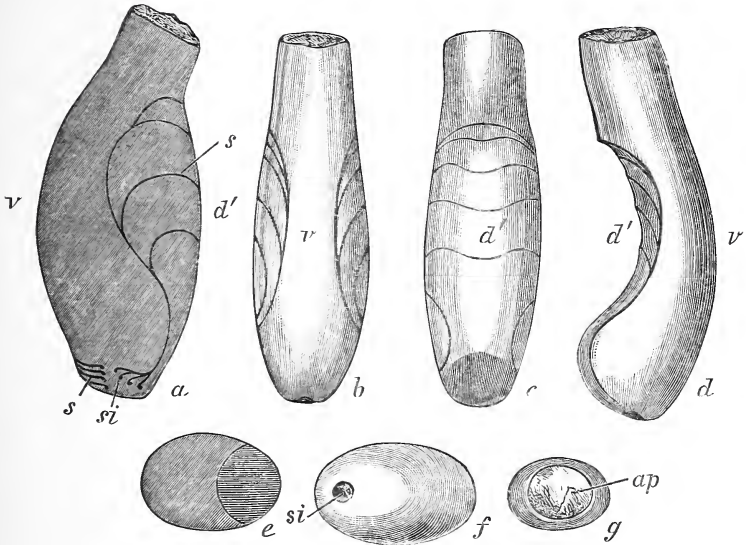
² I have failed to find any species described by Billings under this name. It is not in S. A. Miller's Cat. of Amer. Pal. Foss. I have therefore figured *Septameroceras septoris*, Hall, sp. (fig. 40, *c*). *S. septoris* is described and figured in the 18th Regent's Rep. on the New York State Cabinet of Nat. Hist. 1864, p. 350.

³ Comprising the genera *Ascoceras*, *Glossoceras*, *Billingsites* (?).

⁴ Oesterr. Blätt. für Litt. u. Kunst, 1847, and Haidinger's Berichte über d. Mittheil. v. Freund. d. Naturwiss. in Wien, 1847, p. 268, also Bull. de la Soc. Géol. de France, 1855, sér. 2, vol. xii. p. 157.

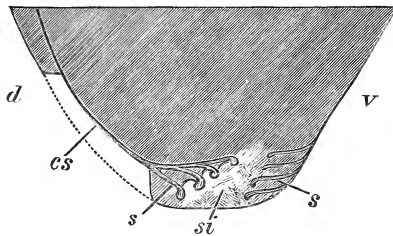
⁵ Notice prélim. sur le Syst. Sil. et les Trilobites de Bohême, 1846, p. 43.

Fig. 41.



Ascoceras Bohemicum.—*a*, longitudinal section, showing *s*, *s*, septa, *si*, siphuncle, reduced from Barrande's figure (pl. dxiii. f. 15); *b*, ventral aspect of cast of the same species (without the test), showing the reduction in size of the body-chamber caused by the encroachment of the septa; *c*, dorsal view of the same individual; *d*, body-chamber of the same, without the septal chambers; *e*, transverse section of the fossil taken in the centre; *f*, truncated posterior extremity, showing position of the siphuncle *si*; *g*, anterior extremity showing the simple form of the aperture *ap*. The letters *v*, *d'* stand for ventral and dorsal respectively. The figures *b*–*f* are copied from Barrande's memoir entitled "Ascoceras, prototype des Nautilides," from the Bull. de la Soc. Géol. de France, 1855, sér. 2, tom. xii. p. 157, pl. v. ff. 22–25 and 27, 28. Figure *g* is copied from Barrande, pl. xvii. f. 22.

Fig. 42.



Enlargement of the posterior extremity of *Ascoceras Bohemicum*, after Barrande, pl. dxiii. f. 16. *cs*, coalesced septa; *s*, *s*, septa; *si*, siphuncle; *v*, ventral, *d*, dorsal side.

of the shell; its ornaments may consist of transverse lines or of annulations, and these two descriptions of markings have been employed by Barrande to separate the species into two groups.

Ascoceras occurs in the Ordovician of North America and the Silurian of Europe, by far the greater proportion of the species coming from Bohemia; thus, fifteen species have been described by Barrande in the last-named country, three in Canada by Billings, and three in England by Salter and Blake.

Remarks. Barrande's opinion that *Ascoceras* offered a more simple type of structure than that of *Orthoceras* has been confuted by Blake, who has very clearly described the structure of the former genus, showing that instead of being one of the most simple among the Nautiloid Cephalopoda, the shell of *Ascoceras* is really the most abnormal.

Barrande's suggestion that the body-chamber of *Ascoceras* is analogous with the large marginal siphuncle in *Endoceras* was based upon the assumption that the siphuncle changed with age, commencing with a comparatively small tubular siphuncle (fig. 42, *si*) and expanding into a large cavity, whose capacity was, however, reduced by the distorted septa formed on one side of it. It may well be supposed, however, that the whole of the cavity posterior to the last-formed (arched) septum contained that portion of the animal's body answering to the visceral cone¹ of *Endoceras*².

***Ascoceras Barrandei*, Salter.**

1858. *Ascoceras Barrandii*, Salter, Quart. Journ. Geol. Soc. vol. xiv. p. 180, pl. xiii. f. 7.

1859. *Ascoceras Barrandei*, Salter, in Murchison's 'Siluria,' 3rd ed. p. 259, Foss. Gr. 62.

1867. *Ascoceras Barrandei*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 335.

1882. *Ascoceras Barrandei*, Blake, British Foss. Ceph. pt. i. p. 207, pl. xxvi. f. 9.

Sp. Char. The type species, which is contained in the Museum of Practical Geology, is thus described by Blake:—"Section at the base

¹ Which secreted the calcareous "sheath" (see fig. 13, p. 131).

² I will take this opportunity of supplying a deficiency in the description of *Endoceras* (p. 129), in which I omitted to mention the body-chamber. This is known only by fragments representing its posterior portion, in two species described by Barrande, viz.:—*Endoceras conquassatum*, and *E. novator* (Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, pp. 675, 676, plates ccxlvii. and ccccxv.).

of the body-chamber, now much compressed, so that the long diameter in the plane of symmetry is in the ratio of 5 to 2 to the short one. The radius of curvature is about $1\frac{1}{2}$ inches at first. The whole body-chamber has a length, as preserved, equal to twice its greatest breadth. The aperture appears simple, and has a diameter $\frac{4}{7}$ the greatest breadth. The ornaments are acute, separate riblets varying in distance from 6 per line at the base to 14 per line near the aperture. The ordinary septa have a convexity of $\frac{1}{4}$ the long diameter. The sutures are straight, but oblique to the general direction of the shell, slanting back to the convex side. The siphuncle is moderately large, and is situated $\frac{1}{3}$ the diameter from the convex side. The sigmoid septa are not more than two in number, and their curvature is not great, as they make an acute angle with the part of the shell above them on the concave side. The second succeeds the first in a nearly horizontal direction. They occupy a length of $\frac{9}{10}$ the whole chamber. Length $2\frac{1}{2}$ inches ; greatest breadth 1 inch."

Remarks. Blake points out that Salter's statement as to *A. Barrandei* being a larger and thicker species than *A. Bohemicum*, Barr., with more oblique lines of growth and more strongly sigmoidal septa, is erroneous. "No specimen of the present species," observes Blake, "has been found of anything like the dimensions of the Bohemian form, and the obliquity of the lines of growth is well matched in the latter." Furthermore, the septa in the present species are much less curved than they are in *A. Bohemicum*.

Horizon. Upper Ludlow.

Locality. Ludlow, Herefordshire.

Represented by a single example presented by J. E. Lee, Esq., F.S.A., F.G.S.

Ascoceras Murchisoni, Barrande.

1867. *Ascoceras Murchisoni*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 357, pl. xcv. ff. 1-35.

1877. *Ascoceras Murchisoni*, Barrande, ibid. Suppl. et Série tardive, p. 98, pl. cccxcxi. ff. 3-7.

Sp. Char. Shell varying in its form with age, the constricted part near the aperture occupying about $\frac{1}{5}$ of the total length of the shell in some individuals, whilst in others this proportion increases to $\frac{1}{4}$ and even to $\frac{1}{3}$. Furthermore, this constricted part is more or less inclined in some specimens towards the straighter or dorsal side of the shell, and in others it conforms to the longitudinal axis. The horizontal section taken in the middle of the shell is oval, of which

the ventro-dorsal is to the transverse axis as 4 : 3. The neck is of a cylindrical form, with circular section, of which the diameter is about $\frac{2}{5}$ of the total width of the fossil. The aperture is circular and a little oblique, its inclination corresponding to the convex or ventral border of the shell. The central or constricted part of the body-chamber represents at least half of the total length of the latter. The septal chambers occupy a little more than half the transverse diameter of the shell, there are generally four of them, but sometimes five; there is a slight sinuosity in their sutures on the dorsal side. The last two septa are always closer together than the rest. The lower part of the body-chamber is much dilated, and occupies a little less than $\frac{1}{3}$ of the total length of the fossil. When the test is preserved at the truncated extremity it is found to be devoid of ornament. This part is separated from the rest by a line which indicates the loss by truncation of the earlier septate portion of the shell, because we find upon the truncated surface, midway between its centre and the convex border, a little siphuncular neck, slightly projecting from the surface and showing a narrow opening. When the posterior extremity of the body-chamber is laid bare by the loss of the lowest septal chamber, the siphuncular opening is seen near the margin. The test in this species is ornamented with extremely fine regular longitudinal lines, scarcely visible to the naked eye; these are crossed by still finer transverse lines. The longitudinal lines are generally the stronger of the two, but sometimes the transverse lines take their place in this respect.

Remarks. This species is well distinguished from others by its ornamentation.

Horizon. Étage E, band *e* 2 (=Salopian).

Locality. Karlstein, Bohemia.

Fairly well represented in the Collection.

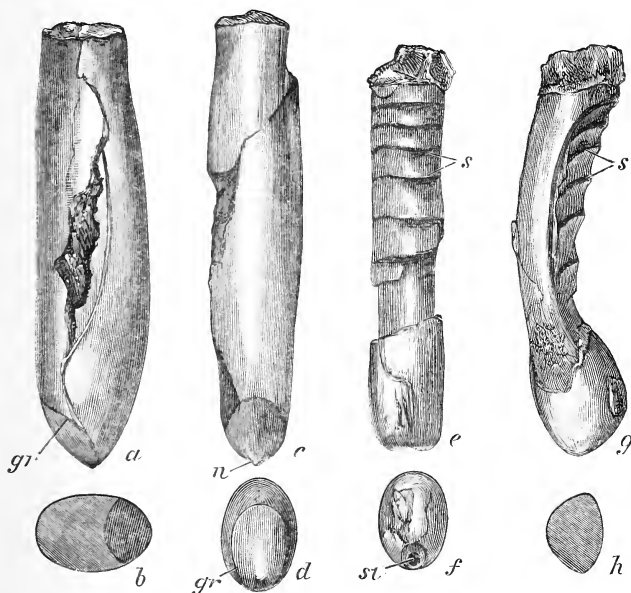
Ascoceras Verneuli, Barrande.

1867. *Ascoceras Verneuli*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 359, pl. xcv. ff. 42-57.

Sp. Char. The general form of this species is cylindrical, obliquely truncated posteriorly, with an elliptical section. The septal side is nearly straight, the other side a little convex. The neck or anterior prolongation of the body-chamber is not constricted; it is extremely short, so that in an example that measures 23 lines in length it scarcely exceeds 1 line (fig. 43, *g*). The constricted part of the body-chamber occupies more than $\frac{2}{5}$ of the total length of the fossil, and receives the septal chambers to the number of six or seven, in

all adult individuals. The posterior, dilated part of the body-chamber occupies a little less than $\frac{1}{3}$ of the total length of the shell. When the fossil is well preserved the test covers the whole of the truncated extremity; nevertheless there are indications, in the shape of a groove surrounding the latter (fig. 43, *gr*), of the removal of one of the earlier chambers during the growth of the animal. A little tubular projection marks the position of a siphuncular neck near the ventral margin (fig. 43, *n*).

Fig. 43.



Ascoceras Verneuli.—*a*, lateral view of a specimen, showing traces of the curved septa; *b*, transverse section of the same taken at about the mid-length, the shaded part represents the body-chamber; *c*, concave side of the same specimen, showing the truncated extremity; *d*, view of the posterior extremity, showing the position of the siphuncle, and at *gr* the outline of the truncated portion; *e*, concave side of another specimen, the septate part has been removed, leaving marks of the septa upon the cast (*s*); *f*, posterior extremity of the same specimen, showing the opening of the siphuncle upon the internal cast; *g*, lateral view of the same individual, showing marks of the septa upon the cast (*s*); *h*, transverse section taken at mid-length, oriented to correspond with *g*.

The surface of the test in this species is rarely preserved, and it thus appears to be devoid of any ornamentation; there are, however,

fine transverse lines upon the surface, which may be seen with the aid of a lens; they are regular, and number from 2 to 3 in the space of a line.

Remarks. *Ascoceras Verneüli* is almost the only described species of the genus having a straight form, without being inflated in the middle, nor constricted above. It is distinguished also by the very short distance which separates the aperture from the last septum.

Horizon. Étage E (= Salopian), in white limestone.

Locality. Dlauha Hora, Bohemia.

Represented by a few very imperfect specimens.

Ascoceras Bohemicum, Barrande.

1855. *Ascoceras Bohemicum*, Barrande, Bull. Soc. Géol. de France, vol. xii. p. 174, pl. v. ff. 20-28.

1855. *Ascoceras Bohemicum*, Barrande, Leonhard and Bronn's Jahrb. p. 277, pl. iii. ff. 1-8.

1867. *Ascoceras Bohemicum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 354, pl. xciii., pl. xciv. ff. 28-37, pl. xcvi. ff. 46-49.

1877. *Ascoceras Bohemicum*, Barrande, *ibid.* vol. ii. Suppl. et Série tardive, p. 97, pl. cccxciv. ff. 14, 15.

? 1882. *Ascoceras Bohemicum*, Blake, British Foss. Ceph. pt. i. p. 208, pl. xxvi.

Sp. Char. This species (fig. 41) attains larger dimensions than any of its congeners. The shell presents a very considerable convexity upon the side on which the body-chamber lies, and a distinct concavity upon the other side. The transverse section taken about the mid-length is oval, of which the ventro-dorsal is to the transverse axis in the ratio of 5 to 4; the principal part of the fossil is therefore considerably flattened. Just above the last septum a constriction occurs and the shell terminates in a sort of cylindrical neck, which is about $\frac{1}{5}$ of the total length of the fossil, its diameter being about $\frac{2}{3}$ of the maximum width. The aperture is circular, and placed a little obliquely with reference to the longitudinal axis of the shell (fig. 41, *a*). The body-chamber is excessively contracted by the encroachment of the septal chambers just above the mid-length of the shell, so that it is here not more than $\frac{1}{5}$ of the width of the fossil. The number of septal chambers varies from 4 to 5 in specimens where these can be accurately observed, and this variation in their number seems to have no connection with size or age, for very small as well as large specimens are found with 5 chambers. The latter are very unequal in size, as will be seen on referring to the figure of the species (fig. 41 *a*, &c.). The lower or dilated part of the

body-chamber occupies about $\frac{1}{4}$ of the total length of the fossil. The test covers the whole of the truncated extremity, as in other species, but the truncated part is as usual quite smooth. The remainder of the test is ornamented with fine imbricating lines, of which about six are contained in the space of one line. The internal cast shows a series of very fine interrupted, irregular, impressed lines produced by the mantle of the animal¹; these can only be seen with the aid of a lens.

Remarks. The characters which distinguish *Ascoceras Bohemicum* from all other allied species are:—its great size (the largest known measures $5\frac{1}{2}$ inches in length, and 2 inches in its greatest diameter²); the ornaments of the test; and the relatively great development of the septal chambers, which considerably reduce the width of the body-chamber, as seen laterally upon a cast.

This species is identified by Blake (*loc. cit.*) from the Upper Ludlow of Whitecliffe, Ludlow; but he observes that “it may well be doubted if our British specimen is indeed *A. Bohemicum*, its section is different, and the septal convexity is greater; but as these differences may arise from compression, there are no ample grounds for their separation.”

Horizon. Étage E (=Salopian).

Locality. Karlstein, Bohemia.

Genus **GLOSSOCERAS**, Barrande³.

Gen. Char. *Glossoceras* differs from *Ascoceras* in its more slender and less inflated form, and in having a lobed, instead of a simple aperture.

Remarks. Barrande has compared the lobated aperture in *Glossoceras* with that of *Hercoceras mirum*, Barr. (pl. cii. ff. 4, 6, 8), *Ophidioceras simplex*, Barr. (pl. xcvi. ff. 1, 2, 6, 7), and *O. rudens*, Barr. (pl. xlv. ff. 13, 18, 20): he also compares it with certain species of *Gomphoceras*, such as *G. pavidum*, Barr. (pl. li.), *G. pusillum*, Barr. (pl. lii.), *G. incola*, Barr. (pl. lxxviii.), &c.

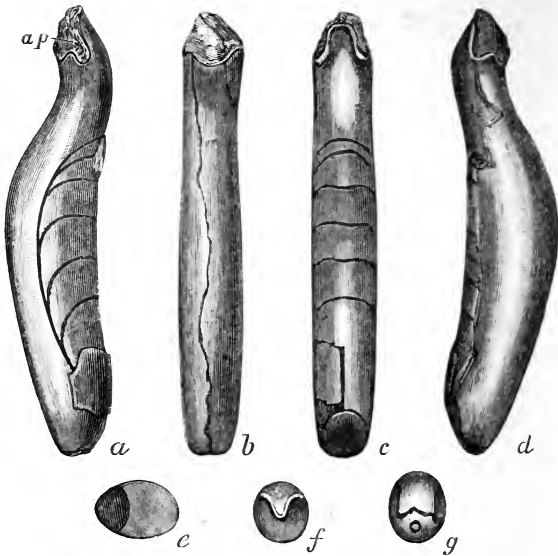
Barrande supposes the constricted aperture in this genus to have been removed by absorption, and renewed during the successive stages of growth of the animal, just as in *Hercoceras* (see *ante*, p. 214).

¹ The specimen showing the ornamentation just described is numbered 80884 in the Collection.

² Barrande, pl. xciii. f. 1.

³ Syst. Sil. de la Bohême, 1867, vol. ii. pt. i. p. 372.

Fig. 44.



Glossoceras gracile, var. *curta*.—*a*, lateral view of cast of a specimen, showing the lobed aperture *ap*; *b*, convex side of the same; *c*, concave side of the same, showing the septal sutures and the outline of the aperture; *d*, lateral view of the same individual, the opposite side to *a*; *e*, transverse section of another specimen, taken at about mid-length, the shaded part represents the body-chamber; *f*, aperture of the same specimen, showing the tongue-like lobe; *g*, view of the posterior extremity, showing the siphuncle.

***Glossoceras gracile*, Barrande.**

1867. *Glossoceras gracile*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 373, pl. xciv. ff. 1-19.

1877. *Glossoceras gracile*, Barrande, *ibid.* vol. ii. Suppl. et Série tardive, p. 241, pl. cccclxxvii. Case iii., pl. dxiii. ff. 10-13.

Sp. Char. The general form of the shell is slender, the transverse section is oval; the body-chamber more or less strongly convex, while the septate border is nearly straight or but slightly concave. The anterior portion of the shell is prolonged into a short, cylindrical neck which bends a little towards the convex border. The dorsal side of the aperture (fig. 44, *a*) is produced into a tongue-shaped lobe, while the ventral side forms a shallow sinus (fig. 44, *b*); between these there are two smaller lobes (fig. 44, *a*, *d*). The whole of the visceral cavity is greatly contracted, and generally occupies less than half the width of the shell. The number of

septal chambers in adult individuals is six, not counting those which have been lost by truncation in the earlier stages of the shell's growth. The ornaments of the test consist of faint longitudinal ridges crossed by very fine and close-set transverse lines, which can only be seen by means of a lens. Just below the aperture in some specimens the surface characters undergo a complete change, the horizontal lines predominating over the longitudinal ones. Another specimen exhibits an equality in the strength of the two series of lines. The cast is marked by very fine, irregular, impressed lines produced by the mantle of the animal; these are more distinct in the young than in the adult shells.

Remarks. The variety *curta* (fig. 44) is distinguished from the species by its shorter and more inflated form. It is not represented in the Collection.

Horizon. Étage E, bande *e* 2 (=Salopian).

Locality. Dlauha Hora, Bohemia.

Represented in the Collection by a very imperfect specimen.

[In the memoir upon *Ascoceras*, published in the Bull. Soc. Géol. de France, 1855, vol. xii. p. 157, and in Leonh. u. Bronn, Jahrb. 1855, Heft iii. p. 277, Barrande drew attention to certain species of that genus in which the septal chambers, bordering the body-chamber, were absent. In 1865 these species were constituted a subgenus—*Aphragmites*—*Ascoceras Buchi* being taken as the type. In 1867 *Aphragmites* was erected by its author into a distinct genus, containing two species, viz. *Aphrag. Buchi* and *Aphrag. Salteri*. Finally, in 1877 (Syst. Sil. de la Bohême, vol. ii. Suppl. p. 94) Barrande came to the conclusion that the absence of the arched septa at the side of the body-chamber was due to absorption, and the genus *Aphragmites* was then abandoned, and the two species representing it relegated, the one (*Aphr. Buchi*) to *Ascoceras Deshayesi*, the other (*Aphr. Salteri*) to *Ascoceras Bronni*. This disposal of them shows that the absence of septa was regarded by Barrande as an individual variation. Professor Hyatt has re-established the genus¹. It is not represented in the National Collection.]

¹ Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 279.

Family POTERIOCERATIDÆ¹.Genus **POTERIOCERAS**, M'Coy².

(*Orthocera* (pars), J. de Carle Sowerby, 1829³; *Orthoceras* (pars), Phillips, 1836⁴; *Gomphoceras* (pars), Münster, 1840⁵; *Nelimenia*, Castelnau, 1843⁶; *Gomphoceras*, Murchison, Verneuil, and Keyserling, 1845⁷; *Oncoceras*, Hall, 1847⁸; *Gomphoceras*, d'Orbigny, 1849⁹; *Gomphoceras*, S. P. Woodward, 1851¹⁰; *Phragmoceras*, Geinitz, 1853¹¹; ? *Gomphoceras* (pars), Eichwald, 1860¹²; *Phragmoceras*, Eichwald, 1860¹³; *Cyrtoceras*, Billings, 1863¹⁴; *Gomphoceras* (pars), Barrande, 1867¹⁵; *Cyrtoceras* (pars), Barrande¹⁶.)

Gen. Char. Shell fusiform, slightly curved, very slender in the apical portion and becoming inflated in the middle, and contracting again towards the aperture, which is simple. Cross section nearly circular in the young, elliptical in the adult. Siphuncle subcentral to marginal, much inflated between the septa; the latter somewhat distant from each other, and oblique to the long axis of the shell. Body-chamber large in proportion to the entire shell; constricted near the aperture. Shell smooth in all the known species.

Remarks. This genus may be distinguished from *Gomphoceras*, with which many authors have confounded it, by its simple aperture and fusiform shape, and from *Cyrtoceras* by the inflation of the central portion of the shell, and its contraction in the region of the aperture. It is to be noted that the inflation is much less conspicuous in the adult than it is in the young.

¹ This name is proposed in substitution for that of *Oncoceratidæ* instituted by Hyatt (Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 282), and it includes the following genera:—*Eremoceras*, Hyatt, type *Cyrtoceras Syphax*, Billings (Pal. Foss. vol. i. p. 194, f. 178); *Clinoceras*, Mascke (Zeit. d. deutsch. geol. Gesell., Band xxviii. p. 49); *Poterioceras*, M'Coy (Synop. Carb. Foss. Ireland, 1844, p. 6). Only the last-named genus is represented in the National Collection.

² *Loc. cit.*

³ Min. Conch. vol. vi. p. 167, tab. dlxxxviii. f. 1 (not f. 2).

⁴ Geol. of Yorkshire, pt. ii. p. 238 (*O. fusiforme*).

⁵ Beiträge z. Petrefact. Heft iii. pp. 103, 105.

⁶ Syst. Sil. de l'Amérique Septentrionale, p. 33.

⁷ Géol. de la Russie d'Europe, vol. ii. Palæont. p. 357.

⁸ Pal. of New York, vol. i. p. 197.

⁹ Prodr. de Paléont. Stratigr. vol. i. p. 112.

¹⁰ Manual of the Mollusca, p. 90.

¹¹ Die Verstein. d. grauw. Form. in Sachsen, Heft ii. p. 33.

¹² Lethæa Rossica, vol. i. Seconde Sect. de l'ancienne Période, p. 1269.

¹³ *Ibid.* p. 1272.

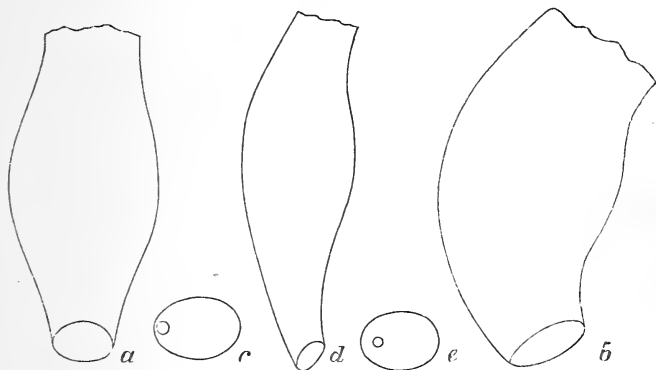
¹⁴ Geol. of Canada, Appendix, p. 951.

¹⁵ Syst. Sil. de la Bohême, vol. ii. pt. i. p. 243.

¹⁶ *Ibid.* p. 550 (*C. heteroclytum*).

Poterioceras makes its first appearance in the Ordovician (*P. constrictum*, Hall, sp.); then it is met with in the Silurian, in well-marked forms (*P. heteroclytum*, Barrande, sp.¹, Syst. Sil. vol. ii.

Fig. 45.



Poterioceras constrictum (after Hall).—*a*, view of the concave side of an imperfect specimen; *b*, lateral view of the same, showing the constriction below the body-chamber, aperture imperfect; *c*, transverse section of the lower extremity, showing siphuncle; *d*, diagram of *Poterioceras fusiforme*, much reduced; *e*, transverse section, showing siphuncle.

pl. cxviii.; *P. lumbosum*, Barr. sp., *ibid.* pl. cccclxiv.). Next it occurs in the Devonian under the generic names of *Gomphoceras* and *Phragmoceras* (see *ante*, p. 215), culminating in the Carboniferous, where it is represented by species of remarkable size (*P. fusiforme*, J. de C. Sowerby, sp.).

ORDOVICIAN SPECIES.

***Poterioceras approximatum*, M'Coy.**

1843. *Gomphoceras subfusiforme*?, Portlock, Geol. of Londonderry, &c. p. 381, pl. xxiv. f. 5 (not of Münster).
 1846. *Poterioceras approximatum*, M'Coy, Synop. Sil. Foss. of Ireland, p. 10, pl. i. f. 5.
 1851. *Cyrtoceras*, sp., Salter, Quart. Journ. Geol. Soc. vol. vii. p. 173, pl. x. f. 8.
 1854. *Phragmoceras approximatum*, Morris, Cat. of British Foss. 2nd ed. p. 312.
 1882. *Poterioceras* (?) *approximatum*, Blake, British Foss. Ceph. pt. i. p. 186, pl. xxiv. f. 6, and the figure copied from M'Coy but not numbered.

¹ *Fide* Hyatt, Proc. Boston Soc. Nat. Hist. 1883, p. 282. *P.* [*Oncoc.*] *Teucer*, Bill., and *P.* [*Oncoc.*] *Pettiti*, Bill., from the Niagara Group of Ontario, may also be cited (*vide* Cat. Sil. Foss. Anticosti, 1866, p. 86).

Sp. Char. "Elongate oval, slightly compressed; septa oblique, very approximate, rather less than a line apart in a specimen nine lines in diameter. Diameter at last chamber nine lines; length of specimen, imperfect at both ends, one inch two lines. The approximation of the septa distinguishes this from every other [species] of the genus with which I am acquainted." (*M. Coy.*)

Horizon. Middle Bala.

Locality. Ardwell, Ayrshire.

Represented by two specimens, one of which is that figured by Salter (*loc. cit.*).

Poterioceras constrictum, Hall, sp.

1832. *Spirula constricta*, von Dechen, Handb. der Geognosie von H. T. De la Beche, p. 536.

1843. *Nelimenia incognita*, Castelnau, Syst. Sil. de l'Amérique Septentrionale, p. 33, pl. x. f. 4.

1847. *Oncoceras constrictum*, Hall, Pal. of New York, vol. i. p. 197, pl. xli. ff. 6 *a-f* and 7 *a-d*.

1849. *Oncoceras constrictum*, d'Orbigny, Prodr. de Paléont. vol. i. p. 5.

1863. *Cyrtoceras constrictum*, Billings, Geol. of Canada, Appendix, p. 951.

1866. *Oncoceras constrictum*, Billings, Cat. of the Sil. Foss. of Anticosti, p. 23.

1869. *Cyrtoceras constrictum*, Safford, Geol. of Tennessee, p. 290.

Sp. Char. "Shell curving, ventricose in the middle, abruptly constricted near the aperture, and rapidly tapering towards the apex; septa very slightly convex, numerous, approximate, slightly undulating and bending upwards on the dorsal margin; section ovate, with the dorsal side narrower and somewhat obtusely angular; siphuncle small, dorsal [=convex, or ventral (?) border of the shell]; surface striated transversely." (*Hall.*)

Remarks. The figure given by Castelnau of his *Nelimenia incognita* undoubtedly represents the present species; it is, moreover, recorded from the same locality whence most of the examples in the Museum Collection were obtained, viz. the Falls of the Montmorenci, near Quebec. Castelnau's species seems, however, to have been overlooked by most of the American palæontologists. It is not mentioned by Hall or Whitfield, nor does S. A. Miller give it in his Cat. of Amer. Pal. Foss. even as a synonym. Scudder, however, records it in his 'Index of Genera.' Castelnau was quite unable to discover the affinities of his fossil, for he describes it as a "singular body, probably related to the class of the mollusks or perhaps to that of the crinoids"; and after describing the specimen he gave it "provisionally" the name above quoted.

Horizon. Trenton and Hudson River (= Bala Limestone?).

Localities. Montmorenci, near Quebec; Middleville, New York State (Trenton); Nottawasaga, Simcoe Co., Canada West (Hudson River).

Well represented in the Collection, most of the specimens having been presented by Dr. J. J. Bigsby, F.R.S.

CARBONIFEROUS SPECIES.

Poterioceras fusiforme, J. de C. Sowerby, sp.

1829. *Orthocera fusiformis*, J. de C. Sowerby, Min. Conch. vol. vi. p. 167, tab. dlxxxviii. f. 1. (excl. f. 2).
 1836. *Orthoceras fusiforme*, Phillips, Geol. of Yorkshire, pt. ii. p. 238, pl. xxi. ff. 14, 15.
 1844. *Poterioceras fusiforme*, M'Coy, Synop. Carb. Foss. of Ireland, p. 10.
 1844. *Apioceras fusiforme*, Fahrenkohl, Bull. de la Soc. Imp. des Natur. de Moscou, vol. xvii. p. 781.
 1848. *Orthoceras fusiforme*, Bronn, Nomencl. Palæont. p. 864.
 1849. *Gomphoceras fusiforme*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 112.
 1852. *Gomphoceras fusiforme*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 216.
 1854. *Poterioceras fusiforme*, Morris, Cat. of British Foss. 2nd ed. p. 312.
 1855. *Orthoceras (Poterioceras) fusiforme*, M'Coy, British Pal. Foss. fasc. iii. p. 569.
 ? 1856. *Gomphoceras lagena*, Eichwald, Bull. de la Soc. Imp. des Natur. de Moscou, p. 183.
 ? 1860. *Gomphoceras lagena*, Eichwald, Lethæa Rossica, vol. i. Seconde Sect. de l'ancienne Période, p. 1269, pl. xlvi. f. 16.
 1862. *Poterioceras fusiforme*, Griffith, Journ. Geol. Soc. of Dublin, vol. ix. p. 55.
 1876. *Poterioceras fusiforme*, Armstrong, Young, and Robertson, Cat. of the Western Scottish Fossils, p. 59.
 1880. *Gomphoceras fusiforme*, de Koninck, Faune du Calc. Carb. de la Belgique, pt. ii. p. 42, pl. xxxvii. ff. 4, a-c.

Sp. Char. Shell slender, very slightly curved, gradually expanding from the very slender (imperfect) apical extremity to within a short distance of the aperture; but before the latter is reached there is a well-marked constriction. The complete margin of the aperture has not been seen. The section of the shell is elliptical, making due allowance for the compression which many specimens have evidently undergone. The length of the body-chamber appears to be at least $\frac{1}{3}$ that of the entire shell, but this measurement is only approximate,

all the specimens that I have had the opportunity of examining wanting a considerable portion of the apex. The septa are numerous, being about 3 lines distant from each other where the shell has a diameter of 2 inches; the last two septa are much nearer together than the preceding ones. The septa have a slightly sigmoid obliquity corresponding to the dorso-ventral diameter of the shell. The siphuncle is much inflated between the septa, giving it a moniliform appearance when seen in a longitudinal section. It is marginal in the young shell, but recedes a little towards the centre in the adult. The test is moderately thick, with a perfectly smooth surface, or with very obscure transverse lines, to be seen only in well preserved specimens. One of the specimens has a series of faint longitudinal ridges in the constriction just below the aperture. There is a slightly raised rim at the base of the body-chamber, seen only upon casts of that portion of the shell.

Remarks. This fine shell is distinguished from *Poterioceras ventricosum*, its nearest ally, by its much more slender proportions.

One of the specimens figured by Sowerby (*loc. cit.* fig. 2) under the name "*Orthocera fusiformis*" represents a *Cyrtoceras*, and it will therefore be found described under that genus.

Horizon. Carboniferous Limestone.

Localities. Bolland, Yorkshire; Kildare, Naas, Cork, Ireland.

Represented in the Museum Collection by a very fine series of examples, including the one from Bolland figured by Phillips (*loc. cit.*), which is now contained in the "Gilbertson Collection."

***Poterioceras cordiforme*, Sowerby, sp.**

1821. *Orthocera cordiformis*, Sowerby, Min. Conch. vol. iii. p. 85, tab. cexlvii.
 1828. *Orthocera cordiformis*, Fleming, Hist. of British Animals, p. 238.
 1844. *Poterioceras ventricosum*, M'Coy, Synop. Carb. Foss. of Ireland, p. 10, pl. i. f. 2.
 1849. *Gomphoceras cordiforme*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 112.
 1849. *Gomphoceras ventricosum*, d'Orbigny, *ibid.*
 1852. *Gomphoceras cordiformis*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 216.
 1876. *Poterioceras cordiforme*, Armstrong, Young, and Robertson, Cat. of Western Scottish Fossils, p. 59.
 1876. *Poterioceras ventricosum*, Armstrong, Young, and Robertson, *ibid.*

Sp. Char. Shell very large, fusiform, much inflated, so that the width amounts to nearly half the length. Circular in cross section. The proportions of the body-chamber relative to the entire shell

cannot be accurately given, as the former is very imperfect in all the specimens I have access to. The septa are comparatively numerous, being about $\frac{1}{2}$ an inch apart where the diameter of the shell is 7 inches. The siphuncle is situated about midway between the centre and the margin, and is inflated between the septa. The surface of the test is marked only by fine lines of growth.

Remarks. This species attains a very large size in the Red Sandstone of Closeburn, Sowerby's type from that place giving the following measurements:—greatest length (imperfect at both ends) 9 inches; greatest diameter $7\frac{1}{2}$ inches.

I can find nothing to separate M'Coy's species (*P. ventricosum*) from this one.

Horizon. Red Sandstone Group of the Calciferous Sandstone series¹ (Closeburn specimens); Carboniferous Limestone (No. C, 326, —locality unknown).

Locality. Closeburn, Dumfriesshire.

Well represented in the Collection, which includes Sowerby's type, figured in the 'Mineral Conchology.'

¹ See footnote, *ante*, p. 121.

Family CYRTOCERATIDÆ.

Genus **CYRTOCERAS**, Goldfuss¹.

(*Amimonus*, Montfort, 1808²; *Conilites* (pars), Blainville, 1825³; *Orthocera* (pars), Fleming, 1828⁴; *Campulites*, Deshayes, 1832⁵; *Orthoceratites*, Steining, 1833⁶; *Lituites* (pars), Quenstedt, 1836⁷; *Phragmoceras* (pars), J. de C. Sowerby, 1839⁸; ? *Phragmoceras*, Portlock, 1843⁹; *Campyloceras*, M'Coy, 1844¹⁰; *Aploceras*, d'Orbigny, 1849¹¹; ? *Phragmoceras*, Schmidt, 1858¹²; *Phragmoceras* (pars), Eichwald, 1860¹³; *Cranoceras*, Hyatt, 1883¹⁴; [*Mælonoceras* and *Oonoceras*, Hyatt¹⁵, are subgenera].)

Gen. Char. Shell more or less curved, but never forming a complete volution; tapering rapidly (brevicone forms) or more slowly (longicone forms), these variations being illustrated in the subgenus *Meloceras*. Or, on the other hand, the shell may increase so slowly that it may be described as almost cylindroid (subgenus *Ooceras*). Cross section usually ovate, the longer axis in the plane of curvature; sometimes subcircular or even circular, more rarely transversely elliptical and depressed. Siphuncle usually small, sometimes with radiating deposits (*C. depressum*, d'Arch. & de Vern. *e. g.*); either external (*exogastric*), internal (*endogastric*), or subcentral (*mediogastric*)¹⁶; cylindrical or nummuloidal. Body-chamber generally large in proportion to the entire shell. Septa usually approximate, the last two often closer together than the rest. Ornamentation in the Ordovi-

¹ Von Dechen's Handb. der Geognosie von H. T. De la Beche, 1832, p. 536 (footnote).

² Conchyl. Systémat. vol. i. p. 327.

³ Manuel de Malacologie, p. 378.

⁴ Hist. of British Animals, p. 239.

⁵ Encyclop. Méthodique, vol. iii. p. 671.

⁶ Mém. Soc. Géol. de France, vol. i. pt. i. p. 368.

⁷ De notis Nautiliarum primariis, p. 23.

⁸ Murch. Sil. Syst. pt. ii. p. 621.

⁹ Geol. of Londonderry, pp. 382, 383.

¹⁰ Synop. Carb. Foss. Ireland, p. 6.

¹¹ Prodr. de Paléont. Stratigr. vol. i. p. 112.

¹² Silur. Form. von Ebstland, N.-Livland u. Oesel, p. 200.

¹³ Lethæa Rossica, vol. i. p. 1274 *et seq.*

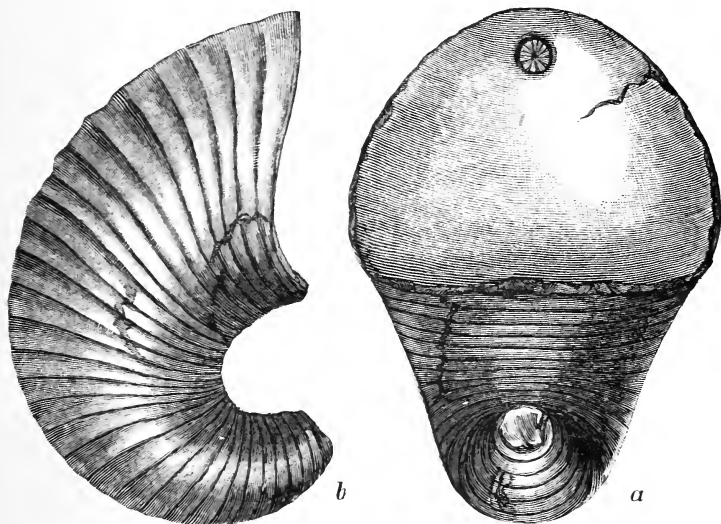
¹⁴ Proc. Boston Soc. Nat. Hist. vol. xxii. p. 281.

¹⁵ *Ibid.* p. 280. These names should be written *Meloceras* and *Ooceras*, in which amended form I shall employ them. *Meloceras* is derived from $\mu\eta\lambda\omicron\nu$, a goat; *Ooceras* from $\phi\acute{o}\nu$, an egg.

¹⁶ A division proposed by Blake to include species "in which the siphuncle is near the centre" (Brit. Foss. Ceph. pt. i. p. 56).

cian and Silurian species consists for the most part merely of lines of growth, sometimes developing into imbricating striæ, which are generally stronger in the region of the body-chamber. A few Silurian species are strongly sculptured; of these the following may be cited, viz.:—*Cyrtoceras* (*Meloceras*) *corbulatum*, Barr., in which there are longitudinal ridges, crossed by imbricating lamellæ; *Cyrtoceras* (*Meloceras*) *pergratum*, Barr., and *Cyrtoc.* (*Meloceras*) *extricatum*, Blake, both of which species are furnished with distinct

Fig. 46.



Cyrtoceras depressum.—*a*, front view; *b*, side view. Reduced to rather less than $\frac{1}{2}$ the natural size. From a specimen in the National Collection.

annulations. Some of the species of *Ooceras* are also annulated, though feebly. These two series of longitudinally ridged and annulated species may be paralleled with species of *Orthoceras* having similar ornaments. Some Devonian species, such as *Cyrtoceras* (*Meloceras*) *lamellosum*, d'Arch. and de Vern., are conspicuously ornamented, as are also some of the Carboniferous species, such as, e. g., *Cyrtoceras* (*Meloceras*) *canaliculatum*, de Kon., &c. Colour-bands are seen in some species¹.

Cyrtoceras ranges from the Cambrian to the Carboniferous, the greater number of forms being found in the Silurian.

¹ See, e. g., *Cyrtoceras depressum*, Goldfuss. Barrande describes and figures several species of *Cyrtoceras* which have bands of dark or light colour upon their shells. See Syst. Sil. de la Bohême, 1867, vol. ii. pt. i. p. 433.

Remarks. The genus *Cyrtoceras* (first called *Cyrtocera*) was originally established by Goldfuss for the reception of certain species of Cephalopods from the Devonian of the Eifel, published in von Dechen's translation of De la Beche's 'Geological Manual.' The new genus was briefly defined in the words "Halbmondförmig gebogene Orthoceræ," in a footnote to p. 536 of that work; the following species being enumerated as belonging to it, viz. :—

- Cyrtocera semilunaris*, Goldfuss.
- *depressa*, Goldfuss.
- *compressa*, Goldfuss (*Orthocera flexuosa*, Schloth.).
- *ornata*, Goldfuss.
- *annulata*, Goldfuss.
- *lineata*, Goldfuss.

From these *semilunaris* and *annulata* may be at once eliminated, as they have neither been described nor figured. The species *ornata* has become *Gyroceras ornatum*. It was described and figured by d'Arch. and de Vern. in the Trans. Geol. Soc. 1842, 2nd ser. vol. vi. p. 349, under the name of "*Cyrthoceratites ornatus*, Goldf., Bonn Museum." The species *compressa* must now be changed to *Cyrtoceras (Ooceras) flexuosum*, Schloth. sp. This also was described and figured by d'Arch. and de Vern. at p. 351 of the work just mentioned, under the name of "*Phragmoceratites subventricosus*, d'Arch. and de Vern., = *Cyrthoceratites compressus*, Goldf., Bonn Museum." Lastly, *depressa* and *lineata* remain to be disposed of, and as the former has been found in a more perfect condition than the latter, it may well be adopted as the type of the genus¹.

Prof. Hyatt, in his "Genera of Fossil Cephalopods" (Proc. Boston Soc. Nat. Hist. 1883, vol. xxii. p. 235), to which I have so often had occasion to refer, abolishes *Cyrtoceras* and *Gyroceras* from his system of classification, on the ground that they represent merely some of the stages through which Cephalopod shells pass in the course of race development. The following extracts may suffice to explain his views :— "The young of nautilian shells [*i. e.* shells that are close coiled as in *Nautilus*] are identical with the adults of the arcuate [like *Cyrtoceras*] and gyroceran [*i. e.* loose-coiled, like *Gyroceras*], and in different series repeat their forms, sutures, shell-markings, and the outlines of their whorl in transverse section. They are in succession, first arcuate, then gyroceran, and lastly nautilian or close coiled.

"In several series genetic lines of adult forms may be followed,

¹ Most of these particulars are taken from Barrande's exhaustive history of the genus *Cyrtoceras*, contained in the Syst. Sil. de la Bohême, vol. ii. pt. i. pp. 375-475.

which lead by gradation from arcuate, cyrtoceran forms to close coiled nautilian shells, the whole showing a connected series of transitions in the form and outline of section, sutures, structure and position of siphon, and shell ornaments and apertures. In some cases these graded series are in accord with the chronological record, the straight appearing first, the arcuate either in company with them or later in time, and the gyroceran and nautilian latest The generic terms *Cyrtoceras*, *Gyroceras*, and *Nautilus* are really only descriptive terms for the different stages in the development of an individual, and also the different stages in the development or evolution of the series of adult forms in time. In other words, each of these genera as now used, include representatives of all the different genetic series of Tetrabranchs which are either young shells in the corresponding stage of growth, or adult shells in the corresponding stage of evolution."

With reference to the retention of the words *Cyrtoceras*, *Gyroceras*, and *Nautilus* in a generic sense, I can see no reason why they should not continue to be so used, if the genera they represent be properly restricted. Prof. Hyatt employs the name *Nautilus* in a restricted sense, why therefore should we drop the other two out of our nomenclature?

The following diagnosis of the typical *Cyrtoceras* is here drawn up in order that the species belonging to it may be more readily distinguished from those of the two sections I have adopted as subgenera, viz. *Meloceras* and *Ooceras*.

Genus *Cyrtoceras* (restricted):—Includes rapidly expanding, usually large shells, which are of a depressed-elliptical form in cross section. The siphuncle is external, marginal or submarginal, often with radiating deposits. The septa are slightly concave, and the sutures point towards the aperture on the outer or peripheral side of the shell. Type, *Cyrtoceras depressum*, Goldfuss¹.

***Cyrtoceras depressum*, Goldfuss².**

1832. *Cyrtocera depressa*, Goldfuss, in von Dechen's Handb. der Geognosie von H. T. De la Beche, p. 536.

¹ The following species, in addition to the type, may be enumerated as examples of this genus:—*Cyrtoceras Llandoveri*, Blake, *C. Turnus*, Barrande, *C. hospitale*, Barr., *C. nigrum*, Barr., Silurian; *C. multiseptatum*, Roemer, Devonian.

² The real author of this species is Bronn, for he was the first to describe and figure it; but as all subsequent writers agree in assigning it to Goldfuss, a change in its authorship at this late date would be attended with considerable inconvenience.

1833. *Orthoceratites nautiloides*, Steuinger, Mém. Soc. Géol. de France, vol. i. p. 369, pl. xxiii. ff. 1, 1 a.
1837. *Cyrtocera depressa*, Bronn, Lethæa Geognostica, 2nd ed. Band i. p. 101, tab. i. f. 5.
1842. *Cyrthoceratites depressus*, d'Archiac and de Verneuil, Trans. Geol. Soc. 2nd ser. vol. vi. pt. ii. p. 350, tab. xxix. ff. 1, 1 a.
- ? 1843. *Cyrtoceras depressum*, Roemer, Die Verstein. des Harzgebirges, p. 35, tab. x. ff. 2, a, b.
1849. *Cyrtoceras nautiloideum*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 53.
1850. *Cyrtoceras depressum*, Roemer, Beiträge z. Geol. Kenntn. des Nordwestl. Harzgebirges, p. 38, tab. vi. f. 4.
1854. *Cyrtoceras depressum*, Roemer, Palæontographica, Band iii. ibid.
1883. *Cranoceras depressum*, Hyatt, Proc. Boston. Soc. Nat. Hist. vol. xxii.—“Genera of Fossil Cephalopods,” p. 281.

Sp. Char. Shell large, rapidly expanding, forming half a volution. Section subtriangular, the transverse diameter wider than the ventro-dorsal, the ratio in an adult specimen being as 43:55. The body-chamber is short, and the aperture somewhat contracted¹. The septa increase gradually in their distance from each other, from $2\frac{1}{2}$ lines in the young shell to 5 lines in the adult; they are but slightly concave, and their sutures bend forwards in crossing the convex or peripheral margin of the shell. The siphuncle increases considerably in diameter with the growth of the shell; for example, where the dorso-ventral diameter is 2 inches 2 lines, the siphuncle is 3 lines in diameter, and where the dorso-ventral diameter of the shell has increased to 3 inches 8 lines, that of the siphuncle measures $7\frac{1}{2}$ lines. It is filled with radiating deposits. “Shell [test] very thick upon the sides, thinner upon the back, marked with fine close-set lines of growth, rising over the back where they cross the suture of the septa at an angle which increases in proportion as these latter are nearer to the aperture” (*d'Archiac and de Verneuil*). Zigzag bands of colour are seen upon the cast in one of the specimens in the Museum Collection (Registered No. 66380)².

Remarks. In its rapid expansion, in the distance of its septa, and in the character and position of the siphuncle, the present species bears a considerable resemblance to the Silurian species *C. Turnus*, Barr.³; but the latter is much less coiled, and the siphuncle proportionately smaller.

¹ According to Prof. Hyatt, *loc. cit.*

² See also *Cyrtoceras (Meloceras) Iridis*, Barr. pl. cliii.

³ Syst. Sil. de la Bohême, vol. ii. 1877, Suppl. et Sér. tardive, p. 46, pl. cccclxxxiii. f. 1, pl. cccclxxxiv. ff. 1, 2.

Horizon. Stringocephalen-Kalk, Middle Devonian (Gerolstein); Goniatiten-Kalk (Adorf); Iberger-Kalk (Winterberg); Upper Devonian.

Localities. Gerolstein, Eifel; Adorf, Waldeck; Winterberg, North-western Hartz.

Fairly well represented in the Collection. The specimen from Adorf was presented by J. E. Lee, Esq., F.S.A., F.G.S.

Cyrtoceras lineatum, Goldfuss.

1832. *Cyrtocera lineata*, Goldfuss, in von Dechen's Handb. der Geognosie von H. T. De la Beche, p. 536.
1833. *Orthoceratites calycularis*, Steininger, Mém. Soc. Géol. de France, vol. i. p. 369, pl. xxiii. f. 2.
1833. *Orthoceratites ventricosus*, Steininger, Mém. Soc. Géol. de France, vol. i. p. 368, pl. xxii. f. 5.
1842. *Cyrtoceratites lineatus*, d'Archiac & de Verneuil, Trans. Geol. Soc. 2nd ser. vol. vi. pt. ii. p. 351, tab. xxx. ff. 2, 2 a.
1843. *Cyrtoceras ventricosum*, Roemer, Die Verstein. des Harzgebirges, p. 35, tab. x. f. 1.
1849. *Cyrtoceratites depressus*, Quenstedt, Die Petrefactenkunde Deutschl. Band i. Abth. i. p. 47, tab. i. ff. 17, a, b.
1849. *Cyrtoceras lineatum*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 53.
- ? 1850. *Cyrtoceras multiseptatum*, Roemer, Beiträge z. Geol. Kenntn. des Nordwestl. Harzgebirges, p. 38, tab. vi. f. 2.
1852. *Cyrtoceras Nessigi*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 201.

Sp. Char. Shell large, rapidly expanding, slightly curved, so that upon a chord of 38 lines subtending the concave side the highest perpendicular is only two lines. Section slightly elliptical, the ratio of the dorso-ventral to the transverse diameter (in an un-compressed example) being as 45 : 48. The septa are very slightly concave, and increase in their distance apart from $2\frac{1}{4}$ lines, where the shell has a diameter of 20 lines, to 5 lines where the diameter has increased to 48 lines. The siphuncle is of medium size and increases with the growth of the shell; it is seven lines in diameter where that of the shell is 48 lines; the interior is filled with radiating deposits. The shell is "marked externally with irregular, simple, sinuous lines of growth, which turn backward and pass above the siphon. The internal lamina of this shell presents longitudinal folds on each side of the back, which are often obsolete, but still distinct enough." (*d'Arch. & de Vern.*) Nothing is at present known of the body-chamber of this species.

Remarks. Some examples from the Eifel district which I have referred to this species are much compressed, so that the ellipticity of their sections is often enormously increased. This is especially the case in the older and wider part of the shell, the narrower portion presenting probably the normal shape. For example, in a specimen in which the dorso-ventral diameter measures 37 lines, the transverse measures 47. At the smaller end of this specimen, which probably represents its natural form, the ratio of the two diameters is as 18 : 21. Taking another example in which the ratio of the larger diameters is as 40 : 53 we find the smaller to be as 12 : 14. In another in which the shell is obviously very much crushed in its more expanded portion, the two diameters at the larger extremity are roughly as 36 : 60, while at the smaller end they are as 17 : 19.

If a fragment from Newton, South Devon, in a very imperfect condition, but showing the form of the section, can be referred to this species, which I think may be pretty safely done, it is the first example of *C. lineatum* recorded in this country.

Steininger states that the siphuncle in his species is situated on the concave side of the shell, but it is not seen in the figure, and it would seem that some other mark in the shell was mistaken for it, for Roemer mentions its situation as being quite close to the outer margin, adding that it is small, rounded, not beaded, and continuous.

Horizon. Great Devon Limestone (S. Devon), Stringocephalen-Kalk (Eifel); Middle Devonian: Iberger-Kalk (North-western Hartz); Upper Devonian.

Localities. British. Ivy-bridge Quarry, near Newton, South Devon.

Foreign. Gerolstein, Prüm, Eifel; Grund, Winterberg, North-western Hartz.

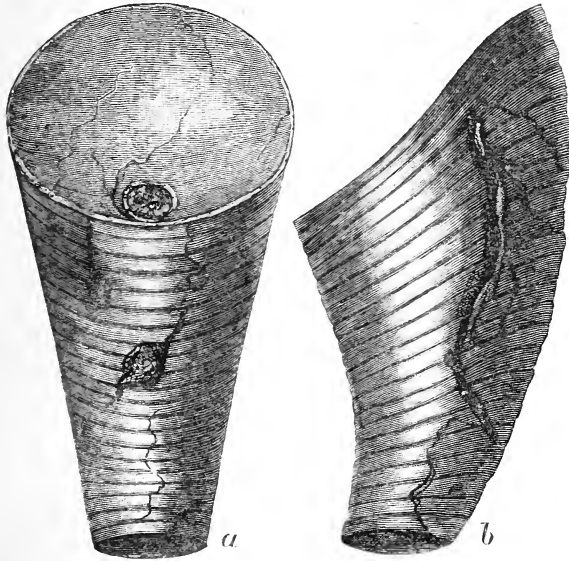
Well represented in the Collection by numerous specimens, the one from Prüm having been presented by Dr. H. Woodward, F.R.S., that from Newton by Martin F. Tupper, Esq., D.C.L., F.R.S.

Cyrtoceras obliquum, Foord.

Shell large, rapidly expanding, pretty strongly curved; upon a chord of 30 lines, subtending the concave side, the highest perpendicular is about 3 lines. Transverse section very slightly elliptical, the ratio of the two diameters being as 32 : 34. Septa approximate, about three lines distant from each other where the diameter of the shell is $2\frac{1}{4}$ inches; very shallow; the sutures pointing strongly forwards so as to make an angle in the thicker part of the shell of nearly 45°. The siphuncle is large and situated close to the inner border. The test is not preserved.

Remarks. This species is known only by a fragment of the septate part of the shell, which measures 4 inches 4 lines along the outer curvature, and $2\frac{1}{2}$ inches along the inner; its greatest diameter is 2 inches 10 lines, its least 1 inch 2 lines.

Fig. 47.



Cyrtoceras obliquum.—*a*, front view; *b*, side view. Reduced to about $\frac{2}{3}$ of the natural size. From a specimen in the National Collection.

The only Devonian species comparable with this one is *Cyrtoceras* (*Ooceras*) *flexuosus*, Schlotheim, sp., but the slow rate of tapering and the oviform character of the transverse section of the latter serve at once to distinguish it.

Horizon. Stringocephalen-Kalk: Middle Devonian.

Locality. Gerolstein, Eifel.

Represented in the Collection by a single imperfect specimen.

Subgenus **MELOCERAS**, Hyatt, emend. Foord.

This subgenus includes laterally compressed, more or less rapidly tapering shells, the section of which is somewhat broadly ovate, the narrower part corresponding with the periphery. The siphuncle may be external (*exogastric*), internal (*endogastric*), or, more rarely, subcentral (*mediogastric*). The body-chamber is usually short, as

compared with the total length of the shell. The curvature of the latter is generally slight. The group contains both longicone and brevicone species, and ranges from the Cambrian to the Carboniferous.

CAMBRIAN SPECIES.

Cyrtoceras (Meloceras) præcox, Salter, sp.

1866. *Cyrtoceras præcox*, Salter, *Memoirs of the Geol. Surv.* vol. iii. p. 358, pl. x. f. 3.
 1872. *Cyrtoceras præcox*, Salter, in Murchison's 'Siluria,' 5th ed. p. 535.
 1882. *Cyrtoceras præcox*, Blake, *British Foss. Ceph.* pt. i. p. 166, pl. xviii. ff. 6, 7.

Sp. Char. "About an inch long, conical, gently curved, the mouth very oblique, the inner (dorsal ?) margin being the prominent one. The septa, which follow the same curve, from within outwards, are placed very near together, four chambers in the space of $\frac{1}{10}$ of an inch." (*Salter.*)

The specimen in the British Museum is thus described by Prof. Blake :—"No section is seen; the curvature has a mean radius of $3\frac{1}{2}$ inches. The rate of increase is about 1 in 4. Across the surface are a number of parallel folds; but whether they are folds of growth, and the deeper lines the septa, or whether they are merely due to the tension of the material, cannot be determined." The position of the siphuncle is unknown.

Remarks. Prof. Blake cautiously observes that these two specimens may not belong to one species. Salter notices the interesting fact that *Cyrtoceras præcox* is the earliest Cephalopod known, and says that "it is not a little remarkable that the first species we meet with in ascending order should be—not *Orthoceras*, which is the most diffused and persistent form, but a genus which, so far as we know, is only Silurian [the term is here used to include Cambrian, Ordovician, and Silurian] and Devonian."

Horizon. Upper Tremadoc.

Locality. Garth, near Portmadoc, Carnarvonshire.

Represented by the example figured by Blake (*loc. cit.* f. 6).

ORDOVICIAN SPECIES.

Cyrtoceras (Meloceras) falx, Billings, sp.

1857. *Cyrtoceras falx*, Billings, *Geol. Surv. of Canada, Rep. of Progress for the years 1853-56*, p. 314.

1859. *Cyrtoceras falx*, Salter, Canadian Organic Remains, e. i. p. 32, pl. vii. ff. 1-4.

1863. *Cyrtoceras falx*, Billings, Geol. of Canada, Appendix, p. 951.

Sp. Char. "Laterally compressed, section an ellipse, somewhat acuminate at either end; diameters as 7 to 10; sides broadly convex; dorsal and ventral aspects more acutely rounded than the sides; septa much arched in the direction from the ventral to the dorsal aspects; in crossing the latter they are strongly undulated towards the aperture; siphuncle small, dorsal [external]; general curvature very slight near the oral extremity, but amounting to more than $\frac{2}{3}$ of a whorl in the last two inches in length of the small end. The specimens examined do not show the distance of the septa. The surface of the shell appears to have been striated transversely. A specimen which measures 3 inches in length along the outside curve tapers from 10 lines to 3 in the dorso-ventral diameter, and from $7\frac{1}{3}$ to $2\frac{1}{3}$ lines in the lateral diameters.

"Fragments of this species cannot well be distinguished from those of *C. simplex*, unless by attention to the form of the section, which in this species is about equally narrowed at either end, while in *C. simplex* it is more rounded on the ventral than on the dorsal aspect." (*Billings.*)

Remarks. To Billings's description of this species it may be added that Salter describes the septa as being "close, concave from back to front." He compares *C. falx* with *C. macrostomum*, *C. arcuatum*, and *C. camurum*, Hall, but recognizes the fact that these all have more distant septa.

Horizon. Black River (= Llandeilo Limestones?).

Locality. Allumettes Island, River Ottawa, Canada.

Represented by two imperfect specimens, transferred from the Museum of Practical Geology.

Cyrtoceras (Meloceras) centrifugum, Salter, sp.

1865. *Cyrtoceras centrifugum*, Salter, in Strachey's Palæont. of Niti in the Northern Himalaya, &c. p. 13, pl. ii. f. 1.

Sp. Char. "Slightly curved, ventricose (contracted toward the last chamber?), the section not much compressed laterally, broad, oval, 17 lines by 13, the siphon quite external. The septa are rather close [?] and concave; considerably arched backwards (but not oblique) on the sides, and therefore projecting forwards on the ventral and dorsal aspects. Last chamber? . . ."

"The shell is slightly curved, very conical from its rapid tapering, and appears to be contracted towards the last chamber. The section is regularly broad-oval; the siphuncle quite external and rather

large. The septa are not oblique, rather close, concave, considerably arched backwards on the sides, and therefore projecting forwards on the ventral and dorsal aspects. They are crowded on the inner side of the curve, and of course wider apart on the outer margin.

"The whole fragment is two inches long; the last chamber is not preserved in our single specimen, nor have we the pointed apex, which was probably more curved than the older part of the shell."

Remarks. The specimen is very imperfect: the most remarkable feature about it is the great proportionate distance of the septa from each other; I can find no species of the size of the present one in which the septa are so wide apart.

Horizon. Lower Silurian (Ordovician?).

Locality. Rimkin, Himalaya Mountains.

Represented in the Collection by the specimen figured and described by Salter, which was transferred from the Museum of Practical Geology.

SILURIAN SPECIES.

a. *Exogastric.*

Cyrtoceras (Meloceras) compressum ?, J. de C. Sowerby, sp.

1839. *Phragmoceras compressum*, J. de C. Sowerby, in Murchison's 'Silurian System,' pt. ii. p. 621, pl. xi. f. 2.

1854. *Phragmoceras compressum*, Salter, in Murchison's *Siluria*, pl. xxxi. f. 4.

1873. *Cyrtoceras ? compressum*, Salter, *Cat. Camb. and Silur. Foss.* p. 160.

1876. *Phragmoceras compressum*, Armstrong, Young, and Robertson, *Cat. of Western Scottish Fossils*, p. 21.

1882. *Cyrtoceras compressum*, Blake, *British Foss. Ceph.* pt. i. p. 177, pl. xviii. ff. 1, 2.

Sp. Char. "The section was probably elliptic, but in none is it perfectly preserved. The rate of increase is about 1 in 5 in the earlier portions, or even greater from contortion, but reduces to almost zero at last. The mean curvature is considerable, having a radius of $1\frac{1}{2}$ inches when the mean diameter of the shell is more than 1 inch. The body-chamber is as long as its basal diameter, and shows no change at the aperture. The ornaments, when preserved, are transverse sharp lines of growth, rather sigmoid in outline, and cutting the sutures towards the outside. The septa are approximate, concave on the side, but really sigmoid; they are very close, occasionally extremely so. The siphuncle is external and bulbous." (*Blake.*)

Remarks. The specimens I have referred to this species are very

imperfect, but they agree tolerably well with the above description and with Sowerby's and Blake's figures. The section is seen to be oval.

Horizon. Wenlock.

Locality. Dudley, Worcestershire.

Represented in the Collection by two imperfect specimens.

Cyrtoceras (Meloceras) isca, Blake, sp.

1882. *Cyrtoceras isca*, Blake, British Foss. Ceph. pt. i. p. 174, pl. xix. ff. 6, 7.

Sp. Char. "The section is elliptic, the diameters in the ratio of 24 to 19, the longer one in the plane of curvature. The curvature is never great, the type having a maximum. The rate of increase is rather greater than 1 in 4. The ornaments are direct, forward imbrications, from $\frac{2}{3}$ to $\frac{1}{2}$ a line apart, convex towards the aperture. These cease on the body-chamber, and give place to lines of growth. There is some appearance in one specimen of the aperture having been contracted like a *Phragmoceras*, but there is no other change in the shape of the body-chamber. The septa are very slightly convex, very close and sigmoid. The siphuncle in all is external and bulbous." (*Blake.*)

Remarks. Prof. Blake compares this species with *C. fortiusculum*, Barr., with which it agrees in "the closeness of the septa, the position and form of the siphuncle, and the general rate of increase;" but, he observes, Barrande's species is smooth, this one is ornamented. "It has also its sutures sigmoidal, and perhaps even closer, and its curvature is less."

Horizon. Lower Ludlow.

Locality. Sedgeley, Staffordshire.

Represented in the Collection by one imperfect example.

LONGICONES¹.

Cyrtoceras (Meloceras) ambiguum, Barrande, sp.

1848. *Cyrtoceras ambiguum*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. d. Naturwiss. in Wien, Band iv. p. 209.

1852. *Cyrtoceras ambiguum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras ambiguum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 482, pl. clviii. ff. 1-21, pl. cciii. ff. 7-10.

¹ The series of Bohemian species in the Museum Collection is sufficiently numerous to be divided into Longicones and Brevicones, according to Barrande's grouping.

Sp. Char. Shell straight above, but slightly curved in the lower or apical portion. The section is oval, the broadest extremity bearing the siphuncle, which is external and cylindrical. The ventro-dorsal diameter is to the transverse as 4 : 3, but it is sometimes reduced to 5 : 4. The body-chamber occupies somewhat less than $\frac{1}{3}$ the total length of the shell; it is slightly constricted near the aperture. The distance between the septa amounts to about $\frac{1}{3}$ of the ventro-dorsal diameter. The surface of the test is ornamented with very distinct, transverse, imbricating, raised lines, which become much more widely separated in the region of the aperture. The spacing of these ornaments upon the shell varies from $\frac{1}{4}$ of a line to 1 line.

Allied forms, such as *M. Suessi*, *M. electum*, and *M. quasirectum*, are endogastric, and may thus be easily distinguished from the present one.

Horizon. Étage E (= Salopian).

Localities. Lochkow, Kosořz, Wiskočilka, Bohemia.

Well represented in the Collection.

Cyrtoceras (Meloceras) clavulus, Barrande.

1867. *Cyrtoceras clavulus*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 491, pl. clvii. ff. 1-4, pl. cxcvii. ff. 1-7, pl. ccxxiii. ff. 4, 5.

Sp. Char. The shell is always of small size and very slightly arcuate, so that in a chord of 36 millim. subtending the concave side the highest perpendicular is 3 millim. The cross section is circular. The body-chamber has a length equal to the diameter of the aperture, and about $\frac{1}{3}$ of the length of the entire shell. There is no sinus observable in the aperture. The septa are distant from each other about $\frac{1}{6}$ the diameter of the shell. The siphuncle is cylindrical, and is situated on the convex border of the shell. The test is marked only with fine transverse lines of growth.

Remarks. This species is distinguished by its small size. Its nearest ally is *M. fugax*, which is differentiated from the present species by its coarser sculpture, and by the longitudinal lines which ornament its apex.

Horizon. Étage E (= Salopian).

Locality. Butowitz, Bohemia.

Represented in the Collection by two examples.

Cyrtoceras (Meloceras) corbulatum, Barrande, sp.

1867. *Cyrtoceras corbulatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 586, pl. cxxv., pl. ccxxiv. ff. 29-31.

Sp. Char. Shell strongly curved. Upon a chord of 70 millim., subtending the concave side, the highest perpendicular is 15 millim. But in several examples the shell shows a tendency to become straighter in the upper part of the more mature individuals. The cross section is an ellipse, of which the ventro-dorsal is to the transverse diameter as 5 : 6. The rate of increase is in the ratio of about 2 to 5 in a length of 60 millim. of the septate part of the shell, but it varies a little in different individuals. The body-chamber is very nearly equal in length to the ventro-dorsal diameter of the shell at its aperture, or about $\frac{1}{4}$ the total length of the shell. There is a series of very regularly spaced crenulations at the base of the body-chamber. A slight sinus presents itself on the convex border of the aperture. The septa are distant from each other in adult individuals about $\frac{1}{5}$ the shell-diameter; the number of septal chambers may be estimated at about 60 in an adult shell. The siphuncle is situated close to the margin of the convex border of the shell, its elements are inflated between the septa. The ornaments of the test consist of longitudinal ridges, so strong as to appear upon the cast; they extend throughout the whole length of the shell, without any intermediate lesser ridges (except in very young shells); they are from 16 to 22 in number; the spaces between them are a little concave. The ridges are crossed at pretty regular intervals by transverse imbricating lamellæ, which form very prominent frills standing out from the surface of the test. In the intervals between the ridges the lamellæ form little festoons whose convexity is directed towards the aperture. The lamellæ are rarely preserved in a calcareous matrix, but in the slaty rocks of Dworetz they are found intact. The spacing of the lamellæ varies considerably in different individuals.

Remarks. Closely allied to this species is the *Cyrtoceras tredecimale*, of Phillips (Pal. Foss. of Cornwall &c. p. 114, pl. xlv. ff. 215, a-d); but in the latter the ornamentation, though of a similar character, is coarser, there being only 13 longitudinal ridges in the circumference of the shell, and these are elevated at distant intervals, so that they form a series of encircling ridges, giving a boldly angulated appearance to the outline of the shell. The *Cyrtoceras acutocostatum* of G. and F. Sandberger (Die Verstein. Nassau, p. 144, Taf. xiii. ff. 5, 5a) seems to be identical with *C. tredecimale*. Phillips indeed mentions that his species is found in the Eifel.

Horizon. Étage E (= Salopian).

Localities. Prague, Dworetz, Bohemia.

Well represented in the Collection.

Cyrtoceras (Meloceras) corniculum, Barrande, sp.

1848. *Cyrtoceras corniculum*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 209.
1852. *Cyrtoceras corniculum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.
1856. *Cyrtoceras corniculum*, G. & F. Sandberger, Die Verstein. Nassau, p. 145.
1867. *Cyrtoceras corniculum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 492, pl. cxxi. ff. 1-19, ? pl. ccxvii. f. 3.
1873. *Cyrtoceras corniculum*, Salter, Cat. Cambrian and Silurian Foss. p. 160. (Figured in the margin.)
1882. *Cyrtoceras corniculum*, Blake, British Foss. Ceph. pt. i. p. 173, pl. xix. ff. 8, 8a.
- [Not 1860. *Cyrtoceras corniculum*, Eichwald, Lethæa Rossica, vol. i. Seconde Sect. de l'ancienne Période, p. 1288, pl. xlvii. f. 11.—
1862. *Cyrtoceras corniculum*, Hall, Rep. Geol. Surv. Wisconsin, vol. i. p. 41, ff. 1, 2.]

Sp. Char. Shell strongly curved, so as to form at least half a whorl when the apical part is preserved. The cross section is elliptical, the ratio of the ventro-dorsal to the transverse axis being about as 4 : 3. The rate of increase is about in the ratio of 2 to 5 in a length of 40 millim. of the apical part of the shell. The length of the body-chamber scarcely exceeds $\frac{1}{3}$ that of the entire shell. There is a well-marked sinus on the convex border of the aperture. The distance between the septa, measured in the central part of the shell, is equal to about $\frac{1}{3}$ of the corresponding diameter. The siphuncle is situated near to the convex border of the shell, but not in contact with the test; its elements are cylindrical. The ornaments of the test consist of irregularly-spaced, transverse raised lines or narrow bands having an upward imbrication. About the region of the body-chamber these bands become coarser, developing into folds, a variation frequently met with in these Bohemian species¹.

Remarks. The species most closely allied to the present one is *M. Thetidis*, Barr. (pl. cxii.), but it is a larger shell, less rapidly tapering, and has coarser ornaments; it is also less curved and more elongated than *M. corniculum*. Prof. Blake observes that "the British species present some little differences from the Bohemian, but the reference is probably right."

Horizon. Étage E (= Salopian).

Localities. Lochkow, Kosořz, Bohemia.

Well represented in the Collection.

¹ See *M. ambiguum*, *M. decipiens*, *M. imperiale*, &c.

Cyrtoceras (Meloceras) cycloideum, Barrande, sp.

1867. *Cyrtoceras cycloideum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 589, pl. cxli. ff. 16-25.

Sp. Char. This species is among the number of those which represent the maximum of curvature in *Cyrtoceras*; it forms in fact almost a complete whorl. No specimens have, however, been collected with the apex perfect. The transverse section is oval. The ventro-dorsal diameter is to the transverse nearly as 5:4. The rate of increase is in the ratio of 2 to 3, in a length of 30 millim. of the septate part of the shell. The body-chamber occupies about $\frac{1}{5}$ of the total length of the shell, making allowance for the missing portion. A row of crenulations encircle it in an oblique direction, about halfway between the base and the aperture. The septa are distant from each other about $\frac{1}{10}$ of the ventro-dorsal diameter. The siphuncle is situated on the convex border of the shell; its elements are slightly inflated between the septa. The test presents only fine lines of growth upon its surface, these form a well-marked sinus upon the periphery.

Remarks. *M. circumflexum*, Barrande (pl. cxx.), comes very near to the present species, but the siphuncle is cylindrical. Other allied species are *M. patiens*, Barr., and *M. discoideum*, Barr.

Horizon. Étage E (=Salopian).

Localities. Lochkow, Dlauha Hora, Bohemia.

Fairly well represented in the Collection.

Cyrtoceras (Meloceras) cyclostomum, Barrande, sp.

1867. *Cyrtoceras cyclostomum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 494, pl. cliv. ff. 1-10, pl. clvii. ff. 9-12.

Sp. Char. The greater number of examples of this species have only a very slight curvature. Upon a chord of 50 millim., subtending the concave side, the highest perpendicular is only 2 millim. The transverse section of the shell is nearly circular. The rate of increase is in the ratio of 1 to 2, in a length of 20 millim. of the septate part of the shell. The body-chamber is a little inflated in the upper part and narrows towards the aperture, where a slight constriction can be seen in the cast, so that the shell is somewhat fusiform in outline. The distance between the septa amounts to about $\frac{1}{3}$ the diameter of the shell. The siphuncle is situated on the convex border. The surface of the test is marked only with lines of growth.

Remarks. The very slight curvature of the shell and the inflation of the body-chamber distinguishes this species from its congeners.

Horizon. Étage E, bande e 1 (=Salopian).

Locality. Butowitz, Bohemia.

Well represented in the Collection.

Cyrtoceras (Meloceras) elongatum, Barrande, sp.

1848. *Cyrtoceras elongatum*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 209.

1852. *Cyrtoceras elongatum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras elongatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 499, pl. cix. ff. 1-10, pl. cxvii. ff. 5-11, pl. clvii. ff. 50-55, pl. ccii. ff. 16-18, pl. ccv. ff. 16-18, pl. ccviii. ff. 29, 30.

1877. *Cyrtoceras elongatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. Suppl. et Sér. tardive, p. 140, pl. dviii. ff. 9-11.

Sp. Char. The curvature is considerable, though stronger in the apical part than in the rest of the shell. Upon a chord of 90 millim., subtending the concave side of the shell, the highest perpendicular is 10 millim. The transverse section is a more or less flattened ellipse, of which the dorso-ventral is to the transverse axis as 7:4 in one individual measured, while in another it is 7:5. The body-chamber is short, being not more than $\frac{1}{6}$ the total length of the shell; it is sometimes crenulated at the base. The distance between the septa amounts to about $\frac{1}{9}$ the ventro-dorsal diameter; there are about 50 septa in adult individuals. The siphuncle is situated upon the convex border of the shell, at a little distance from the test; it is cylindrical. The surface of the test is either smooth or marked only with indistinct lines of growth.

Remarks. *M. sociale*, Barr., comes nearest to this species in form, but it is distinguished by the sculpture of the test, which consists of regular and prominent transverse plications, whose surface is covered with fine striæ running in the same direction.

Horizon. Étage E (=Salopian).

Localities. Lochkow, Konieprus, Bohemia.

Well represented in the Collection.

Cyrtoceras (Meloceras) fraternum, Barrande, sp.

1867. *Cyrtoceras fraternum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 503, pl. cix. ff. 22-27.

Sp. Char. Shell strongly curved, especially in the apical portion of it. Upon a chord of 80 millim., subtending the concave side of a nearly perfect specimen, the highest perpendicular is 17 millim. The transverse section is oval, of which the narrowest part corre-

sponds with the convex border of the shell. It should be observed that this border narrows very considerably, so that it forms in some specimens an obtuse keel along the median line. The dorso-ventral axis of the shell is to the transverse as 17 : 14. The rate of increase is in the ratio of 4 to 7, in a length of 40 millim. measured in the septate part of the shell; it is less above. The body-chamber occupies nearly $\frac{1}{3}$ of the total length of the shell; it is a little constricted near the aperture; there are crenulations at the base in some specimens¹. The aperture is nearly parallel to the plane of the last septum. The septa are distant from each other about $\frac{1}{10}$ of the diameter of the shell; the sutures have a slightly sinuous outline and point forward along the median line of the convex side of the shell. The siphuncle is situated close to the peripheral margin of the shell; its elements are cylindrical. The surface of the test is marked with irregular lines of growth, which form a very distinct sinus upon the convex side of the shell. A series of faint longitudinal and transverse lines are seen upon the cast.

Remarks. The species having the closest resemblance to this one is *M. Geinitzi*, Barr. (pl. cxxii.); but the latter has a much more flattened transverse section, its body-chamber is shorter, and its siphuncle nearer to the margin.

Horizon. Étage E (= Salopian).

Locality. Lochkow, Bohemia.

Well represented in the Collection.

Cyrtoceras (Meloceras) imperiale, Barrande, sp.

1848. *Cyrtoceras imperiale*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 209.

1852. *Cyrtoceras imperiale*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras imperiale*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 510, pl. cxi., pl. ccviii. ff. 17-20.

Sp. Char. The shell has a considerable curvature, especially in the apical portion. Upon a chord of 100 millim. subtending the concave side, the highest perpendicular is 20 millim. The transverse section is elliptical, of which the ventro-dorsal is to the transverse axis as 22 : 19. The increase in the lower half of the shell is in the ratio of 1 to 3, in a length of 60 millim. The body-chamber is not well developed; its length is about $\frac{1}{4}$ that of the entire shell. The aperture is parallel to the plane of the last septum. The distance of the septa from each other amounts to about $\frac{1}{10}$ the diameter of

¹ See one of the specimens registered No. 80332 in the Museum Collection.

the shell. The siphuncle is placed near the margin of the shell on the convex side. The test is thick; it is ornamented with very prominent transverse, imbricating plications, which become extremely coarse in the upper part of the shell, forming sharply angular ridges; the whole is covered with fine transverse lines.

Remarks. This species is distinguished from others of the same group by its general form and by its characteristic surface ornaments.

Horizon. Étage E (=Salopian).

Locality. Lochkow, Bohemia.

Well represented in the Collection.

Cyrtoceras (Meloceras) nuntius, Barrande, sp.

1867. *Cyrtoceras nuntius*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 606, pl. cxli. ff. 7-15, pl. ccii. ff. 5-13.

1877. *Cyrtoceras nuntius*, Barrande, *ibid.* Suppl. et Sér. tardive, p. 162, pl. dxvi. ff. 12-15.

Sp. Char. Shell moderately and uniformly curved. Upon a chord of 50 millim., subtending the concave side, the highest perpendicular is 5 millim. The transverse section is oval, the smaller extremity corresponding with the convex side of the shell, which is here slightly carinated. The ventro-dorsal is to the transverse axis as 7:6. The rate of increase in the septate part of the shell is in the ratio of 4 to 5, in a length of 20 millim. The body-chamber occupies about $\frac{1}{3}$ of the total length of the shell in adults. The distance between the septa increases slowly and scarcely exceeds $\frac{1}{2}$ of the ventro-dorsal diameter; about 40 septa may be counted in the entire shell. The siphuncle is placed upon the convex border of the shell; it is a little inflated between the septa. The surface of the test presents fine, irregular, transverse lines of growth.

Remarks. One of the nearest allies of the present species is *M. fortunatum*, Barr. (pl. cxiii.), but it is a thicker shell with a more rounded section, and its test is ornamented with crenulated striæ.

Horizon. Étage E, bande e 1 (=Salopian).

Locality. Butowitz, Bohemia.

Represented in the Collection by a single example.

Cyrtoceras (Meloceras) plebeium, Barrande, sp.

1848. *Cyrtoceras plebeium*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 209.

1852. *Cyrtoceras plebeium*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1860. *Cyrtoceras plebeium*, Barrande, Bull. Soc. Géol. de France, 2° sér. vol. xvii. p. 625.
1867. *Cyrtoceras plebeium*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 525, pl. cix. ff. 11-16, ?pl. clvii. ff. 44-46, pl. ccvii. ff. 1-5, pl. ccviii. ff. 10-16.
1882. *Cyrtoceras plebeium*, Blake, British Foss. Ceph. pt. i. p. 176, pl. xix. f. 5.

Sp. Char. Shell strongly and uniformly curved. Upon a chord of 50 millim., subtending the concave side of an incomplete specimen, the highest perpendicular is 14 millim. The section is oval, the ratio of the ventro-dorsal to the transverse axis being as 8:7. The body-chamber is a little longer than its basal diameter, and occupies about $\frac{1}{5}$ of the total length of the shell. The septa have a slight curvature forwards on the convex border; they are distant from each other $\frac{1}{8}$ the diameter of the shell. There are from 40 to 45 septa in the adult shell. The siphuncle is placed upon the convex border, without touching the test; it is about $\frac{1}{12}$ the diameter of the shell. The test has nothing upon it but irregular lines of growth.

Remarks. The species nearest to this one appears to be *M. famelicum*, Barr. (pl. ccvii.), but it has a proportionately longer body-chamber, and it is a stouter and more cylindrical shell. Barrande remarks upon the close resemblance between the present species and "*Cyrtoceras corniculum*, Hall, of the second fauna in America" (Rep. Geol. Surv. Wisconsin, 1862, vol. i. p. 41, figs. 1-2).

M. plebeium is identified by Prof. Blake from the Wenlock Limestone in this country. He says:—"Some little specimens, flattened in the Wenlock Limestone, agree, so far as their characters are preserved, with this species" (*loc. cit.*). He regards *M. macrum*, Blake, as its nearest ally in the British rocks.

Horizon. Étage E, bande e 2 (= Salopian).

Localities. British. Dudley, Worcestershire (Wenlock Limestone). *Foreign.* Dlanha Hora, Butowitz, Wiskočilka, Bohemia.

Well represented in the Collection, which contains the specimen figured by Blake.

Cyrtoceras (Meloceras) problematicum, Barrande, sp.

1848. *Cyrtoceras problematicum*, Barrande, Haidinger, Bericht über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 209.
1852. *Cyrtoceras problematicum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.
1867. *Cyrtoceras problematicum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 256, pl. cxvi. ff. 1-9, pl. ccvi. ff. 17-25.
1877. *Cyrtoceras problematicum*, Barrande, *ibid.* Suppl. et Sér. tardive, p. 172, pl. dvi. ff. 1-6.

Sp. Char. The curvature in this species is always distinct, without being strong. Upon a chord of 60 millim., subtending the concave side of a young specimen, the highest perpendicular is 7 millim. The transverse section is oval, the ratio of the two diameters being as 4 : 3. The rate of increase is in the ratio of 3 to 4, measured in a length of 35 millim., in the septate part of the shell. The body-chamber occupies between $\frac{1}{3}$ and $\frac{1}{4}$ of the total length of the shell; the aperture is in the plane of the last septum, it is slightly emarginate upon the ventral border. The distance between the septa is equal to about $\frac{1}{3}$ of the corresponding ventro-dorsal diameter. The siphuncle is situated close to the convex border; its elements are elongated and cylindrical. The surface of the test is ornamented with transverse, irregularly spaced, upwardly imbricating folds, and these are covered with fine lines running in the same direction.

Remarks. The species most closely allied to this one is *M. sociale*, Barr. (pl. cviii. &c.); but the latter is much more strongly arcuate and increases less rapidly, its ornaments are also more strongly developed.

Horizon. Étage E, bande e 2 (=Salopian).

Localities. Lochkow, Wiskočilka, Bohemia.

Fairly well represented in the Collection.

Cyrtoceras (Meloceras) sociale, Barrande, sp.

1848. *Cyrtoceras sociale*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 209.

1852. *Cyrtoceras sociale*, Gumbel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras sociale*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 530, pl. cviii. ff. 1-12, pl. ccv. ff. 1-7.

Sp. Char. Shell strongly curved, more especially in the apical portion. Upon a chord of 67 millim., subtending the concave side of the specimen, the highest perpendicular is 29 millim. The transverse section is oval, the ratio of the two diameters being as 6 : 5. The body-chamber is short, occupying scarcely $\frac{1}{6}$ of the total length of the shell in the larger examples; the aperture is parallel to the plane of the last septum. The distance between the septa equals about $\frac{1}{7}$ of the corresponding diameter of the shell. The siphuncle is very near the convex border; its elements are elongate and cylindrical. The test is ornamented with somewhat irregular transverse folds or narrow bands, which become coarser as the shell attains adult dimensions, the whole being covered with exceedingly fine transverse lines, visible only with the aid of a lens.

Remarks. A comparison has already been instituted between *M. problematicum*, Barr., and the present species.

Horizon. Étage E (= Salopian).

Locality. Dlauha Hora, Bohemia.

Well represented in the Collection.

Cyrtoceras (Meloceras) tardum, Barrande, sp.

1867. *Cyrtoceras tardum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 533, pl. cxvi. ff. 10-22, pl. cxlvii. ff. 39-48.

Sp. Char. This species is characterized by its very strong curvature, uniformly developed throughout the whole length of the shell, and making almost a complete whorl. The transverse section is elliptical, the ratio of the two diameters being as 18:17. The increase is in the ratio of 1 to 2 in a length of 50 millim. measured in the septate part of the shell. The body-chamber is nearly as wide at the base as it is at the aperture; its length is a little less than that of the ventro-dorsal diameter at the aperture, or $\frac{1}{4}$ the length of the shell. The distance between the septa is in the largest examples $\frac{1}{11}$ of the ventro-dorsal diameter. The siphuncle is placed close to the convex border, but without touching the test. The latter is ornamented with regular, transverse, very close-set striæ, which make a very distinct sinus in the median line of the convex border; a few faint longitudinal lines are sometimes seen crossing these.

Remarks. *M. gibbum*, Barr. (pl. cxix.), is a very closely allied species, but its septa are more approximate in the upper part of the shell, and its ornaments, though of the same character as those of *M. tardum*, are coarser.

Horizon. Étage E (= Salopian).

Locality. Karlstein, Bohemia.

Represented in the Collection by two imperfect specimens.

Cyrtoceras (Meloceras) velox, Barrande, sp.

1867. *Cyrtoceras velox*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 538, pl. cliv. ff. 14-24, ? pl. clvii. ff. 20-24, pl. ccxl. bis. ff. 10-18.

Sp. Char. Curvature well marked and nearly uniform throughout the whole length of the shell. Upon a chord of 55 millim., subtending the concave side of the largest specimen measured, the highest perpendicular is 10 millim. The transverse section is nearly circular at the apex, but becomes elliptical in the adult part

of the shell. The rate of increase is in the ratio of 1 to 3 in a length of 40 millim., measured in the septate part of the shell. The body-chamber occupies about $\frac{1}{3}$ of the total length of the shell; the aperture is a little oblique to the plane of the last septum. The distance between the septa equals about $\frac{1}{10}$ of the corresponding diameter of the shell. The siphuncle is situated close to the convex border of the shell, at a little distance from the test; its elements are elongated and cylindrical. The surface of the test is ornamented with transverse, imbricating striæ, covered with extremely fine lines running in the same direction; in some specimens the latter are obsolete.

Remarks. *M. decipiens*, Barr. (pl. cliv.), is very closely allied to *M. velox*, but it has a more rapid rate of increase and is much less curved.

Horizon. Étage E, bande e 1 (= Salopian).

Locality. Butowitz, Bohemia.

Represented in the Collection by a single example.

BREVICONES.

Cyrtoceras (Meloceras) acutum, Barrande, sp.

1848. *Cyrtoceras acutum*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. d. Naturwiss. in Wien, Band iv. p. 209.

1852. *Cyrtoceras acutum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras acutum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 539, pl. cli. ff. 1-10.

Sp. Char. Curvature very slight; upon a chord of 30 millim., subtending the concave side, the highest perpendicular is only 2 millim. The transverse section is circular. The rate of increase in the septate part of the shell is about 2 in 3. Body-chamber greatly developed, its length being equal to nearly $\frac{2}{3}$ the diameter of the aperture, or half that of the entire shell. The aperture has neither sinus nor constriction. The septa are distant from each other about $\frac{1}{7}$ the diameter of the shell. The siphuncle is cylindrical, and is situated close to the external border of the shell. The test is ornamented with fine transverse, somewhat regular raised lines, while a series of very faint longitudinal lines may be seen, under a low magnifying-power, crossing them.

Remarks. The species that has the nearest resemblance to this one is *M. sequax*, Barr. (pl. clii.), but it is distinguished by its larger siphuncle and by the character of its ornaments.

Horizon. Étage E (= Salopian).

Locality. Karlstein, Bohemia.

Represented in the Collection by two examples.

Cyrtoceras (Meloceras) decipiens, Barrande, sp.

1867. *Cyrtoceras decipiens*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 544, pl. cxlvii. ff. 30-33, pl. clix. ff. 25-33.

1877. *Cyrtoceras decipiens*, Barrande, *ibid.* Suppl. et Sér. tardive, p. 135, pl. dxxxv. ff. 4-12, pl. dxxxix. ff. 3-12.

Sp. Char. Curvature very slight; upon a chord of 60 millim., subtending the concave side, the highest perpendicular is only 2 millim. The transverse section is elliptical; the ventro-dorsal diameter is to the transverse as 7 : 6. The rate of increase in a length of 45 millim. in the septate part of the shell is in the ratio of 1 to 5. The body-chamber occupies about $\frac{2}{7}$ of the total length of the adult shell. The distance between the septa amounts to about $\frac{1}{8}$ of the corresponding ventro-dorsal diameter. The siphuncle is situated close to the convex border of the shell, without touching the test. The ornaments of the test consist of regular transverse plications which have an upward imbrication; these are covered with fine, close-set, transverse lines. The plications become coarser in the upper part of the shell, especially upon the body-chamber.

Remarks. A comparison has already been made between this species and *M. velox*, Barr. sp. (*q. v.*). It may also be compared with *M. inversum*, Barr. sp. (pl. clv.), which, however, has a more rapid rate of increase and a proportionately longer body-chamber.

Horizon. Étage E (=Salopian).

Locality. Lochkow, Bohemia.

Represented in the Collection by two imperfect specimens.

Cyrtoceras (Meloceras) intermedium, Barrande, sp.

1848. *Cyrtoceras intermedium*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. d. Naturwiss. in Wien, Band iv. p. 209.

1852. *Cyrtoceras intermedium*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras intermedium*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 552, pl. cxlvii. ff. 27-29, pl. cxlix. ff. 13-17, pl. cli. pl. cli. ff. 22-27.

1877. *Cyrtoceras intermedium*, Barrande, *ibid.* Suppl. et Sér. tardive, p. 29, pl. cccxxvii. ff. 26-40.

[Not 1882. *Cyrtoceras intermedium*, Blake, British Foss. Ceph. pt. i. p. 179, pl. xx. f. 6, &c.]

Sp. Char. Shell always rapidly expanding, though more so in some examples than in others. In the most arcuate forms it is found that upon a chord of 50 millim. the highest perpendicular is 5 millim. In some specimens, however, the shell is straight except in the apical portion, *i. e.* for about $\frac{1}{5}$ of the length. The transverse section is elliptical, the ratio of the two diameters being as 7 : 8. The body-chamber varies considerably in its dimensions in different individuals; its length in some examples is about $\frac{3}{7}$ that of the entire shell, in others it is nearly $\frac{1}{2}$. The convex border of the aperture has a slight sinus, otherwise it is quite simple. The distance between the septa is equal to about $\frac{1}{12}$ the diameter of the shell. The siphuncle is close to the convex border, without touching the test; its elements are elongated and cylindrical. The surface of the test is ornamented with strong transverse striæ, having a direct imbrication, upon these still finer lines are seen in the upper part of the shell. Longitudinal lines are met with upon the upper part of the body-chamber; they are variable in number in different individuals, and are somewhat widely spaced.

Remarks. The present species is distinguished from others of similar character by the longitudinal lines upon its test.

Horizon. Étage E (=Salopian).

Localities. Karlstein, Kosořz, Bohemia.

Fairly well represented in the Collection.

Cyrtoceras (Meloceras) obesum, Barrande, sp.

1848. *Cyrtoceras obesum*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. d. Naturwiss. in Wien, Band iv. p. 209.

1852. *Cyrtoceras obesum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras obesum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 557, pl. cxiv. ff. 22-26.

1877. *Cyrtoceras obesum*, Barrande, *ibid.* Suppl. et Sér. tardive, p. 163, pl. dviii. ff. 6-8, pl. dxxi. ff. 10-13.

Sp. Char. Shell pretty strongly curved; upon a chord of 50 millim., subtending the concave side, the highest perpendicular is 8 millim. The transverse section is nearly circular, the ratio of the two diameters being as 11 : 10. The rate of increase in the septate part of the shell is about 1 in 2. The body-chamber occupies about $\frac{2}{5}$ of the total length of the shell; there are crenulations at its base in some examples¹. The plane of the aperture is slightly inclined towards the concave side; there is a slight constriction

¹ See Barrande, *loc. cit.* pl. dviii. f. 6.

below the aperture. The distance between the septa is equal to about $\frac{1}{2}$ the ventro-dorsal diameter. The siphuncle is placed at a little distance from the convex border; it is slightly inflated between the septa. The outer surface of the test shows a series of irregularly spaced and indistinct lines of growth crossed by extremely fine longitudinal lines. Beneath this outer layer is an inner one, the surface of which is ornamented with a series of close-set transverse lamellæ, with a direct imbrication.

Remarks. This species is distinguished from all others of the same group by its short and inflated form, as well as by the ornaments of its test. *M. validum*, Barr. sp. (pl. cxiv. ff. 13-21), is its nearest ally, but that species increases less rapidly and its surface ornaments are different.

Horizon. Étage E, bande e 2 (= Salopian).

Locality. Lochkow, Butowitz (bande e 1), Bohemia.

Represented in the Collection by two examples.

Cyrtoceras (Meloceras) sericarius, Barrande, sp.

1877. *Cyrtoceras sericarius*, Barrande, Syst. Sil. de la Bohême, vol. ii. Suppl. et Sér. tardive, p. 182, pl. dxxviii. ff. 6-10.

Sp. Char. The shell is very slightly curved. Upon a chord of 35 millim., subtending the concave side of the shell, the highest perpendicular is only 3 millim. The transverse section is nearly circular. The rate of increase in a length of 25 millim., measured in the septate part of the shell, is in the ratio of 2 to 5. The body-chamber occupies nearly half the entire length of the shell. The outline of the aperture is parallel to the plane of the last septum. The distance between the septa near the body-chamber is equal to about $\frac{1}{8}$ the diameter of the shell. The siphuncle is close to the convex border, without touching the test; its elements are cylindrical. The ornaments of the test consist of a series of transverse, fine, and regular raised lines, separated by spaces equal to about half their diameter; about five of the lines may be counted in the space of 1 line.

Remarks. The specimen figured by Barrande under the name of *Orthoceras infundibulum* (pl. cxc. f. 1) appears to me to be identical with the present species, and that author admits this to be probable, though he places it with other types.

Horizon. Étage E, bande e 2 (= Salopian).

Locality. Karlstein, Bohemia.

Represented in the Collection by a single example.

Cyrtoceras (Meloceras) verna, Barrande, sp.

1867. *Cyrtoceras verna*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 569, pl. cviii. ff. 19-22, pl. cxlvii. ff. 23-26.

Sp. Char. The curvature in this species is considerable, and nearly uniform throughout the whole length of the shell. Upon a chord of 50 millim. in length, subtending the concave side of a specimen measured, the highest perpendicular was found to be 9 millim. The transverse section is circular. The rate of increase measured in the septate part of the shell is about 1 in 2. The body-chamber occupies nearly $\frac{2}{5}$ of the total length of the shell. The distance between the septa is equal to about $\frac{1}{10}$ of the diameter of the shell. The siphuncle is situated close to the convex border, but without touching the test; its elements are cylindrical. The ornaments of the test consist of extremely fine transverse striæ having a direct imbrication, and becoming more prominent towards the aperture.

Remarks. The species most nearly resembling the present one is *M. validum*, Barr. sp. (pl. cxiv.), but it is distinguished by its more rapid rate of increase and larger size.

Horizon. Étage E, bande e 2 (= Salopian).

Localities. Butowitz, Hinter Kopanina, Bohemia.

Represented in the Collection by two examples.

Barrande observes that while the largest individuals of *M. verna* are longicones in form, those most frequently met with are brevicones.

Cyrtoceras (Meloceras) arcticameratum, Hall, sp.

1852. *Cyrtoceras arcticameratum*, Hall, Pal. of New York, vol. ii. p. 349, pl. lxxxiv. ff. 7 a-d.

1882. *Cyrtoceras arcticameratum*, Whitfield, Geol. of Wisconsin, pt. iii. Palæont. p. 360.

Sp. Char. "Elongated, slender, gradually tapering and gently incurved; septa numerous, slightly convex; section transversely oval; siphuncle dorsal" [*i.e.* on the external border]. (*Hall.*)

Horizon. Niagara Group (Wenlock).

Locality. Chicago, Illinois.

Represented in the Collection by a single example.

b. *Endogastric*.

LONGICONES.

Cyrtoceras (Meloceras) neutrum, Barrande, sp.

1867. *Cyrtoceras neutrum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 679, pl. clxv. ff. 1-7, pl. cc. ff. 5-8.

Sp. Char. Examples of this species are always more or less strongly arcuate, and the shell would form at least half a whorl if complete. The transverse section is oval; the slightly smaller of the two extremities corresponding with the concave border of the shell. The ratio of the two diameters of the oval is as 5 : 4, increasing to about 4 : 3 in some individuals. The rate of increase is 1 in 2; but this varies a little in different examples, the dilatation being more rapid in the apical portion of the shell, as in other species of *Meloceras*. The body-chamber is relatively short, occupying about $\frac{1}{4}$ of the total length of the shell. The aperture shows a very distinct sinus on the concave side, and a very shallow one appears also on the convex border. The distance of the septa from each other is equal to about $\frac{1}{10}$ of the ventro-dorsal diameter of the shell. The siphuncle is placed close to the concave border; it is slightly inflated between the septa, so that its elements are nummuloidal in character. The test is ornamented with striæ of growth somewhat irregularly spaced and of unequal strength.

Remarks. The nearest ally of the present species is *M. Murchisoni*, Barr., sp. (pls. clx., clxv., &c.), but the latter has a much more rapid rate of tapering, and the body-chamber is considerably larger in proportion to the entire shell.

Barrande compares the present species with *M. intermedium*, M'Coy, sp. (= *M. arcuatum*, J. de C. Sow., sp.), to which he finds that it bears a strong resemblance. I shall have occasion to refer to this subject again when dealing with the latter species¹.

Horizon. Étage E (= Salopian).

Localities. Lochkow, Dlauha Hora, Bohemia.

Represented in the Collection by three examples.

BREVICONES.

Cyrtoceras (Meloceras) aduncum, Barrande, sp.

1848. *Cyrtoceras aduncum*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, p. 209.

¹ See *infra*, p. 303, under *M. M'Coyi*.

1852. *Cyrtoceras aduncum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras aduncum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 683, pl. clxix. ff. 9-14, pl. clxxxi. ff. 10, 11.

Sp. Char. Shell large and of robust habit, having only a slight curvature in the apical portion, the rest being nearly straight. The transverse section is nearly circular. The rate of increase is about 1 in 2, measured in the septate part of the shell. The body-chamber, which occupies nearly one half of the total length of the shell, dilates less rapidly than the septate part. The aperture is parallel to the plane of the last septum; it has a strongly marked sinus on the concave border. The distance between the septa is equal to about $\frac{1}{7}$ the diameter of the shell, and their convexity equals about $\frac{1}{5}$ of the same. The siphuncle is situated in close proximity to the concave border, without, however, touching it; it is composed of flattened nummuloid segments disposed obliquely, in conformity with the inclination of the septa; the width of the segments is equal to $\frac{1}{7}$ the diameter of the shell. The test is ornamented with transverse lamellose striæ having a direct imbrication; they are but rarely preserved.

Remarks. *M. speciosum*, Barr., sp. (pl. clxx.), resembles *M. aduncum* in its general appearance, but it expands more rapidly, and the siphuncle has quite a different form (pl. clxxviii. f. 3).

The appearance of the siphuncle in the present species recalls that of *Actinoceras*.

Horizon. Étage F (= Downtonian).

Locality. Konieprus, Bohemia.

Represented in the Collection by two examples.

Cyrtoceras (Meloceras) Beaumonti, Barrande, sp.

1848. *Cyrtoceras Beaumonti*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, p. 209.

1852. *Cyrtoceras Beaumonti*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras Beaumonti*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 685, pl. clxv. ff. 21-26.

Sp. Char. The curvature in this species represents the maximum attained in the genus *Cyrtoceras*; but the initial point of the shell is at some distance from the body-chamber, the latter projecting considerably beyond it as in some other genera, such as the endogastric forms of *Gomphoceras*, &c. The initial point of the shell instead of being acute, as in other allied forms, is rounded; it is covered by the *calotte conique* (pl. clxv. f. 21). The transverse

section is oval, the ratio of the two diameters being as 4 : 3. The rate of increase is very rapid, being about 1 in 2, measured in the septate part of the shell. The body-chamber is proportionately very large, occupying at least half of the total extent of the shell, and its bulk is equal to twice or three times that of the septal chambers. The outline of the aperture corresponds with that of the transverse section, but it expands rapidly in the direction of the ventro-dorsal diameter. The distance between the septa is equivalent to about $\frac{1}{10}$ of the ventro-dorsal diameter. The siphuncle is situated close to the concave border, and is composed of nummuloidal segments whose breadth increases very rapidly: thus, between the last two septa it occupies $\frac{1}{5}$ of the ventro-dorsal diameter, whilst at the fifteenth septum below it is only $\frac{1}{10}$ of the same. The form of the segments is oval, and they are much elongated ventro-dorsally, their interior is filled with an "organic deposit" of a peculiar appearance. The test is ornamented with fine and pretty regular transverse striæ, which are convex towards the aperture on the sides of the shell, whilst they are concave on the convex border, and on the concave border they make a relatively deep and narrow sinus.

Remarks. This species is distinguished from its congeners, such as *M. neutrum*, Barr., sp. (pl. clxv.), and *M. Murchisoni*, Barr., sp. (pl. clxv.), by the great rapidity of its expansion, by its curvature, by the form of its siphuncle, organic deposit, &c.

Horizon. Étage E, bande e 2 (=Salopian).

Localities. Lochkow, Konieprus, Bohemia.

Well represented in the Collection.

Cyrtoceras (Meloceras) debile, Barrande, sp.

1848. *Cyrtoceras debile*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, p. 208.

1852. *Cyrtoceras debile*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras debile*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 655, pl. clxviii. ff. 25-29, pl. clxxvii. ff. 19-24.

Sp. Char. Shell variable in its amount of curvature. Upon a chord of 45 to 50 millim. the highest perpendicular varies from 2 to 5 millim. The transverse section is nearly circular. The rate of increase is 1 in 4, measured in the septate part of the shell. The body-chamber is well developed, its length being a little less than half that of the entire shell, and its bulk nearly three times that of the septate part. The aperture exhibits a distinct though shallow sinus on the concave border. The distance between the septa amounts to about $\frac{1}{8}$ the diameter of the shell. The siphuncle is

situated close to the concave border of the shell, without, however, touching the test; it is cylindrical. The surface of the test is ornamented with striæ, which in several examples are stronger upon the septate part of the shell than they are upon the body-chamber.

Remarks. The species having the nearest affinity to this one is *M. imbelle*, Barr., sp. (pl. clxvii.), which is easily distinguished by its greater curvature, its less developed body-chamber, and by the fine longitudinal lines upon its test in the septate part of the shell.

Horizon. Étage E (=Salopian).

Locality. Wiskočilka, Bohemia.

Represented in the Collection by a single example.

Cyrtoceras (Meloceras) expandens, Barrande, sp.

1867. *Cyrtoceras expandens*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 659, pl. clxvii. ff. 11-14.

Sp. Char. Shell nearly straight. Transverse section circular. Rate of increase of the septate part of the shell about 1 in 2. The body-chamber occupies nearly one half of the entire shell, while its bulk is at least four times that of the septate part. The distance between the septa is equal to about $\frac{1}{10}$ the diameter of the shell. The siphuncle is close to the concave border without touching the test, it is cylindrical, but very slightly inflated between the septa. The test is ornamented with regular, close-set imbricating striæ, of which there are from 6 to 8 in the space of a line. The septate part of one of the specimens in the Museum Collection is beautifully ornamented with light-coloured zigzag bands resembling those figured by Barrande in *M. Iridis*, Barr., sp. (pl. cliii. f. 21).

Remarks. This species is readily distinguished from its congeners by its very rapid expansion, forming an angle of about 30°.

Horizon. Étage E (=Salopian).

Locality. Karlstein, Bohemia.

Represented in the Collection by three examples.

Cyrtoceras (Meloceras) forte, Barrande, sp.

1867. *Cyrtoceras forte*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 660, pl. clxi., pl. clxxiv. ff. 1-8, pl. clxxvi. ff. 1-4.

1877. *Cyrtoceras forte*, Barrande, *ibid.* Suppl. et Sér. tardive, p. 24, pl. ccccxv. ff. 32-35, pl. cccclxix. ff. 6-9; p. 143, pl. dii. ff. 9-12.

Sp. Char. Shell nearly straight. In adult specimens it is found that upon a chord of 150 millim. subtending the concave side the highest perpendicular measures 6 millim. The transverse section is sometimes subcircular, sometimes oval. The ratio of the two

diameters in an adult specimen is as 6 : 5. The rate of increase is about 1 in 2, measured in the septate part of the shell. The body-chamber varies in its relative length, but it may be taken at about $\frac{2}{5}$ of the total length of the fossil; its capacity is nearly equal to that of the whole of the septate part of the shell; the base is sometimes crenulated. The aperture is for the most part parallel to the plane of the last septum, in rare cases it is inclined towards the convex side. The distance between the septa varies very considerably in different individuals: thus, in a short and wide form it is $\frac{1}{15}$ of the diameter of the shell, in a long individual it is $\frac{1}{9}$ of the same near the body-chamber. The siphuncle is situated close to the concave border; its elements are on the whole elongated and cylindrical; in some specimens, however, they have a tendency to become nummuloidal between the uppermost septa. The surface of the test is ornamented with irregular lines of growth, which have a lamellose appearance in certain individuals; they form a sinus both on the convex and the concave borders of the shell. Longitudinal lines are seen upon the cast of the body-chamber.

Remarks. This species is distinguished from all others of the same group by its large size, by its straightness, and by the form of its siphuncle.

Horizon. Étage E (=Salopian).

Localities. Kosořz, Lochkow, Hinter-Kopanina, Bohemia.

Well represented in the Collection.

Cyrtoceras (Meloceras) hybrida, Barrande, sp.

1848. *Cyrtoceras hybrida*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 208.

1852. *Cyrtoceras hybrida*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras hybrida*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 662, pl. clxxvii. ff. 1-11.

Sp. Char. Shell moderately curved; upon a chord of 70 millim., subtending the concave side, the highest perpendicular is 5 millim. The transverse section is nearly circular. The rate of increase is about 1 in 2 in the septate part of the shell. The body-chamber occupies nearly $\frac{1}{3}$ of the total length, and its capacity is nearly that of the whole of the septate part. The distance between the septa increases regularly until it attains to $\frac{1}{9}$ of the diameter of the shell. There are about 40 septa in the entire shell. The siphuncle is situated close to the concave border, without coming in contact with the test; its elements are cylindrical, becoming somewhat cordiform in the upper part of the shell. The surface of the test is ornamented

with fine, transverse, angular plications having a direct imbrication, and their surface covered with very fine transverse lines.

Remarks. The species having the closest affinity with the present one are *M. debile*, Barr., sp. (pl. clxviii.), and *M. parvulum*, Barr., sp. (pl. clxxvii.). The former of these is distinguished from *M. hybrida* by its larger body-chamber, filiform siphuncle, and less prominent ornaments; the latter by its greater curvature, and broad and nummuloidal siphuncle.

Horizon. Étage E (=Salopian).

Locality. Lochkow, Bohemia.

Represented in the Collection by a single specimen.

Cyrtoceras (Meloceras) insociale, Barrande, sp.

1867. *Cyrtoceras insociale*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 666, pl. cxlviii. ff. 10-15, pl. clix. ff. 1-8, pl. clxvi. ff. 6-14.

Sp. Char. Shell very slightly curved; upon a chord of 68 millim., subtending the concave side, the highest perpendicular is 3 millim. The transverse section is nearly circular, but in several specimens there is a tendency to assume an oval form. The rate of increase is variable, but omitting extreme forms it may be taken to be about 3 in 5. The body-chamber occupies nearly half the length of the shell; it is slightly contracted near the aperture. The latter is slightly inclined towards the convex side, upon which there is a wide sinus; a narrower one is found also upon the concave side. The distance between the septa is equal to about $\frac{1}{15}$ of the diameter of the shell; they are direct and parallel with the plane of the aperture. The siphuncle is situated close to the concave border and is cylindrical. The surface of the test is ornamented with very fine, irregular, transverse striæ, which form a slight sinus upon the concave border, in the median line. The striæ are grouped in irregular bands in some specimens.

Remarks. The species having the closest affinity with the present one is *M. capuloides*, Barr., sp. (pl. clxvi.), but it is distinguished by its more inflated form and proportionately larger body-chamber.

Horizon. Étage E (=Salopian).

Locality. Lochkow, Bohemia.

Represented in the Collection by two examples.

Cyrtoceras (Meloceras) Murchisoni, Barrande, sp.

1848. *Cyrtoceras Murchisoni*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 209.

1852. *Cyrtoceras Murchisoni*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras Murchisoni*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 687, pl. cxlviii. ff. 7-9, pl. clx. ff. 10-19, pl. clxv. ff. 8-20, pl. clxxvi. ff. 5-12, pl. cc. ff. 9-12.

Sp. Char. Shell very strongly curved, without, however, forming a complete whorl. The transverse section is oval, the narrower extremity corresponding with the concave border of the shell. The ratio between the two diameters varies from $\frac{1}{4}$ to $\frac{3}{11}$ to $\frac{11}{9}$. The rate of increase of the shell is also subject to variation; it averages 1 in 3, measured in the septate part of the shell. The body-chamber occupies between $\frac{1}{3}$ and $\frac{2}{5}$ of the total length of the shell, and its capacity equals that of the septate part. The aperture is parallel to the plane of the last septum. The distance between the septa does not exceed $\frac{1}{2}$ the diameter of the shell, their concavity equals about $\frac{1}{4}$ of the same. The siphuncle is close to the concave border of the shell; it is composed of flattened nummuloid segments, much constricted at the necks of the septa, and being more expanded above than below. The test is ornamented with irregular lines of growth, which sometimes develop into plications; they cross the sutures of the septa obliquely with their convexity turned towards the aperture, making a well-marked sinus in the median line of the concave border, but only a very slight inflexion on the convex side.

Remarks. The species having the closest affinity with *M. Murchisoni* are *M. Beaumonti*, Barr., sp. (pl. clxv.), and *M. neutrum*, Barr., sp. (pl. clxv., pl. cc.): the former is distinguished by its more rapid expansion, conjoined with a stronger curvature, and the siphuncle being filled with lamellæ of a peculiar appearance; the latter by its elongated and more slender form.

Barrande compares the present species with *Phragmoceras arcuatum*, J. de C. Sowerby (Murch. Sil. Syst. pl. x. f. 1); but as the latter belongs to a different genus, there can be no relationship between the two.

Horizon. Étage E (=Salopian).

Localities. Konieprus, Lochkow, Butowitz, Dlauha Hora, Bohemia. Well represented in the Collection.

Cyrtoceras (Meloceras) quasi-rectum, Barrande, sp.

1848. *Cyrtoceras quasi-rectum*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 208.

1852. *Cyrtoceras quasi-rectum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras quasi-rectum*, Barrande, Syst. Sil. de la Bohême,

vol. ii. pt. i. p. 669, pl. cxlvi. ff. 12-15, pl. clx. ff. 1-9, pl. clxiii., pl. ccxxiii. ff. 18, 19.

1877. *Cyrtoceras quasi-rectum*, Barrande, *ibid.* Suppl. et Sér. tardive, p. 176, pl. diii. ff. 12-16.

Sp. Char. Shell curved only in the apical portion; upon a chord of 75 millim., subtending the concave side, the highest perpendicular is 2 millim. The transverse section is elliptical in the greater number of specimens examined, the ratio of the two diameters being as 8 : 7; in others it was found to be circular. The rate of increase is also subject to variation; thus, in one specimen measured it is in the ratio of 1 : 2 in a length of 66 millim., measured in the septate part; in another it is in the ratio of 2 : 5 in a length of 45 millim., measured in the apical portion of the shell. The body-chamber is well developed, occupying somewhat less than $\frac{1}{3}$ of the total length of the shell. The aperture has a well-marked sinus upon the concave border. The distance between the septa is very regular, and amounts in adults to about $\frac{1}{3}$ of the diameter of the shell. The siphuncle is situated close to the concave border and is cylindrical. The test is ornamented with transverse, regular, very prominent plications, having a direct imbrication: they become stronger in the upper part of the shell.

Remarks. This species is distinguished from *M. Orion*, Barrande, sp. (pl. cxl.), which has similar ornaments; but it increases less rapidly in diameter, its siphuncle is nummuloidal and external, and its plications rounded instead of subangular.

M. quasi-rectum, var. *contrarium*, Barr., occurs in the Wenlock of the Usk district, according to Blake (*Brit. Foss. Ceph.* pt. i. p. 175, pl. xix. ff. 9, 10).

Horizon. Étage E (=Salopian).

Locality. Dlauha Hora, Bohemia.

Well represented in the Collection.

***Cyrtoceras (Meloceras) parvulum*, Barrande, sp.**

1848. *Cyrtoceras parvulum*, Barrande, Haidinger, *Berichte über die Mittheil. von Freund. der Naturwiss. in Wien*, Band iv. p. 208.

1852. *Cyrtoceras parvulum*, Giebel, *Fauna der Vorwelt*, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras parvulum*, Barrande, *Syst. Sil. de la Bohême*, vol. ii. pt. i. p. 689, pl. clxxvii. ff. 12-18.

1877. *Cyrtoceras parvulum*, Barrande, *ibid.* Suppl. et Sér. tardive, p. 39, pl. cccclxxxi. ff. 1-15, p. 168, pl. div.

Sp. Char. Shell strongly and uniformly curved; upon a chord of

45 millim., subtending the concave side of a nearly complete specimen, the highest perpendicular is nearly 7 millim. Transverse section circular. The increase in diameter, which is somewhat variable, is in the ratio of 1 : 6 in a length of 35 millim., measured in the septate part. The body-chamber occupies nearly $\frac{1}{3}$ of the total length of the shell. The aperture is inclined towards the convex side, where it forms a wide sinus. The distance between the septa is equivalent to about $\frac{1}{2}$ the diameter of the shell. The siphuncle is situated on the concave border, but without touching the test; it is slightly inflated between the septa. The test is ornamented with small and regular transverse striæ, having a direct imbrication; these are covered with fine lines, running in the same direction; very fine longitudinal striæ are also present in some examples. In addition to these ornaments the test when well preserved exhibits very beautiful colour patterns, the intensity of which is increased by wetting. These consist of bands of which the white tint contrasts with the brown of the test. The bands form a zigzag pattern made up of rounded and pointed arches, the former directed towards the aperture, the latter away from it. There are about seven of these arches in the circumference of the shell.

Remarks. The species that comes nearest to this is *M. debile*, Barr. sp. (pl. clxxvii.), but it is less arcuate, dilates less rapidly, and has a cylindrical siphuncle.

Horizon. Étage E (= Salopian).

Locality. Kosořz, Bohemia.

Fairly well represented in the Collection.

Cyrtoceras (Meloceras) virgula, Barrande, sp.

1848. *Cyrtoceras virgula*, Barrande, Haidinger, Berichte über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 209.

1852. *Cyrtoceras virgula*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras virgula*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 694, pl. clxxiii. ff. 8-15.

Sp. Char. Shell strongly curved, especially in the region of the aperture. Upon a chord of 27 millim., subtending the concave side, the highest perpendicular is 7 millim. The transverse section is oval, the ratio of the two diameters being as 4 : 3. The rate of increase, measured in the septate part of a young example, is in the ratio of 2 to 5 in a length of 22 millim. : it is less than this in adult shells. The body-chamber occupies about $\frac{1}{4}$ of the total length of the shell. The aperture has a sinus upon the concave border, and a

very distinct constriction runs around it just below its margin. The distance between the septa amounts to about $\frac{1}{11}$ the diameter of the shell; their convexity equals $\frac{1}{7}$ of the same. The siphuncle is situated close to the concave border, without, however, touching it: it is somewhat nummuloidal. The test is ornamented with transverse, somewhat prominent, raised lines, the surface of which appears to be smooth.

Remarks. This species is readily distinguished by its small size and characteristic curvature.

Horizon. Étage E (= Salopian).

Locality. Konieprus, Bohemia.

Represented in the Collection by two examples.

c. *Mediogastric*¹.

LONGICONES.

Cyrtoceras (Meloceras) extricatum, Blake, sp.

1839. *Lituites articulatus*, J. de C. Sowerby, in Murchison's Sil. Syst. pt. ii. p. 622, pl. xi. f. 7 (not ff. 5, 6).

1882. *Cyrtoceras extricatum*, Blake, British Foss. Ceph. pt. i. p. 183, pl. v. ff. 10, 11, 11a.

[Not 1852. *Lituites articulatus*, M'Coy, British Pal. Foss. fasc. ii. p. 323.—1873. *Lituites articulatus*, Salter, Cat. Cambr. & Sil. Foss. p. 174.]

Sp. Char. "The section is circular. The rate of increase in the septal portion is unseen, the example chosen as type consisting of body-chamber only, which decreases towards the aperture. The mean radius of curvature is $2\frac{1}{3}$ inches at a diameter of $\frac{3}{5}$ inch. The body-chamber is four times as long as its basal diameter. The aperture is circular, and not marked by any constriction. The ornaments are strong radial non-separate ribs, about $\frac{1}{3}$ the diameter apart; the shell-surface is not preserved. The septa are parallel to the ribs, and the convexity is nearly equal to their interval. The siphuncle is small and nearly central.

. . . "This species has entered into the confusion that has arisen over the curved and straight transversely-ribbed species. First, Sowerby thought it might be the straight portion of his *Lituites articulatus*—now *Ophidioceras*. The distinctness of the latter has long been seen. Next, the quite straight *Orthocerata*

¹ = *Aploceras*, d'Orb. (Prodr. vol. i. p. 112), instituted for "*Cyrtoceras* in which the siphuncle is subcentral instead of being marginal."

were confounded with it, and this was placed with *O. ibex*. Now that nearly complete straight shells of the latter have been seen, it is known never to be curved. The ribs too and the circular form of the present species ought easily to separate it. Again, it is similar to the curved shells which may be true *Lituities*, but is more robust, and the specimens figured prove it to have a quite different aperture. It is indeed a *Cyrtoceras*, which none of the others are, and it appears to be not an unusual thing, to judge by Barrande's figures, for *Cyrtocerata* of this ribbed and mediogastric group to contract in the body-chamber. The present species is very like several figured by that author¹, but has coarser ribs than any." (*Blake*.)

Horizon. Wenlock.

Locality. Dudley, Worcestershire.

Represented in the Collection by a single example.

Cyrtoceras (Meloceras) cognatum, Barrande, sp.

1867. *Cyrtoceras cognatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 633, pl. excix. ff. 35-45.

Sp. Char. Shell strongly curved. Upon a chord of 38 millim., subtending the concave side, the highest perpendicular is 8 millim. The transverse section is circular. The increase in the septate part is in the ratio of 1 : 2, in a length of 25 millim. The body-chamber is moderately developed, and occupies about $\frac{1}{3}$ of the total length of the shell. The plane of the aperture is inclined towards the convex side. The distance between the septa does not exceed $\frac{1}{3}$ the diameter of the shell. The siphuncle is about midway between the centre and the convex border; its elements are cylindrical. The surface of the shell is ornamented with very prominent transverse annulations about $1\frac{1}{2}$ line distant from each other where the diameter of the shell is 5 lines. These annulations form a sinus upon the convex border, and the sutures of the septa lie between them. The surface of the test is ornamented with a network of fine, close-set, transverse striæ which are crossed by widely-spaced longitudinal striæ. These ornaments are scarcely visible to the unaided eye. The transverse striæ number from 8 to 10 between 2 annulations measured from summit to summit.

Remarks. The nearest ally of this species is *M. pergratum*, Barr., sp. (*infra*), but the form of the latter is much less arcuate, and its longitudinal striæ are but little developed beyond the septate part

¹ See Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i., plates cxviii., cxcix.

of the shell, while the transverse striæ are much closer together than in the present species.

Horizon. Étage E (=Salopian).

Locality. Lochkow, Bohemia.

Fairly well represented in the Collection.

Cyrtoceras (Meloceras) pergratum, Barrande, sp.

1867. *Cyrtoceras pergratum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 640, pl. excix. ff. 1-23.

Sp. Char. Shell slightly curved; upon a chord of 62 millim., subtending the concave side of a nearly complete specimen, the highest perpendicular is 4 millim. The shell tends to become straight in the upper part. The transverse section is circular. The increase in the septate part of the shell is in the ratio of 1 : 2, in a length of 25 millim. The length of the body-chamber amounts to about twice the diameter of the aperture, or $\frac{2}{5}$ of the total length of the shell. The aperture is a little inclined towards the convex side. The distance between the septa is equal to about $\frac{1}{4}$ the diameter of the shell. The siphuncle is situated at a little distance from the centre, towards the convex border; it is cylindrical. The surface of the shell is ornamented with prominent annulations, about 1 line distant from each other where the shell has a diameter of 5 lines, the interspaces being about equal in width to the annulations. These coarser ornaments are covered with very fine transverse striæ, following the direction of the ribs, and these are crossed longitudinally by a series of fine ridges, about 5 of which are contained within the space of 1 line; the latter do not appear to extend above the septate part of the shell.

Remarks. I have already instituted a comparison between this species and *M. cognatum* under the description of the latter.

One cannot but be struck with the marked resemblance this species bears to *Orthoceras dulce*, Barr., var. *caelebs*, Barr. (pl. ccxev.). We seem, in fact, to have reached in such species as this forms which connect *Cyrtoceras* with *Orthoceras*.

Horizon. Étage E (=Salopian).

Localities. Kosoř, Lochkow, Wiskočilka, Bohemia.

Fairly well represented in the Collection.

Cyrtoceras (Meloceras) urbanum, Barrande, sp.

1867. *Cyrtoceras urbanum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 699, pl. excviii. ff. 11-20.

Sp. Char. Shell elongated, having a considerable and uniform curvature; upon a chord of 80 millim., subtending the concave border, the highest perpendicular is 13 millim. The transverse section is circular. The increase in the septate part is in the ratio of 1:3, in a length of 54 millim. The body-chamber occupies about $\frac{1}{3}$ of the total length of the shell. The distance between the septa is equal to about $\frac{1}{8}$ the diameter of the shell. The siphuncle is situated nearly midway between the centre and the convex border; its elements are cylindrical. The shell-ornaments consist of subacute annulations barely 1 line distant from each other where the shell has a diameter of 5 lines. These coarser ornaments are covered with extremely fine transverse striæ, which give a silky appearance to the surface of the test when seen under a low magnifying-power.

Remarks. This species resembles *M. semitectum*, Barr., sp. (pl. excviii.), and *M. nitidum*, Barr., sp. (ibid.), in its general form, but these last are distinguished by having a considerable part of the shell, below the aperture, devoid of annulations.

Horizon. Étage E (=Salopian).

Localities. Dlauha Hora, Konieprus, Bohemia.

Fairly well represented in the Collection.

BREVICONES.

Cyrtoceras (Meloceras) mundum, Barrande, sp.

1867. *Orthoceras mundum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. (1874), p. 64, pl. clxxxvi. ff. 1-34, pl. cccclxxxviii. case iv. ff. 1-3.

Sp. Char. Shell straight in most specimens, sometimes very slightly curved. The apex, instead of being acute, is bluntly rounded. The increase in diameter is very rapid; it varies from 1 in 2 to 1 in 3, some specimens tapering more slowly than others. The transverse section is circular in some examples, elliptical in others. The body-chamber is well developed, its length equals at least $\frac{2}{3}$ that of the entire shell. The distance between the septa is equal to about $\frac{1}{8}$ the diameter of the shell. The siphuncle is remarkable for the variability of its position in different specimens. In some it is central throughout the whole of the septate part; in others it shifts its position nearer to the border until this latter point is actually reached; its elements are cylindrical. The ornaments of the test

consist of transverse striæ of growth, which are sometimes lamellose, and these are often accompanied by very fine longitudinal striæ which cut through the former. The transverse striæ form a shallow sinus on the convex border of the shell.

Remarks. The remarkable changes in the position of the siphuncle in the present species might have been held sufficient for the establishment of a great many species, were it not for the fact that examples are met with connecting the extreme cases above mentioned¹.

M. particeps, Barr. sp. (pl. clxxxvi.), resembles the present species in its general form, but is distinguished by the great relative development of the septate part, and by the longitudinal ridges upon its internal cast.

Horizon. Étage E, bande e 2 (= Salopian).

Locality. Karlstein, Bohemia.

Well represented in the Collection.

d. *Position of siphuncle unknown or doubtful.*

Cyrtoceras (Meloceras) Barrandei, Salter, sp.

1851. *Orthoceras Barrandei*, Salter, Quart. Journ. Geol. Soc. vol. vii. p. 177, pl. ix. f. 19.

? 1867. *Cyrtoceras æmulus*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 540, pl. ccxl. ff. 7-10; *ibid.* 1877, Suppl. et Sér. tardive, p. 17, pl. cccclxxxi. ff. 25-33, p. 114, pl. dvii. ff. 1-5.

1873. *Phragmoceras (Gomphoceras) liratum*, Salter, Cat. Camb. & Sil. Foss. p. 174.

? 1882. *Orthoceras Barrandei*, Blake, British Foss. Ceph. pt. i. p. 79, pl. xviii. ff. 10-12, pl. xix. ff. 4, 4 a.

Sp. Char. "Short, tapering at an angle of 40°; acute at the extremity; the mouth broad and very oblique, surface covered by regular close ridges of growth, which are not waved, but pass obliquely across parallel to the mouth; septa in the same direction, occupying half the length of the shell, and about $\frac{1}{6}$ their diameter apart." (*Salter.*)

Remarks. The type specimen, which is contained in the Museum Collection, is so buried in the matrix that only about half of it can be seen. Another specimen, figured by Blake (*loc. cit.* pl. xviii. f. 11), is also in an unsatisfactory condition of preservation. Its septa are wider apart than those of the type, and it may perhaps belong to a different species. I am not able to identify it with any of Barrande's.

¹ See Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iv. 1877, p. 566,— "Anomalies dans la position du Siphon des Nautilides."

Horizon. May Hill Sandstone (Mulloch Hill Group of the New-land's Series of Lapworth¹). Lower Ludlow.

Localities. Mulloch, Ayrshire; Mocktree Hill, Herefordshire.

Represented in the Collection by Salter's type, and by one of the specimens figured by Blake (*loc. cit.* pl. xviii. f. 11).

Cyrtoceras (Meloceras) M'Coyi, Foord.

? 1839. *Phragmoceras arcuatum*, J. de C. Sowerby, in Murchison's Sil. Syst. pt. ii. p. 621, pl. xi. f. 1 (*not* pl. x. f. 1).

1851. *Phragmoceras intermedium*, M'Coy, Ann. Mag. Nat. Hist. ser. 2, vol. vii. p. 45.

1852. *Phragmoceras intermedium*, M'Coy, British Pal. Foss. fasc. ii. p. 322.

1873. *Phragmoceras?* *intermedium*, Salter, Cat. Cambr. & Sil. Foss. p. 174.

1882. *Cyrtoceras intermedium*, Blake, British Foss. Ceph. p. 179, pl. xx. f. 6, pl. xxi. f. 2, pl. xviii. f. 13.

[*Not* 1867. *Cyrtoceras intermedium*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 552, pl. cxlvii. ff. 27-29, pl. cxlix. ff. 13-17, pl. cli. pl. cli. ff. 22-27; *ibid.* 1877, Suppl. et Sér. tardive, p. 29, pl. ccccxvii. ff. 26-40.]

Sp. Char. "Slightly arched, tapering at the rate of 4 lines in 1 inch; section ovate, sides gently convex, outer and inner faces rounded; a specimen (not quite perfect) 2 inches 5 lines long has the long (antero-posterior) diameter at the large end 1 inch 4 lines, at the small end 9 lines; short (lateral) diameter at large end 10 lines; length of last chamber 1 inch 1 line; the last five or six septa 1½ line apart in the middle of the side.

"I have not seen the siphon of this species . . ." (*M'Coy*).

Remarks. The specimen representing the present species in the Museum Collection is one of those figured by Blake (*loc. cit.* pl. xviii. f. 13), and his remark concerning it that it is "a small specimen possibly of this species," expresses a doubt as to its relations which I fully share in. I have been obliged to substitute another name for M'Coy's *intermedium*, to avoid repetition, now that that species is assigned to *Cyrtoceras*, and I have conferred upon it the name of the distinguished palæontologist who first described it.

Horizon. Wenlock Shales.

Locality. Dudley, Worcestershire.

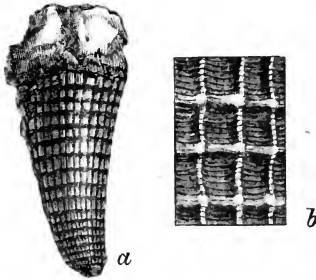
¹ See Lapworth on "The Girvan Succession," Quart. Journ. Geol. Soc. 1882, vol. xxxviii. p. 537.

Cyrtoceras (Meloceras) clathratum, Foord.

? 1876. *Cyrtoceras*, sp., Tromelin & Lebesconte, Assoc. Franç. pour l'avancement des Sciences, 4^{me} (Nantes), Tabl. D. No. 25.

Sp. Char. Shell slightly and uniformly curved. Transverse section nearly circular. Rate of increase about 1 in 3. Septa and siphuncle unknown. Surface ornaments consisting of prominent acute annulations, which are somewhat wider apart in the upper

Fig. 48.



Cyrtoceras (Meloceras) clathratum.—*a*, fragment of the shell, natural size; *b*, portion of the test, greatly enlarged.

part of the shell than they are in the lower; their distance from each other increasing from about $\frac{1}{4}$ to $\frac{3}{4}$ of a line; these are crossed by pretty close-set longitudinal ridges (about three in the space of 1 line) which form nodes at their junction with the annulations. Where the test is well preserved, fine, transverse, thread-like lines are seen, crossing the ridges and the interspaces; ten or twelve of these lines are contained in the space of 1 line.

Remarks. Though some important characters are wanting in our knowledge of this species, yet its ornamentation would be quite sufficient to distinguish it. Its nearest ally appears to be *M. Panderi*, Barr., sp. (pl. clvii.), but the latter expands more slowly, and the longitudinal ridges of its test are very feebly developed, while the annulations are stronger than those of the present species, furthermore the fine transverse lines are wanting in *M. Panderi*. Both belong to about the same horizon.

Horizon. Calcaires ampéliteux (=Third Fauna of Barrande).

Locality. Feugueroles (Calvados), France.

Represented in the Collection by three specimens.

DEVONIAN SPECIES.

Cyrtoceras (Meloceras), sp.

A much weathered fragment¹, consisting of eight or nine of the septa and part of the body-chamber of a rather rapidly tapering, slightly curved species, too imperfect for specific identity.

Horizon. Upper Devonian².

Locality. Lower Dunscombe, near Chudleigh, Devonshire.

Presented by J. E. Lee, Esq., F.S.A., F.G.S.

Cyrtoceras (Meloceras) Belgicum, Foord.

? 1853. *Phragmoceras Brateri*, Geinitz, Die Verstein. der Grauwacken. in Sachsen, p. 33, Taf. v. ff. 2 a, 2 b. (Not of Münster.)

Sp. Char. Shell very slightly curved. The transverse section elliptical, the ratio of the two diameters being as 23 : 36. The rate of increase is slow, but cannot be accurately determined. The body-chamber (crushed on one side) is very short, its length being about $\frac{2}{5}$ that of the greatest basal diameter. The outline of the aperture is simple, and no sinus is observable in it. The septa are 3 lines distant from each other where the (greater) diameter of the shell is 2 inches 2 lines; their convexity is about $\frac{1}{6}$ of that diameter. The siphuncle is $2\frac{1}{2}$ lines from the convex border of the shell in the median line; its internal structure is not seen. No traces of the test remain, the specimen being in a bad state of preservation. There is a row of well-marked crenulations at the base of the body-chamber. The total length of the fossil is $3\frac{1}{4}$ inches, the greatest diameter $2\frac{1}{4}$ inches.

Remarks. The figures given by Geinitz (*loc. cit.*) come very near to this fossil, though his shell appears to taper more rapidly; it has, however, the same very short body-chamber, with crenulations at the base, and the septa are similarly distant from each other.

Horizon. Schistes de Couvin (Eifelien); Middle Devonian.

Locality. Nismes, Belgium.

Represented in the Collection by a single example, transferred from the Museum of Practical Geology.

Cyrtoceras (Meloceras) subplicatum, Roemer, sp.

1854. *Cyrtoceras subplicatum*, F. A. Roemer, Palæontographica, Band iii. p. 38, tab. vi. ff. 3 a, b.

1866. *Cyrtoceras subplicatum*, F. A. Roemer, Beitr. z. geologisch. Kenntn. des nordwestlichen Harzgebirges, p. 32.

¹ Registered C. 1831 in the Museum Collection.

² See footnote, *ante*, p. 91.

Sp. Char. Shell very slightly curved. Section nearly circular. Rate of increase about 1 in 4. Septa distant from each other $1\frac{1}{2}$ line where the diameter of the shell is 9 lines. Siphuncle close to the convex border. Test apparently smooth.

Horizon. Iberger-Kalk ; Upper Devonian.

Locality. Winterberg, North-western Hartz.

Represented in the Collection by a single example.

Cyrtoceras (Meloceras) subrugosum, d'Orbigny, sp.

1849. *Cyrtoceras subrugosum*, d'Orbigny, Prodr. de Paléont. Stratigraphique, vol. i. p. 53.

Sp. Char. D'Orbigny gives the following description of his species:—"Espèce en corne ronde, peu allongée, arquée, pourvue de rides transversales irrégulières. Cloisons très-obliques."

The curvature of the shell is moderate. The rate of increase is probably about 1 in 4. The septa, which are very oblique, are distant from each other about $1\frac{1}{2}$ line upon the convex border of the shell, where the latter has a diameter of 10 lines. The ornamentation consists of irregularly spaced transverse riblets, which have a tendency to run in pairs; they form a very shallow sinus on the convex border of the shell. Very faint close-set longitudinal lines may also be seen, if the specimens be held in a good light. The siphuncle is situated close to the convex border; its internal structure is not seen.

Remarks. I can find no mention of this species in any of the numerous memoirs in the Soc. Géol. du Nord, or other French geological journals. Messrs. de Tromelin and Lebesconte¹ in an enumeration of Devonian fossils of the "grès de Gahard" mention that "several species" of *Cyrtoceras* are found therein, but they make no attempt to name them.

Horizon. Lower Devonian?

Locality. Néhou (Manche), France.

Represented in the Collection by three fairly good specimens.

CARBONIFEROUS SPECIES.

a. *Exogastric.*

Cyrtoceras (Meloceras) cornu, de Koninck, sp.

1829. *Orthocera fusiformis*, J. de C. Sowerby, Min. Conch. vol. vi. p. 167, tab. dlxxxviii. f. 2 (excl. f. 1).

¹ Soc. Géol. de France, sér. 3, vol. iv. 1876, footnote, p. 614.

² I give this horizon on the authority of de Tromelin,—Assoc. Franç. 6me Sess. Havre, 1878, p. 493,—"Terr. Paléoz. de Normandie."

1880. *Cyrtoceras cornu*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 26, pl. xxxvi. ff. 5-8.

Sp. Char. Shell of medium size, strongly curved; initial point obtuse, and showing the cicatrix. Rate of increase about 1 in 4. Transverse section circular. Septa rather widely separated from each other, undulating, rather deeply concave. Siphuncle nummuloidal, situated at a little distance from the ventral border, in the median line. Test thin, its surface perfectly smooth.

Remarks. To this species I have referred several examples (including the specimen figured by Sowerby) which agree tolerably well with de Koninck's description, though he does not mention the undulation of the sutures, which is a marked feature in the specimens before me. The body-chamber of *M. cornu* was unknown to de Koninck, but it is well shown in one of the Museum specimens¹, in which it occupies at least half the entire length of the shell.

Horizon. Calschiste de Tournai (Assise i. e); = Carboniferous Limestone.

Localities. *British.* Dublin, Kildare.—*Foreign.* Belgium.

Represented in the Collection by several good specimens, including the one figured by Sowerby² (*loc. cit.*), and now contained in the "Sowerby Collection."

Cyrtoceras (Meloceras) acus, de Koninck, sp.

1844. *Cyrtoceras unguis*, de Koninck, Descrip. des Anim. Fossiles de la Belgique, p. 524, pl. xlvii. f. 8 a (excl. ff. 8, b, c), pl. xlviii. f. 6 b (excl. ff. 6, a, c). (*Not of Phillips.*)

1876. *Cyrtoceras unguis*, F. Roemer, Lethæa Palæozoica, Taf. xvi. f. 4.

1880. *Cyrtoceras acus*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 28, pl. xxxv. ff. 6, 7, pl. xxxvi. f. 3.

Sp. Char. Shell slightly curved at the apical extremity, straight above; obtusely pointed at the apex, which shows traces of the cicatrix in one of the specimens. Transverse section elliptical, the ratio of the two diameters as 7 : 9. Rate of increase measured in the plane of the greater diameter 1 in 2; some specimens, however, dilate less rapidly than this. Septa numerous, 40 having been counted in a specimen measuring 3 inches 5 lines in length. Siphuncle near the convex border; its elements nummuloidal. Surface of the test smooth, but traces of the original colour pattern are often preserved, consisting of zigzag bands alternately light and dark-coloured³.

¹ Registered No. 30257.

² Registered No. 43837.

³ These are well shown in the specimen in the Museum Collection, registered No. 64837.

Horizon. Calschiste de Tournai (Assise i. e); = Carboniferous Limestone.

Localities. Tournai, Visé, Belgium.

Well represented in the Collection.

Cyrtoceras (Meloceras) Verneuilianum, de Koninck, sp.

1843. *Orthoceras Verneuilianus*, de Koninck, Précis élément. de géologie par J. J. d'Omalius, p. 515.

1844. *Cyrtoceras Verneuilianum*, de Koninck, Descrip. des Anim. Fossiles de la Belgique, p. 525, pl. xlv. f. 7, pl. xlviii. ff. 6 a, c (excl. f. 6 b).

1849. *Aploceras Verneuilianum*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 112.

1852. *Cyrtoceras Verneuilianum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 202.

1880. *Cyrtoceras Verneuilianum*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 35, pl. xxxiv. ff. 9, 9 a-c.

Sp. Char. Shell slightly and uniformly curved. Transverse section circular in the young shell, but becoming elliptical in the adult, the ratio of the two diameters being then as 13:16. The septa are rather deeply concave, and the later ones are distant from each other about $2\frac{1}{4}$ lines. The siphuncle is situated near the convex border; its elements are nummuloidal. The surface of the test is ornamented with very fine, close-set, regular, longitudinal lines, which can only be seen with the aid of a lens, some 25 or 26 of them being included in the space of $2\frac{1}{4}$ lines.

Remarks. The species nearest to this is *M. Antilope*, de Kon., sp. (*loc. cit.* p. 36), but the latter has a smaller siphuncle, closer septa, and much coarser, though similar ornaments.

Horizon. Calschiste de Tournai (Assise i. e); = Carboniferous Limestone.

Locality. Tournai, Belgium.

Represented in the Collection by a single example.

Cyrtoceras (Meloceras) rugosum, Fleming, sp.

1815. *Orthocera rugosa*, Fleming, Thomson's Annals of Philosophy, vol. v. p. 203, pl. xxxi. f. 9.

1828. *Orthocera rugosa*, Fleming, Hist. of British Anim. p. 239.

1836. *Orthoceras rugosum*, Phillips, Geol. of Yorkshire, pt. ii. p. 239, pl. xxi. f. 16.

1854. *Orthoceras rugosum*, Morris, Cat. of British Foss. p. 311.

1855. *Orthoceras (Cycloceras) rugosum*, McCoy, British Pal. Foss. fasc. iii. p. 573.

1876. *Cyrtoceras rugosum*, Armstrong, Young, and Robertson, Cat. of the Western Scottish Fossils, p. 58.

1877. *Cyrtoceras (Orthoceras) rugosum*, Barrande, Syst. Sil. de la Bohême, vol. ii. Supplém. pl. cccclxxxvii. case x. (after Phillips).

Sp. Char. "Subcylindrical, and nearly straight when old, abruptly and irregularly tapering, and moderately curved towards the smaller end; section circular; surface girt with equal, obtusely rounded, very prominent, irregularly-waved, slightly oblique rings (having two septa in the space between each pair of rings); interannular spaces flat, and slightly more than twice the thickness of the rings in width; rings nodulated by the crossing of about twenty-six equal, filiform, slender, tuberculated ridges, separated by flat spaces nearly twice their width, such spaces being at least twice as long as wide (four ridges and three intervening spaces equalling the space from the centre of one transverse ring to the other); septa moderately convex; siphon very minute, close to the margin (coinciding with the convex aspect of curved specimens, and at the higher edge of the septa and external rings). Specimens five lines in diameter have their rings two lines from centre to centre; specimens one inch in diameter have their rings on the sides, about three lines from centre to centre, but five lines on the exterior and only two lines on the inner aspect of curved specimens.

"This species tapers so irregularly, and the fragments are so short, that any measurements of their proportions would be deceptive. Some of the large specimens show traces of very fine, close, transverse striæ." (*M' Coy.*)

Remarks. M. de Koninck expresses the opinion that the present species is identical with the *O. reticulatum* of Phillips (*ante*, p. 108), but the latter is a perfectly straight shell, and tapers less rapidly than *C. rugosum*.

Horizon. Upper Limestone Group¹.

Localities. Lanark; Orchard Quarry, near Glasgow.

Represented in the Collection by three specimens, one of which (No. 80385 in the Register) has no locality recorded against it.

Cyrtoceras (Meloceras) ornatum, Eichwald, sp.

1840. *Amplexus ornatus*, Eichwald, Bull. Scient. de l'Acad. des Sciences de St. Pétersbourg, p. 17.

1844. *Cyrtoceras rugosum*, de Koninck, Descrip. des Anim. Fossiles de la Belgique, p. 527, pl. xlv. f. 8, pl. xlvii. f. 7.

? 1849. *Cyrtoceras rugosum*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 112.

¹ Carboniferous Limestone Series (see footnote, p. 121).

- ? 1852. *Cyrtoceras rugosum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 207.
1857. *Amplexus ornatus*, Eichwald, Bull. Soc. Imp. des Natur. de Moscou, p. 176.
1860. *Cyloceras ornatum*, Eichwald, Lethæa Rossica, vol. i. Seconde Sect. de l'Ancienne Période, p. 1234, pl. xlviii. ff. 13, a, b.
1867. *Cyrtoceras rugosum*?, Trautschold, Bull. Soc. Imp. des Natur. de Moscou, vol. xl. p. 44.
1880. *Cyrtoceras rugosum*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 31, pl. xxxiii. ff. 8, a, b.

Sp. Char. Shell slightly curved, slowly tapering, nearly circular in transverse section. Siphuncle close to the margin on the convex curvature of the shell. The surface ornaments consist of distant, transverse, rounded, somewhat waved annulations; these are crossed by about thirty close-set longitudinal ridges which cross the annulations and the interspaces, causing the annulations to be distinctly nodose at their junction with the ridges. There are indications also of fine transverse lines between the ribs, which have also a nodose character at their intersection with the longitudinal ridges.

Remarks. This species may be readily distinguished from *M. rugosum* by the greater distance of its annulations.

Horizon. Calcaire Carbonifère de Visé; = Carboniferous Limestone.

Locality. Visé, Belgium.

Represented in the Collection by two examples.

b. *Endogastric.*

Cyrtoceras (Meloceras) arachnoideum, de Koninck, sp.

1844. *Cyrtoceras reticulatum*, de Koninck, Descrip. des Anim. Fossiles du Terr. Carb. de la Belgique, p. 529.
1851. *Cyrtoceras arachnoideum*, de Koninck, *ibid.* Suppl. p. 707, pl. lix. ff. 6, a-c.
1852. *Cyrtoceras reticulatum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.
1880. *Cyrtoceras arachnoideum*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 37, pl. xxxiii. ff. 14, a, b.

Sp. Char. Shell small, somewhat more curved in the apical portion than in the rest of the shell; apex acutely pointed. Transverse section circular. Septa shallow, the last distant from each other about one line. Body-chamber occupying about one third of the total length of the shell. Siphuncle very slender, situated near the concave side at one third of the distance across the dorso-ventral diameter. The surface is ornamented with a

number of extremely fine longitudinal striæ, and these are crossed at right angles by a series of equally fine transverse striæ, which together form a very delicate network, like a spider's web, hence the name of the species.

Remarks. The name of this species was changed by its author from *reticulatum* to *arachnoideum*, the former name having already been bestowed by Phillips upon a Devonian species¹.

Horizon. Calschiste de Tournai (Assise i. e); = Carboniferous Limestone.

Locality. Tournai, Belgium.

Represented in the Collection by a single example.

c. *Mediogastric.*

Cyrtoceras (Meloceras) cinctum, Münster, sp.

1843. *Cyrtocera cincta*, Münster, Beiträge z. Petref. Heft i. p. 57, Taf. ii. f. 4.

1843. *Dentalium cinctum*, de Koninck, Descr. des Anim. Foss. du terr. Carb. de la Belgique, p. 318, pl. xxiii. f. 3.

1844. *Orthoceras subcentrale*, de Koninck, *ibid.* p. 514, pl. xlv. f. 3.

1844. *Cyrtoceras cinctum*, de Koninck, *ibid.* p. 526, pl. xlvi. f. 4.

1849. *Aploceras cinctum*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 112.

1849. *Orthoceratites subcentralis*, d'Orbigny, *ibid.* p. 113.

1852. *Cyrtoceras cinctum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 203.

1852. *Orthoceras subcentrale*, Giebel, *ibid.* p. 252.

1880. *Cyrtoceras cinctum*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 29, pl. xxxiii. ff. 12, 13.

Sp. Char. Shell very elongated, regularly curved, slowly increasing in diameter, transverse section perfectly circular. Septa distant from each other about 2 lines, where the shell has a diameter of 6 lines. Body-chamber large, occupying about one third of the total length of the shell. Siphuncle very slender, almost filiform, situated in the line of the ventro-dorsal diameter at a distance of $\frac{1}{3}$ of that diameter from the margin. Surface ornamented with numerous acute riblets, separated from each other by spaces as wide as themselves; they are generally, but not always, parallel with the plane of the septa.

Remarks. A portion of the body-chamber of this species was referred by de Koninck (in 1844) to the genus *Dentalium*, and another fragment was erroneously ascribed to *Orthoceras subcentrale*, de Kon.

¹ Pal. Foss. of Cornwall, Devon, and West Somerset, p. 117, pl. xlvi. f. 224.

Horizon. Calschiste de Tournai (Assise i. e); = Carboniferous Limestone.

Locality. Tournai, Belgium.

Fairly well represented in the Collection.

I have decided, after some hesitation, to place the following species in the genus *Cyrtoceras*:—

Cyrtoceras (Meloceras) scalpratum, J. de C. Sowerby, sp.

1840. *Orthoceras scalpratum*, J. de C. Sowerby, Trans. Geol. Soc. 2nd ser. vol. v. pt. iii. Explanation of plate xl. f. 3.

1854. *Orthoceras scalpratum*, Morris, Cat. of British Foss. 2nd ed. p. 311.

Sp. Char. "Lanceolate, compressed, smooth [cast], slightly curved, with the edges angular, the inner one sharp; septa numerous; siphuncle small, near the obtuse edge." (*Sowerby.*)

Remarks. This species is remarkably compressed, the ratio of the two diameters being about as 12:6. The curvature is very slight, but quite perceptible.

The only species in British rocks with which I can compare this one is the *Cyrtoceras compressum* of J. de C. Sowerby, but the latter has a much greater curvature.

Horizon. Wenlock.

Locality. Coalbrookdale¹, Shropshire.

Represented in the Collection by three specimens.

Subgenus **OOCERAS**, Hyatt, emend. Foord.

This subgenus includes very slowly tapering, laterally compressed, elongated shells, with very short body-chambers. The cross section is ovate, the narrower end corresponding with the outer or ventral curvature of the shell. The siphuncle is usually external (exogastric); rarely internal (endogastric).—Ordovician to Devonian.

ORDOVICIAN SPECIES.

Exogastric.

Cyrtoceras (Ooceras) falcatus, Schlotheim, sp.

1820. *Orthoceratites falcatus*, Schlotheim, Petrefactenkunde², p. 53.

1822. *Orthoceratites falcatus*, Schlotheim, Nachträge z. Petrefactenkunde, Abth. i. p. 58, Taf. viii. ff. 2, a, b.

¹ See *ante*, p. 54.

² The Plates illustrating this work are dated 1832.

1849. *Lituites falcatus*, Quenstedt, Petrefactenkunde Deutschlands, Band i. Abth. i. p. 50, tab. i. ff. 15, *a, b* (copied from Schlotheim).
 1860. *Cyrtoceras falcatum*, Eichwald, Lethæa Rossica, vol. i. Seconde Section de l'Ancienne Période, p. 1280, pl. 1. ff. 8, *a, b*.
 1867. *Cyrtoceras falcatum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 376.
 [Not 1833. *Orthoceratites falcatus*, Steininger, Mém. Soc. Géol. de France, vol. i. pt. i. p. 369.]

Sp. Char. Shell elongated, curved, laterally compressed. The curvature well marked, so that upon a chord of 24 lines subtending the concave side of an incomplete specimen 3 inches in length the highest perpendicular is 4 lines. The transverse section is elliptical. The body-chamber has not been seen in a complete state. The septa are numerous and strongly waved. The siphuncle is situated submarginally, close to the convex border of the shell. The test, which is admirably preserved in one of the specimens in the Collection, is ornamented with subregular lines of growth, which have an upward imbrication.

Remarks. M. Eichwald figures a portion of the body-chamber of this species (*loc. cit.* f. 8, *a*), and in the middle of it there is a double, transverse, curved groove, and a little above this is another superficial rounded depression, which Eichwald supposes to be a muscular impression.

Horizon. *Orthoceras*-Limestone (= Arenig).

Locality. Reval (Esthonia), Russia.

Fairly well represented in the Collection. One of the specimens was transferred from the Museum of Practical Geology.

SILURIAN SPECIES.

Cyrtoceras (Ooceras) approximatum,

J. de C. Sowerby, sp.

1839. *Orthoceras approximatum*, J. de C. Sowerby, in Murchison's Sil. Syst. p. 642, pl. xxi. f. 22.
 1854. *Cyrtoceras approximatum*, Salter, in Murchison's 'Siluria,' pl. xi. f. 4.
 1854. *Cyrtoceras approximatum*, Morris, Cat. of Brit. Foss. 2nd ed. p. 302.
 1882. *Cyrtoceras approximatum*, Blake, British Foss. Ceph. pt. i. p. 172, pl. xx. ff. 1, 1 *a*.

Sp. Char. "The section is circular. The rate of increase is very slight at the smaller end, and almost zero at the larger. The curvature is slight, having a radius of $7\frac{1}{2}$ inches. The surface is only

seen by the external cast. The appearances presented are rather contradictory. In the part preserved the septa appear to be $\frac{1}{4}$ the diameter apart, but on the external cast there are lines which are twice as close: these may be interpreted either as ribs or septa. The apparent remoteness of the latter on the upper part would lead to the former, but another specimen suggests the latter interpretation. The convexity is moderate, and the siphuncle minute and external."

This is Prof. Blake's description of the type-specimen contained in the Museum of the Geological Society. The specimen preserved in the National Collection (figured by Blake, *loc. cit.*) is referred by him with some hesitation to Sowerby's species; he thus describes it:—"A better preserved example, apparently referable to this [*Ooc. approximatum*], shows a section with equal axes, but scarcely circular; the increase is greater on approaching the inflated body-chamber, which is $\frac{5}{8}$ its basal diameter in length, and the aperture has a simple circular outline. The curvature is almost lost. The septa in this are certainly $\frac{1}{8}$ the diameter apart, but no siphuncle can be found on the conically-shaped septal surface.

"The nearest species to this in shape is *Orthoceras fretum*, but there is no sign of curvature in that, and the body-chamber is different."

Horizon. Wenlock Limestone.

Locality. Dudley, Worcestershire.

Represented in the Collection by the specimen figured by Prof. Blake in his work above cited.

Cyrtoceras (Ooceras) acinaces, Barrande, sp.

1867. *Cyrtoceras acinaces*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 476, pl. cxviii. ff. 9-14, pl. cxxiv. ff. 16-18.

Sp. Char. Shell very strongly curved, especially in the apical portion. Upon a chord of 120 millim., subtending the concave side of a specimen wanting the apical part, the highest perpendicular is 32 millim. The transverse section is oval, of which the small end corresponds with the convex side of the shell. The ventro-dorsal is to the convex axis as 5 : 4. The rate of increase is very gradual. The body-chamber is short, and occupies scarcely $\frac{1}{8}$ of the total length of the shell. The length of the body-chamber is in some specimens exactly equal to the diameter of the aperture (Barrande, pl. cxviii. f. 9). The septa are exceedingly numerous, being about $\frac{1}{3}$ of the ventro-dorsal diameter distant from each other; they arch sharply forward on the convex border of the shell, and form a

shallow sinus on its sides. The siphuncle is situated close to the convex border. The test is ornamented with pretty distinct, rounded annulations, which form a narrow sinus on the convex border; their surface is covered with fine striæ of growth.

Remarks. The species having the closest affinity with the present one is *C. sociale*, Barr., but it differs notably from the former in its ornaments, rate of tapering, and other minor characters.

Horizon. Étage E, bande e 2 (=Salopian).

Localities. Dworetz, Dlauha Hora, Bohemia.

Fairly well represented in the Collection.

Cyrtoceras (Ooceras ?) æquale, Barrande, sp.

1848. *Cyrtoceras æquale*, Barrande, Haidinger, Bericht über die Mittheil. von Freund. der Naturwiss. in Wien, Band iv. p. 209.

1852. *Cyrtoceras æquale*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 209.

1867. *Cyrtoceras æquale*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 479, pl. cviii. ff. 13-18, pl. ccii. ff. 14, 15.

Sp. Char. Shell strongly curved. Upon a chord of 105 millim., subtending the concave side, the highest perpendicular is 27 millim. The transverse section is oval, the narrower end corresponding with the convex side of the shell. The ventro-dorsal is to the transverse axis about as 4:3. The increase in diameter is rapid in the inferior third of the shell, where the ventro-dorsal diameter increases in the ratio of 1 to 3 in a length of 50 millim. The body-chamber is very short. In adult shells it is about equal to the ventro-dorsal diameter of the aperture, and occupies about $\frac{1}{5}$ of the total length of the shell. The distance between the septa increases slowly, reaching a maximum of about $\frac{1}{8}$ of the ventro-dorsal diameter. The siphuncle is situated close to the convex border, but without touching the test. The surface of the test is covered with somewhat irregular striæ of growth, which in the upper part of the shell assume the aspect of imbricating lamellæ.

Remarks. The species most nearly allied to the present one is *Ooc. sociale*, Barr., sp., which is, however, clearly distinguished by the ornaments of the test, consisting of well-marked imbricating plications.

Horizon. Étage E (=Salopian).

Locality. Lochkow, Bohemia.

Represented in the Collection by a single example.

Cyrtoceras (Ooceras) superbum, Barrande, sp.

1867. *Cyrtoceras superbum*, Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 623, pl. cxxviii.

Sp. Char. Shell strongly and uniformly curved throughout its whole length. Upon a chord of 75 millim., subtending the concave side of a very incomplete specimen, the highest perpendicular is 20 millim. Some specimens, however, are less strongly curved. The transverse section is oval, of which the smaller end corresponds with the convex side. The ratio of the ventro-dorsal axis is to the transverse axis as 3 : 2 at the smaller end of the shell, but at the other extremity it is as 11 : 10, but the oval character is always maintained. The form of the section in different individuals differs considerably, the ratio of the two axis being as 9 : 7 in one of the specimens figured by Barrande (pl. cxxviii. f. 3), while in the other it is as 19 : 17 (f. 6). The length of the body-chamber rather exceeds the diameter of the aperture, and occupies about $\frac{1}{4}$ of the total length of the shell. The septa are very numerous, and increase regularly in their distance from each other throughout $\frac{3}{4}$ of the septate part of the shell, after which they again diminish in distance towards the body-chamber. The space which separates them is not more than $\frac{1}{13}$ of the ventro-dorsal diameter. The siphuncle is situated close to the convex border of the shell, but without coming in contact with the test. The latter is known only by a few transverse striæ upon the internal cast of the shell; there are also a few obscure longitudinal ridges observable upon some specimens.

Remarks. This species is sufficiently distinguished from its congeners by its general proportions and by its transverse section.

Horizon. Étage E (= Salopian).

Locality. Dworetz, Bohemia.

Fairly well represented in the Collection.

DEVONIAN SPECIES.

*Endogastric.***Cyrtoceras (Ooceras) flexuosum**, Schlotheim, sp.

1820. *Orthoceratites flexuosus*, Schlotheim, Petrefactenkunde, p. 52.

1822. *Orthoceratites flexuosus*, Schlotheim, Nachträge zur Petrefactenkunde, Abth. i. p. 58, Taf. viii. f. 1.

1842. *Phragmoceratites subventricosus*, d'Archiac & de Verneuil, Trans. Geol. Soc. ser. 2, vol. vi. p. 351, pl. xxx. ff. 1, 1 a.

1849. *Campulites subventricosus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 56.
 1852. *Phragmoceras subventricosum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 211.
 1853. *Cyrtoceratites subventricosus*, Steininger, Geogn. Beschreib. der Eifel, p. 41.

Sp. Char. The following is the description of this species given by d'Archiac and de Verneuil:—"Shell in the form of a slightly elevated cone, compressed upon the sides and slightly arched so as to present only half a revolution when the shell is complete. Septa slightly concave, elliptical, having their greater diameter between the back and the ventral part, and being also a little sinuous anteriorly on the dorsal region. Chambers two and three times higher dorsally than ventrally. Siphon ventral [*i. e.* internal], very near the edge, and madreporiform."

Remarks. I can discover no character by which to separate Schlotheim's species from the one described by d'Archiac and de Verneuil (*loc. cit.*), and therefore the name bestowed by these authors must give place to that of Schlotheim.

The example in the National Collection, which, like the one figured by d'Archiac and de Verneuil, is a cast, is marked with obscure longitudinal ridges. These are of sufficient prominence to justify the conclusion that they must have formed a distinguishing feature in the ornamentation of the test of this species, and we do in fact find such ornaments in the example figured by Schlotheim.

There is thus good ground for establishing the identity of the two species, especially as they agree perfectly in all other characters. The name *flexuosum* is not inappropriate, when applied, as it presumably was, to the septa, which are conspicuously bent or arched forward.

Horizon. Middle Devonian.

Locality. Gerolstein, Eifel.

Represented in the Collection by a single example.

Cyrtoceras? fimbriatum, Phillips.

1841. *Cyrtoceras fimbriatum*, Phillips, Pal. Foss. of Cornwall, Devon, and West Somerset, p. 114, pl. xlv. f. 214.
 1842. *Cyrtoceratites fimbriatus*, d'Archiac & de Verneuil, Trans. Geol. Soc. ser. 2, vol. vi. p. 386.
 1849. *Cyrtoceras fimbriatus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 53.
 1852. *Cyrtoceras fimbriatum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 206.

Sp. Char. "General figure arched, tapering; surface ornamented with about fifteen longitudinal ridges, crossed by many equal undulated membranaceous elevations; section elliptical (nearly as in *C. quindecimale*); septa apparently coinciding with the membranaceous risings; siphuncle near the dorsal convex line." (*Phillips.*)

Remarks. This specimen is far too imperfect for any comparison of it to be made with other species; more than half of it is buried in the rock, and what is visible has been much decomposed by weathering.

Horizon. Middle Devonian.

Locality. Newton Bushel, Devonshire.

Represented in the Collection by the specimen figured by Phillips (*loc. cit.*).

Cyrtoceras? quindecimale, Phillips.

1841. *Cyrtoceras quindecimale*, Phillips, Pal. Foss. of Cornwall, Devon, and West Somerset, p. 114, pl. xlv. f. 216.

1842. *Cyrthoceratites quindecimalis*, d'Archiac & de Verneuil, Trans. Geol. Soc. ser. 2, vol. vi. p. 386.

1849. *Cyrtoceras quindecimalis*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 53.

1852. *Cyrtoceras quindecimale*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 205.

Sp. Char. "General figure arched and regularly tapering; surface ornamented with fifteen longitudinal ridges and furrows, crossed by annular membranaceous ridges, of which each fourth is more prominent than the others; section elliptical, the shorter axis being in the plane of inflexion, with diameters as 67 : 100; septa generally concave; siphuncle small, near the dorsal or convex line of the flexure." (*Phillips.*)

Remarks. The specimen in the Collection referred to this species is a small fragment, 13 lines long, 5 lines in diameter at the broader end, and 2 lines at the narrower; the ornamentation, which can only be obscurely made out, owing to the bad preservation of the specimen, consists of longitudinal ridges crossed by waved imbricating (?) striæ. The section is transversely elliptical. All the characters seen agree very well with Phillips's figure.

Horizon. Middle Devonian.

Locality. Newton Bushel, Devonshire.

Represented in the Collection by a single specimen presented to the Museum by J. E. Lee, Esq., F.G.S.

SUPPLEMENT¹.

Genus **ORTHO CERAS.**

Orthoceras sulcatulum, M'Coy.

1844. *Orthoceras sulcatulum*, M'Coy, Synops. Carb. Foss. of Ireland, p. 8, pl. i. f. 4.

1876. *Orthoceras subcentrale*, Armstrong, Young, and Robertson, Cat. of Western Scottish Fossils, p. 59.

Sp. Char. Shell elongate, tapering at the rate of about 1 in 4. Transverse section nearly circular. Septa distant from each other one fifth the diameter of the shell. Test ornamented with irregular waved riblets, which are much coarser in the adult shell than in the young; they are often displaced, showing that the shell sustained fractures (probably at the aperture) and was afterwards repaired by the animal.

Remarks. Having had the opportunity afforded me, through the courtesy of Mr. John Young, of seeing some fine examples of the present species in the Museum of the University of Glasgow, I must confess myself still unconvinced that *O. sulcatulum* is identical with *O. subcentrale* of de Koninck. The figure of the last-named species represents a shell with regular transverse riblets, without the slightest undulation in them, and much coarser, more equal and direct than those of *O. sulcatulum*, in which the riblets are irregular and most distinctly waved.

On again examining Sowerby's type-specimen of *O. teres* (see *ante*, p. 121) and comparing it with an example of *O. sulcatulum* procured by myself at the Arden Quarry, I now feel pretty certain that *O. teres* is the young of *O. sulcatulum*.

Horizon. Upper Limestone Group².

Locality. Arden Quarry, Nitshill, near Glasgow.

Represented in the Collection by a single example.

¹ Consisting of a few species inadvertently left out of their proper places, and one (*Orthoceras sulcatulum*) added to the Collection during the progress of the present volume. Also note on *Ascoceras* from Sweden; and on a specimen of *Orthoceras annulatum*, from Dudley.

² See footnote, p. 121.

Orthoceras discrepans, de Koninck.

1844. *Orthoceras cinctum*, de Koninck, Descrip. des Anim. Foss. du terr. Carb. de la Belgique, p. 512, pl. xliii. f. 6, pl. xlv. ff. 5, *a, b*, pl. xlvii. ff. 3, *a, b* (synon. excl.). (Not of Sowerby nor of Phillips.)
 1880. *Orthoceras discrepans*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 68, pl. xl. ff. 5, *a-c*.

Sp. Char. Shell straight, rate of increase about 1 in 8; transverse section circular. Body-chamber not very large, about one fourth the total length of the shell. Septa numerous, 1 line distant from each other where the diameter of the shell is 5 lines. Siphuncle sub-central. Ornaments of the test consisting of very fine, regular, direct, transverse raised lines, about four of which are contained in the space of 1 line; between these there are four or five finer striæ, visible only under a lens.

Remarks. M. de Koninck observes that he originally confounded this species with the *Orthoceras cinctum* of J. de C. Sowerby, from which, however, it is to be distinguished by its smaller size, by the sharpness of the rings that ornament its surface, and by its higher rate of tapering. From *O. salutatum*, de Kon., and *O. salvum*, de Kon., it is distinguished by the lesser number of the rings that ornament its surface, and by the greater width of the interspaces separating them.

It now becomes necessary to remove *O. cinctum*, de Koninck (non Sowerby) from the synonymy of *O. cinctum*, Sow. (see *ante*, p. 106), where I had erroneously placed it.

Horizon. Calschiste de Tournai (Assise *i.e.*); = Carboniferous Limestone.

Locality. Tournai, Belgium.

Represented in the Collection by a single example.

Orthoceras denticulus, de Koninck.

1880. *Cyrtoceras denticulus*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 21, pl. xxxvi. ff. 11, 11 *a*, 12.

Sp. Char. Shell slightly curved at the apex, but straight above. Transverse section circular. Rate of increase about 1 in 6. Body-chamber not observed. Septa numerous, shallow, nearly equidistant. Siphuncle between the centre and the margin. Test apparently smooth, or only feebly marked.

Remarks. This is a badly characterized species, and may be the young of a larger one.

Horizon. Calschiste de Tournai (Assise i. e); = Carboniferous Limestone.

Locality. Tournai, Belgium.

Represented in the Collection by three small fragments.

Orthoceras dentatum, Foord.

1844. *Orthoceras Gesneri*, de Koninck, Descrip. des Anim. Foss. du terr. Carb. de la Belgique, p. 520, pl. xlvii. ff. 4, a-c.

1880. *Cyrtoceras canaliculatum*, de Koninck, Faune du Calc. Carbonifère de la Belgique, p. 33, pl. xxxiii. ff. 9, 9 a.

Sp. Char. Shell long and slender, very slightly (almost imperceptibly) curved. Transverse section generally elliptical, owing to compression, but probably the normal form is circular, as seen in some specimens. The rate of increase is 1 in 10. The body-chamber occupies nearly one third of the total length of the shell. The septa are very numerous and close to each other in the young, but as the shell attains to maturity they become less approximate and maintain a distance of about $1\frac{1}{2}$ line apart. The siphuncle is slender and nearly central in its position. The surface of the test is ornamented with about twenty-three very regular, prominent, longitudinal ridges, which are crenulated so as to form a series of very fine spinulose denticles throughout the whole of their length.

Remarks. In changing the name of the genus it was necessary also to substitute another specific name for de Koninck's, *Orthoceras canaliculatum* having already been used by J. de C. Sowerby (see ante, p. 67).

Horizon. Calschiste de Tournai (Assise i. e); = Carboniferous Limestone.

Locality. Tournai, Belgium.

Fairly well represented in the Collection.

Orthoceras subellipticum, d'Orbigny.

1843. *Orthocera ellipticum*, Klipstein, Beitr. zur geol. Kenntn. der östlichen Alpen, p. 144, Taf. ix. ff. 5, a, b.

1849. *Orthoceratites subellipticus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 179.

1852. *Orthoceras subellipticum*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 237.

1869. *Orthoceras subellipticum*, Laube, Fauna der Schichten von St. Cassian, p. 11, tab. xxxvi. ff. 7, 7 a, 7 b.

1882. *Orthoceras subellipticum*, Mojsisovics, Die Cephalopoden der

Mediterranen Triasprovinz, in Abhandl. der k.-k. geologisch. Reichsanst. p. 292, Taf. xciii. ff. 9 a, 9 b.

Sp. Char. Shell straight, tapering at the rate of about 1 in 10. Transverse section elliptical, the ratio of the two diameters being as 4 : 5. Septa very deeply concave, apparently numerous. Siphuncle a little eccentric, sometimes surrounded by a series of radiating lines which may represent a *dépôt organique*, but the shell has not been seen internally. The test is covered with exceedingly fine lines of growth; it is always broken off at the apex, leaving this part bare. The test is admirably preserved, even to the nacreous layer.

Remarks. The best figure of this species is that of Mojsisovics, which represents a fragment about 2 inches long, the test being, as usual, broken off at the apical extremity. The name *Orthoceras ellipticum* being preoccupied by Münster, was changed by d'Orbigny to *Orthoceras subellipticum*.

Horizon. Trias: Cassianer Schichten (St. Cassian Beds).

Locality. St. Cassian, South Tyrol.

Represented in the Collection by two small fragments.

Genera of doubtful Affinities.

Genus **GONIO CERAS**, Hall¹.

(*Conoceras*, Saemann, 1854²; *Orthoceras*, Giebel, 1852³; *Orthoceras*, Billings, 1863⁴; *Orthoceras*, Safford⁵.)

Gen. Char. "General form and structure of the *Orthoceras*; the tube flattened, with extremely salient angles; septa sinuous; section an extended ellipse, with projecting angles; siphuncle ventral." (Hall.)

Remarks. No new light has been thrown upon the affinities of this singular genus since it was first described by Hall. Professor

¹ Palæontology of New York, vol. i. 1847, p. 54.

² Palæontographica, Band iii. p. 161.

³ Fauna der Vorwelt, Band iii. Abth. i. p. 263.

⁴ Geol. of Canada, Appendix, p. 949.

⁵ Geol. of Tennessee, p. 289.

Hyatt makes a special reference to it in his "Genera of Fossil Cephalopods"¹, and he there places it in a separate family (*Gonioceratidæ*), stating that Professor Hall considers his genus *Eudoceras*² as very closely allied to it. The genus *Eudoceras* is described by Hyatt as including "straight shells of the Silurian and Devonian, with whorls flattened, sides angular," &c. He also defines *Gonioceras* as having "a broad winged shell, which in form and structure, as indicated by the septa and striæ of growth, closely resembles the internal shells of *Sepia*"; and he considers that "the facts are sufficient to warrant our assuming this [*Gonioceras*] as probably one of the passage-forms from the compressed *Orthoceratites* to the true *Sepioidea*, and possibly a more or less remote ally of *Palæoteuthis Dunensis*, Roem., of the Devonian"³.

There is, however, no reason whatever to doubt that the shell of *Gonioceras* was external, like that of *Orthoceras* and *Actinoceras*, to the latter of which genera *Gonioceras* is by no means remotely related. On the other hand, the shell in the *Sepioids* is internal, and functions not as a habitat for the animal, but as an internal support, which, after dwindling to a horny plate in *Loligo*, totally disappears in *Octopus*⁴. This difference in the function of the shells points to a different line of descent in the two groups to which the forms in question belong.

Referring to certain species described by Billings⁵ under the names of *Orthoceras Xiphias* and *O. hastatum*, Barrande says that they "may be considered as establishing a sort of transition between the

¹ Proc. Boston Soc. Nat. Hist. vol. xxii. 1883, p. 288.

² Referring to the Supplement to vol. v. pt. ii. of the 'Palæontology of New York,' contained in vol. vii. of that work (dated 1888), no such genus as *Eudoceras* is to be found, though I am informed by Mr. C. E. Beecher, of Albany, N. Y., that the species adopted by Prof. Hyatt as the type of his (not Hall's) genus is *Trochoceras*? (*Gonioceras*?) *pandum*, Hall. This species is fully described in vol. v. pt. ii. Palæont. of N. Y. 1879, p. 403, pl. cxi. f. 4. The strongly inflated upper part of the shell (specially observable in Hall's fig. in the Suppl. to vol. v. pt. ii. Pal. of N. Y. pl. cxvii. f. 3) gives this species very much the aspect of a *Gomphoceras*; it is too imperfect to warrant the application of a new generic name.

³ This fossil, however, has been pronounced to be the dermal plate of a placogonoid fish (see Zittel's Handb. der Paläontologie, Band i. Abth. ii. footnote, p. 521). This species was described at first under the genus *Archæoteuthis* (1854) by Roemer, and subsequently referred by him to d'Orbigny's genus *Palæoteuthis* (*Palæontographica*, Band iv. 1856, pp. 72-74).

⁴ Except that the rudiments of the shell-sac appear in the embryo, and then evanesce. (Lankester, Encycl. Brit. 9th ed. vol. xvi. Mollusca, p. 672.)

⁵ Geol. Surv. of Canada, Rep. of Progress, 1853-1856, pp. 318, 333 (1857).

Orthocerata with circular section and the remarkable American form described by Prof. J. Hall under the name of *Gonioceras anceps*." Barrande expresses the opinion, however, that the latter should be retained in a distinct group.

Finally, *Gonioceras* requires further working up with better material than is at present available for the purpose, before any conclusions can be arrived at with respect to its true affinities.

Gonioceras anceps, Hall.

1847. *Gonioceras anceps*, Hall, Pal. of New York, vol. i. p. 54, pl. xiv. ff. 1, 1 a-d.
1849. *Gonioceras anceps*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 2.
1852. *Gonioceras anceps*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 263¹.
1855. *Gonioceras anceps*, Swallow, Geol. Surv. of Missouri (First and Second Annual Report), p. 114.
1863. *Orthoceras anceps*², Billings, Geol. of Canada, p. 150, ff. 108, a, b.
1865. *Gonioceras anceps*, Kjerulf, Veiviser ved geol. excurs. i Christiania omegn. p. 9.
1866. *Gonioceras anceps*, Worthen, Geol. Surv. of Illinois, vol. i. p. 146.
1869. *Orthoceras anceps*, Safford, Geol. of Tennessee, p. 289.
1873. *Gonioceras anceps*, Shumard, Geol. Surv. of Missouri (1855-1871), p. 307.
1874. *Gonioceras anceps*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. p. 786.
1876. *Gonioceras anceps*, Ferd. Roemer, Lethæa Geognostica, Theil i. Leth. Palæoz., Atlas, Taf. vi. ff. 5 a, 5 b.
1880. *Gonioceras anceps*, Kjerulf & Gurlt, Geol. des südlichen und mittleren Norwegen, p. 68.
1882. *Gonioceras anceps*, Whitfield, in Chamberlin's Geol. of Wisconsin (1873-1879), vol. iv. pt. iii. Palæont. p. 361.
- [Not 1840. *Orthoceras anceps*, Münster, Beiträge zur Petrefactenkunde, Heft iii. p. 104, Taf. ix. f. 6.—1844. *Orthoceras anceps*, de Koninck, Descrip. des Anim. Foss. du terr. Carb. de la Belgique, p. 517, pl. xlv. ff. 7 a, b.]

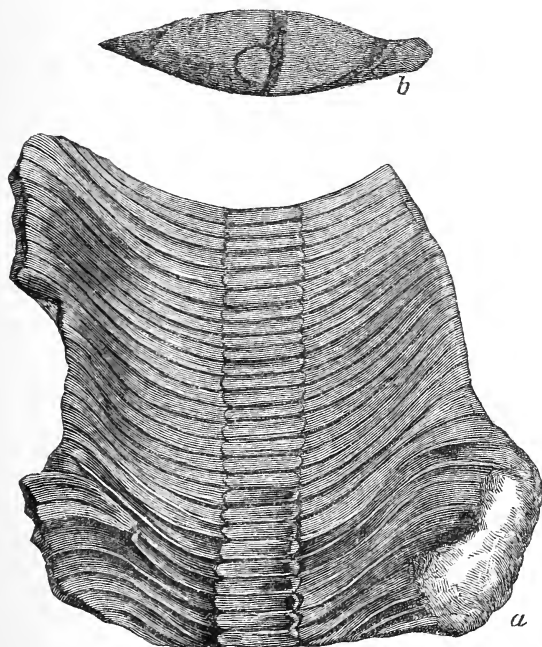
Sp. Char. "General form elongated, somewhat rapidly tapering from the base, extremely compressed; section an eccentric ellipse, compressed laterally towards the extremities, and extending into very acute angles; diameters as 1 to 4 or 1 to 5; septa composed

¹ *G. anceps* is placed by Giebel with "imperfectly known and doubtful species."

² The name "*Orthoceras anceps*" had already been employed by de Koninck in 1844 (Descrip. des Anim. Foss. du terr. Carb. de la Belgique, p. 517).

of double laminæ, deeply concave in the centre, numerous, thin, approximate, sinuous on the longest diameter; siphuncle moniliform, ventral, consisting of a round tube, which is exceedingly expanded between the septa, like the siphuncle of *Ormoceras* [*Actinoceras*].

Fig. 49.



Goniceras anceps.—*a*. Much weathered fragment, drawn from a specimen in the National Collection: natural size. *b*. Section, showing position of siphuncle: copied from Hall, *loc. cit.* f. 1 *c*.

“This remarkable fossil, usually appearing upon the weathered surfaces of rocks, with the ventral or dorsal side exposed, and presenting a broad surface with extended septa and central siphon, has received the appellation of ‘*petrified fish’s bones*.’ I had been disposed to regard this structure . . . as due, in part at least, to pressure; but the examination of numerous specimens in the rock, and of a portion of one nearly perfect, compels me to decide that their apparent disproportions are natural, and not the result of accident. In a portion of a nearly perfect individual, the siphuncle is so near the outer shell as to produce a longitudinal ventral ridge.

In this instance the relative diameters confirm previous measurements.

"The shell is apparently smooth or very finely striated, and extremely thin, as also are the septa. There is very little evidence of compression, and the original form seems to have been very nearly what it now is.

"In the longest diameter of the ellipse, the septa bend rapidly forward from the siphuncle till a little more than halfway to the external shell, where they make a gentle curve more directly towards the exterior, and before reaching it curve a little backwards. In the opposite direction, the septa have but a simple curve. In this character the septa bear some resemblance to *Goniatites*." (Hall.)

Remarks. I have given Hall's description of the type species in full; he has described another—*G. occidentale*—in the Rep. of Progr. Wisconsin, 1861, but I have not access to this work. It is described in Scudder's 'Cat. of Scientific Serials' under the title of "Report of the Superintendent . . . exhibiting the progress of the work; by Hall, &c. 1859-60 (1860-61), Madison. 2 n. 8°."

Horizon. Black River Formation (= Llandeilo Limestones?).

Localities. Watertown, Jefferson County, New York State. Canada.

Fairly well represented in the Collection.

Genus **JOVELLANIA** (Bayle¹), Foord.

(*Tripleuroceras* (pars), Hyatt, 1883²; *Gonioceras* (pars), Zittel, 1884³.)

Gen. Char. This genus (together with several others) was proposed by Bayle in a communication to the Geological Society of France; no description of it was given, but a type species—*Orthoceras Buchi*, de Vern.—was chosen to represent it.

Under *Jovellania* I now propose to class the species which constitute the "*triangulare*-group" of Dr. Emanuel Kayser⁴, upon which I shall have some remarks to make later on.

The present genus includes straight and usually slowly tapering shells, which have a subtriangular section; the siphuncle is situ-

¹ Bull. Soc. Géol. de France, sér. 3, vol. vii. 1879, p. 91.

² Proc. Boston Soc. Nat. Hist. vol. xxii. p. 289.

³ Handb. der Palæontologie, Band i. Abth. ii. Lief. iii. p. 370.

⁴ "Die Fauna der ältesten Devon-Ablagerungen des Harzes," in the Abhandl. zur geol. Specialkarte von Preussen, Band ii. Heft iv. 1878, p. 65.

ated near the margin, either at the apex of the triangle (*Orth. Buchi*, de Vern.) or at its base (*Orth. triangulare*, d'Arch. and de Vern.); or, again, it may be nearly central ("*Gomphoceras*" *hesperis*, Eichw.¹); in all cases it lies in the median line of the dorso-ventral diameter. It is generally nummuloidal, rarely cylindrical; in the former case it is filled with radiating deposits. The septa are very crowded; their sutures form a broad and shallow sinus on the ventral side of the shell (fig. 50 a), and arching upwards at the lateral angles bend slightly backwards, and then forwards on the opposite (dorsal) aspect (fig. 50 b), on the summit of which they form an obscure "saddle." The test is known only in one species (*Jovellania Buchi*, de Vern., sp.), and in this it is ornamented with transverse coarse annulations.

I recognize, at present, the following species as comprised in the genus *Jovellania*, viz.:—*Orthoceras Murrayi*, Billings, *Orthoceras capitolum*, Safford² (Ordovician of North America), *O. Archiaci*³ and *O. victor*⁴, Barr. (Silurian of Bohemia), *O. triangulare*, d'Arch. and de Vern. (Devonian of the Eifel), *O. Jovellani*, de Vern. (Devonian of Spain), *O. Buchi*, de Vern. (Devonian of France), and perhaps "*Gomphoceras*" *Hesperis*, Eichw. (Carboniferous of Russia).

Remarks. The "*triangulare*-group" of Kayser, referred to above, was constituted for the reception of *Orthoc. Archiaci* and *O. victor*, Barr., and *O. Jovellani* and *O. Buchi*, de Vern., of the Spanish Devonian, besides other undescribed species. With reference to its systematic position, Kayser questions whether the "*triangulare*-group" can be correctly classified with *Orthoceras*; and he observes that the thick and rayed siphuncle, and the unusually crowded septa of the species comprehended in it, vividly recall similar features in the large Cyrtocera of the Eifel and of the Bohemian Étages E & G, such as *lineatum*, Goldfuss, and *latifcans* and *desolatum*, Barrande⁵.

Dr. Kayser adds that the generic position of the forms included

¹ Lethæa Rossica, vol. i. p. 1270, pl. xlix ff. 4 a-c & 8 a-c.

² Geol. of Tennessee, 1869, p. 290, pl. iv. (G 3) ff. 1 a, 1 b (excl. 1 c). I referred this species above (p. 174) to the genus *Actinoceras*, but that reference I now believe to have been erroneous, and I take this opportunity of correcting it. The species figured by Safford (*i. e.* ff. 1 a, 1 b) agrees perfectly well (so far as one can judge by outline drawings only) with the forms I have included in *Jovellania*.

³ Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, p. 102.

⁴ *Loc. cit.* p. 104. Barrande admits, however, that this species may be only the young of *O. Archiaci*.

⁵ Syst. Sil. de la Bohême, vol. ii. pl. cccclxviii. and pl. dxiii.

by him in the "*triangulare*-group" must remain doubtful until the initial parts of their shells shall have been observed. Such a discovery, however, is not likely to be of much value if the question cannot be settled upon the evidence afforded by the adult shells.

Though these forms have hitherto been placed in the genus *Orthoceras*, yet their subtriangular section, close and undulating septa, and usually nummuloidal and marginal siphuncles, are all characters which mark them off very distinctly from that already unwieldy genus. If, therefore, it should be deemed advisable to found a separate family for the "*triangulare*-group," it would bear the name *Jovellaniidae*.

Jovellania Murrayi, Billings, sp.

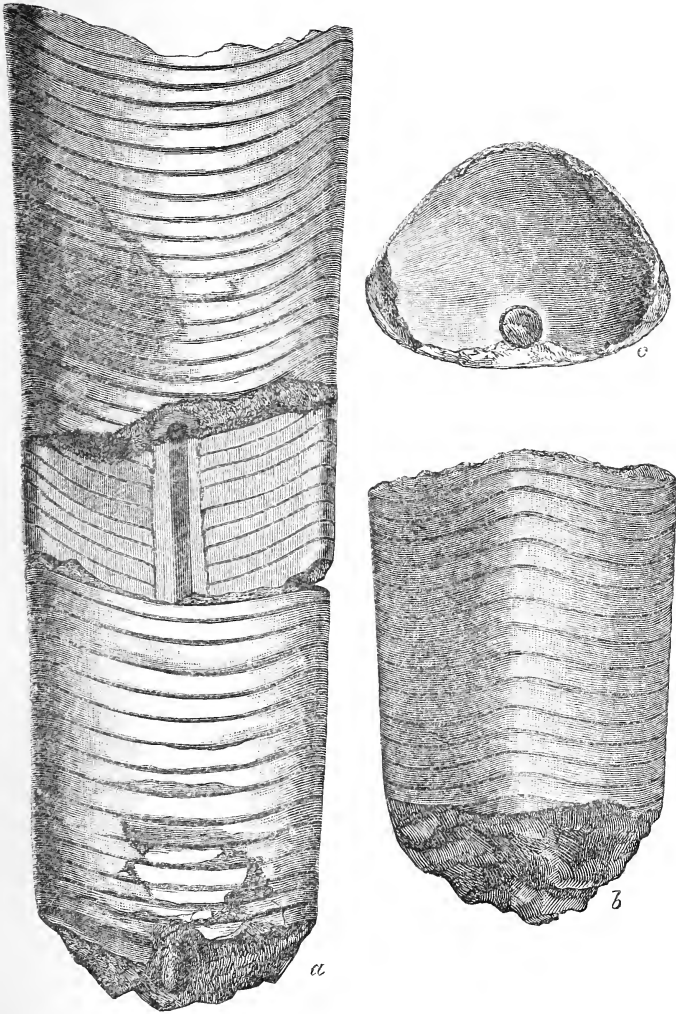
1857. *Orthoceras Murrayi*, Billings, Geol. Surv. of Canada, Rep. of Progr. for the years 1853-1856, p. 332.

1863. *Orthoceras Murrayi*, Billings, Geol. of Canada, Appendix, p. 950.

Sp. Char. "Section subelliptical or obscurely triangular, tapering at the rate of one line and a third to the inch, from a lateral diameter of thirteen lines; ventral aspect the broader; flattened or but slightly convex; dorsal side most convex along the centre, giving to the section a subtriangular shape; lateral diameter greater than the dorso-ventral in the proportion of about eleven to thirteen; siphuncle cylindrical, one sixth of the greatest diameter of the fossil, situated near the ventral margin. The septa on the ventral side make a strong curve towards the apex; they are distant from one seventh to one tenth of an inch. In a specimen three and a half inches in length and thirteen lines wide at the largest end, in the first inch of the smaller extremity there are not quite seven septa; in the next inch the same number, in the third nine, and in the half inch five. Another specimen shows ten septa to one inch, at a diameter of thirteen and a half lines, and in a third there are nine at a diameter of one inch; they are moderately convex. An artificial section through five of the chambers shows that the siphuncle is cylindrical, and that the septa, at the point of their contact with it, are bent suddenly towards the apex [the septal necks are here meant]; the surface, which is not well shown, appears smooth. . . ." (*Billings.*)

Remarks. There are some features observable in the fine examples of this species in the British Museum which are not touched upon in Billings's description of the fossil. These consist of numerous well-marked longitudinal ridges, which are seen upon the cast; also

Fig. 50.



Jovellania Murrayi.—*a*. Fragment of the septate part of the shell, the centre of which has been cut so as to expose the siphuncle; in the latter is seen a peculiar dark brown deposit, which is probably of organic origin; this is present also in another specimen near the apical extremity of the shell, and in this case it is of varying thickness; in yet another specimen the deposit is absent altogether. *b*. Dorsal aspect of the lower half of the same specimen, to show its convexity on this side. *c*. Section of the larger extremity of *b*, showing the position of the siphuncle. All of the natural size. Drawn from a specimen in the National Collection.

along the median line of the dorsal aspect of the shell there is a narrow impressed zone, upon which there are four fine longitudinal ridges. This zone is coincident with the narrow dorsal sinus formed by the arching forward of the septa in the direction of the aperture. A portion of the test remains upon one of the specimens, and it appears to be perfectly smooth, as stated by Billings.

The species to which *J. Murrayi* is most nearly related is the *Orthoceras triangulare* of d'Archiac and de Verneuil, described below; but the latter has transverse ridges in the young shell, which swell into nodose prominences upon the dorsal ridge, and the siphuncle is filled with radiating deposits. In the subtriangular shape of the shell, the position of the siphuncle, and the character of the septa the two species agree perfectly, and their relationship cannot be doubted¹.

Horizon. Trenton Formation (= Bala Limestone Group).

Locality. St. Joseph's Island, Lake Huron.

Represented in the Collection by some fine examples presented by Dr. J. J. Bigsby, F.R.S., and a small specimen which was transferred from the Museum of Practical Geology.

Jovellania triangularis, d'Archiac & de Verneuil, sp.

1842. *Orthoceratites triangularis*, d'Archiac & de Verneuil, Trans. Geol. Soc. ser. 2, vol. vi. p. 347, pl. xxvii. ff. 1, 1 a.

1856. *Orthoceras triangulare*, G. & F. Sandberger, Die Verstein. Nassau, p. 155, Taf. xvi.

1866. *Orthoceras triangulare*, Roemer, Beitr. zur geol. Kenntn. des nordwestl. Harzgeb. Abth. v. p. 4, tab. xxxiii. ff. 2, a-b.

1874. *Orthoceras triangulare*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. p. 104.

1878. *Orthoceras triangulare*, Kayser, "Die Fauna des ältesten Devon-Ablagerungen des Harzes," in Abhandl. zur geol. Specialkarte von Preussen, Band ii. Heft iv. p. 66, Taf. ix. ff. 2, a, b, f. 3?

1884. *Orthoceras? triangulare*, Kayser, Jahrb. der Königl. Preuss. geol. Landesanst. und Bergakad. f. d. Jahr 1883, p. 15.

[Not 1843. *Orthoceras triangulare*, Portlock, Rep. on the Geol. of Londonderry, p. 375, ff. 3, a-c.]

Sp. Char. "Shell in the form of an extremely elongated triangular pyramid, of which the section is a rectangular isosceles triangle with rounded angles, whose two smaller sides are curvilinear, but the larger or hypotenuse is straight, whence it results

¹ Cf. the above figures of *J. Murrayi* with those of *Orth. triangulare*, G. & F. Sandberger, Verstein. Nassau, Atlas, Taf. xvi.

that the small faces of the pyramid are curved, but the large face flat. Notwithstanding the absence of the shell, there may still be observed fine, irregular, slightly prominent striæ, which upon each of the lateral faces rise towards the dorsal keel, forming with the suture of the septa an angle of 45° , and then pass over the ventral face, where they describe a curve whose convexity seems turned towards the summit. Septa triangular, rounded, concave, with slightly undulated edges, the latter turning forwards a little upon each angle or keel, then turning backwards again in passing over the face. Height of the chambers variable, but they are generally very low, as eighteen may be counted in a space equal to the width of one of the smaller sides. Siphon circular, rather large, placed against the middle of the larger side and opposite to the right angle of the pyramid.

“This gigantic species was at least two metres in length; the fragment we possess, and which could not be figured entire, measures 0.36 [of a metre]. We have seen at Wurzburg, in the possession of Professor Landaberger, a specimen of this *Orthoceratite*, upon which are wide, rounded, slightly raised folds, corresponding to swellings or nodosities, placed upon the principal keel; in the specimen which we have represented there are only slight indications of these folds, which must undoubtedly be more prominent towards the summit of the shell than at the anterior part, the only portion which we have.” (*d'Archiac and de Verneuil.*)

Remarks. This species was afterwards described and figured by the brothers Sandberger, who represent a young specimen with sculpture such as that mentioned in the above description of the fossil. These ornaments are also described by Kayser, who observed them in a specimen from the Rhenish Schiefergebirge, and in a variety which he describes under the name of *Bickensis* (*loc. cit.* 1878, Taf. xi. fig. 2) they are very strongly marked. This author remarks upon the wide distribution of *J. triangularis*, which occurs at Wissenbach, Haiger, and Cramberg, in Orthocerasschiefer (Lower Devonian); Hausen, near Butzbach, in similar deposits; Niederlahnstein and Laubbach, near Coblenz, in Spiriferensandstein (Lower Devonian); and at Gerolstein in the Eifel (Middle Devonian).

A fragmentary specimen in the National Collection from the Wissenbach Slates has much wider septa than the type figured by d'Archiac and de Verneuil, or any of the individuals figured by G. and F. Sandberger; it may therefore be regarded as a variety, and I would suggest the name *latiseptatum* for it. The distance of the septa in this variety is equal to $\frac{1}{3}$ of the corresponding diameter of

the shell. In the specimens figured by the brothers Sandberger, the distance of the septa from each other varies from $\frac{1}{9}$ to $\frac{1}{7}$ the corresponding diameter. The septa are, moreover, exceedingly variable in their distance apart even in the same individual, three or four of them being sometimes crowded together, and occupying only one half the space that the others do.

Horizon. Orthoceratiten-Schiefer; Lower Devonian: Stringocephalen-Kalk; Middle Devonian.

Localities. Wissenbach, Nassau (L. Dev.); Gerolstein, Eifel (M. Dev.).

Represented in the Collection by two very imperfect fragments.

Jovellania Jovellani, de Verneuil, sp.

1845. *Orthoceratites Jovellani*, de Verneuil, Bull. Soc. Géol. de France, sér. 2, vol. ii. p. 461, pl. xiii. ff. 1a, 1b, 2.
1849. *Orthoceratites Jovellani*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 54.
1852. *Orthoceras Jovellani*, Giebel, Fauna der Vorwelt, Band iii. Abth. i. p. 246.
1855. *Orthoceras Jovellani*, Barrande, Bull. Soc. Géol. de France, sér. 2, vol. xii. pp. 476, 488, pl. xii. ff. 16, 17.
1875. *Orthoceratites Jovellani*, Mallada, "Synop. Fósiles de España," in Bol. Com. del Mapa geológico de España, tom. ii. p. 49.
1876. *Orthoceratites Jovellani*, Mallada, *ibid.* tom. iii. pl. ii. ff. 1, 2¹ (copied from de Verneuil).
1876. *Orthoceras Jovellani*, de Tromelin and Lebesconte, "Terr. Prim. de Bretagne," in Bull. Soc. Géol. de France, sér. 3, vol. iv. p. 614.
1876. *Orthoceras Ruppbachii*, Maurer, Neues Jahrb. für Min. &c. p. 831, Taf. xiv. ff. 2, a, b (teste Kayser).
1877. *Orthoceras Jovellani*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte v. p. 1273, pl. ccliv.² ff. 1-3.
1877. *Orthoceras Jovellani*, Barrande, *ibid.* Suppl. et Série tardive, p. 69.
1878. *Orthoceras Jovellani*?, Kayser, Abhandl. zur geol. Specialkarte von Preussen, Band ii. Heft iv. p. 68, Taf. ix. ff. 5, 5a.
1884. *Orthoceras* ? *Jovellani*, Kayser, Jahrb. der Königl. Preuss. geol. Landesanst. und Bergakad. f. d. Jahr 1883, p. 42.

Sp. Char. Shell very large, subconoidal in the young, and becoming subtriangular in the adult, the angles rounded in casts without the test; such rounding being probably due partly to weathering.

¹ These plates should have accompanied the descriptions of the fossils in vol. ii., with which their numbers correspond.

² The volume of Plates, of which this one forms a part, was published in 1868.

Rate of increase about 1 in 5. Septa numerous and very approximate, varying in their distance apart from 2 to $2\frac{1}{2}$ lines, where the diameter of the shell is $2\frac{1}{2}$ inches. On the flattened side of the shell (the base of the triangle) the sutures form a wide and shallow sinus, and arching upwards on either side upon the lateral angles they bend slightly backwards and then forwards upon the convex side of the shell (the apex of the triangle). Their course is in fact precisely similar to that which has been described in the sutures of *Jovellania triangularis*. The siphuncle is proportionately large and is filled with radiating deposits; it is situated nearly midway between the centre and the margin of the shell upon the convex side, being thus exactly on the opposite side to that in which it is found in *J. triangularis*. Nothing is known either of the body-chamber or of the test.

Remarks. This species offers at first sight a singular resemblance to *Jovellania triangularis*, d'Arch. & de Vern., sp., but it is at once distinguished by the position of the siphuncle. Dr. Kayser, in an important memoir entitled "Die Orthocerasschiefer zwischen Balduinstein und Laurenburg an der Lahn,"¹ observes that "it is not improbable that Maurer's *O. Ruppbachense* (*Ruppbachii*) is founded only upon a weathered and distorted example of our species" [*Jovellania*]. It may be mentioned that Barrande gives a very minute description of the crystalline deposits which fill up the siphuncle in the present species².

Horizon. Lower Devonian.

Locality. Gijon, District of Ferroñes (Asturias), Spain.

Represented in the Collection by a very good specimen, which was presented by S. P. Pratt, Esq.

Jovellania Buchi, de Verneuil, sp.

1850. *Orthoceratites Buchii*, de Verneuil, Bull. Soc. Géol. de France, sér. 2, vol. vii. p. 778.

? 1877. *Orthoceras Buchi*, Ehlert, Bull. Soc. Géol. de France, sér. 3, vol. v. p. 585.

1878. *Jovellania Buchi*, Bayle, Explication de la Carte Géol. de France, vol. iv. Atlas, pl. xxxv. ff. 1-3.

Sp. Char. This species is thus briefly described by de Verneuil:—"Test ornamented with transverse annulations; siphuncle lateral, a little inflated as in *Ormoceras*. When the test is removed, this

¹ Jahrb. der Königl. Preuss. geol. Landesanst. und Bergakad. f. d. Jahr 1883, p. 42 (1884).

² Syst. Sil. de la Bohême, vol. ii. Texte v. 1877, p. 1273.

species may be easily mistaken for *O. Jovellani*, Vern. The septa are very approximate, and the interior of the siphuncle is filled from the centre to the circumference with radiating lamellæ."

Remarks. It was justly observed by the brothers Sandberger¹, that the short description given by de Verneuil, unaccompanied by figures, was not sufficient to distinguish his species from *triangularis*; but the position of the siphuncle, as we learn from the excellent figures subsequently furnished by Bayle, serves at once to distinguish *Buchi* from *triangularis*. Were it not, however, for the ornaments of the test, there would be nothing by which to distinguish the former species from *Jovellani*, as de Verneuil himself remarked, so that the validity of the present species must remain an open question until a specimen of *Jovellani* shall have been discovered with the test preserved.

Horizon. Devonian.

Locality. Néhou (Manche), France.

Represented in the Collection by a single imperfect example.

NOTE ON ASCOCERAS².

An interesting discovery has lately been made by Professor G. Lindström, of Stockholm, which throws new light upon the structure of the shell of the remarkable genus *Ascoceras*³. The specimens which formed the subject of Dr. Lindström's investigations were found in the "uppermost limestone stratum" (homotaxial with the Upper Ludlow) of the Island of Gothland, which contains a large assemblage of Cephalopoda, about 200 species being known, and amongst these nine species of *Ascoceras* (including *Glossoceras*). The chief facts elicited by the study of these species are the following:—That the shell of *Ascoceras* consists of two portions, the first, or older, resembling that of an *Orthoceras* (see fig. 51), having a cylindrical shell, with wide septa, and slender, tubular siphuncle, this stage being succeeded by a second or *Ascoceras*-stage, after the completion of which the older or *Orthoceras* portion became decolated or cast off; hence its rare preservation.

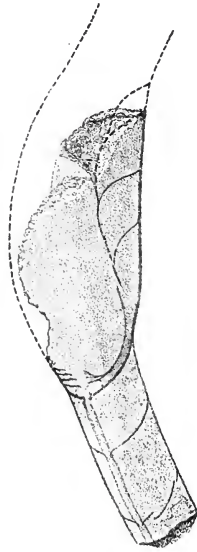
¹ Die Verstein. Nassau, 1856, p. 157.

² See paper by Prof. G. Lindström in *Geological Magazine*, Decade iii. vol. v. pp. 532-534 (1888).

³ *Ante*, p. 246.

Dr. Lindström observes that "the truncated end appears in all cases to have been strengthened from within by fresh linings of shelly material, and the animal continued to secrete its shell until the *Ascoceras* portion was formed." It is further stated that

Fig. 51.



Ascoceras, showing the *Orthoceras*- and *Ascoceras*-stage; after Lindström.

"broken off stumps of the former [*Orthoceras*¹] stage have been found, which can be matched to five of the nine Gothland species of *Ascoceras*. They all show the characteristic peculiarities of a narrow thin shell, very gradually increasing in width, oval or elliptical in transverse section, and ornamented by oblique, transverse striae. The body-chamber is extraordinarily long, the intervals between the septa, at first short and irregular, became, during the progress of the growth, unusually long. The siphuncle is narrow and straight, generally situated near the ventral surface. The decollation is oblique, following the direction of the septa.

"The commencement of the *Ascoceras*-stage is partially indicated by the increased distance between the septa." Dr. Lindström

¹ Dr. Lindström calls this the "*Nautilus*" stage.

concludes by recalling Bronn's opinion¹ that if *Ascoceras* could be proved to have thrown off some of its septa at an early stage, then *Orthoceras* may be taken as the ancestral form of *Ascoceras*, and not *vice versa*, as held by Barrande².

Although Dr. Lindström's discovery shows that *Ascoceras* began with a simple *Orthoceras*-like shell, yet the strange and withal sudden transformation in its structure, by which it assumed a sac-like shape, with an extremely irregular septation, remains as inexplicable as before. No doubt, as Dr. Lindström remarks, this alteration in the shell was due to important structural and functional changes in the animal.

NOTE ON A SPECIMEN OF *ORTHO CERAS*
ANNULATUM, SOWERBY³.

A very fine example of this species from the Wenlock of Dudley has lately been added to the Collection. The fossil consists of the septate part of the shell, very much crushed; it measures 1 foot $5\frac{1}{2}$ inches in length, $1\frac{3}{4}$ inch at the larger and 4 lines at the smaller extremity. Owing to the shell being crushed, the siphuncle is exposed to view for the space of about 5 inches of the upper part of the specimen. The lower or apical portion of the shell is covered with the matrix; but in the centre, where this has been removed, the annulations are very distinct, becoming, however, almost obsolete above. Some of the test is preserved, and shows the finely fimbriated surface characteristic of this species.

¹ Neues Jahrbuch für Min. &c. 1855, p. 283 (footnote).

² "Ascoceras, prototype des Nautilides," Bull. Soc. Géol. de France, 1855, sér. 2, tom. xii. p. 157.

³ See *ante*, p. 53.

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[Names which are regarded as synonyms or as invalid are printed in italics.]

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