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REVISION OF THE JURASSIC CEPHALOPOD FAUNA OF KACHH (CUTCH).

By
L. F. SPATH, D.Sc., F.G.S.

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REVISION OF THE JURASSIC CEPHALOPOD FAUNA OF KACHH (CUTCHE).  

BY  

L. F. SPATH, D.Sc., F.G.S.  

INTRODUCTION.  

WHEN describing, two years ago, the Blake Collection of Ammonites from Kachh (Cutch), the writer (1924, p. 1) regretted that owing to the fact that he had not been able to re-examine Waagen's types, the affinities of some of the oft-quoted Kachh species would have to remain uncertain. The kind offer, soon after, by Dr. E. H. Pascoe, the Director of the Geological Survey of India, to undertake the revision of the Ammonite fauna of Kachh, was therefore eagerly accepted by the writer. Mr. Oldham's anticipation of 1873 that Waagen's work would turn out to be one of the most important contributions to the Cephalopod palaeontology of the Upper Jurassic formations ever issued, was completely realised, and the writer feels deeply grateful to Dr. Pascoe for entrusting him with the revision of so important a fauna.  

Noetling had stated (1897, p. 1) that Waagen's figures were in many cases considerably, and not always successfully restored. Waagen, however, above all, was an enthusiastic and skilled student of ammonites, although his results were often questioned by later workers, less versed in ammonitology than he was. Waagen's writings contain much, or perhaps it should be said, between the lines one can detect much—that may escape the non-specialist. Students of ammonites at least cannot fail to appreciate the work of this great palaeontologist, whatever views they may hold as to the permanent value of the opinions of the early evolutionary enthusiasts.  

It is scarcely fair to blame Waagen for misrepresenting most of J. de C. Sowerby's species of Kachh ammonites since these were based on reduced figures published in 1840. There is certainly less excuse for many of Waagen's followers overlooking the wrong numbering of two of his plates.  

The writer previously mentioned that there are a number of new species in the Blake Collection. Others were discovered by Mr. J. H. Smith, of Bhuj in Kachh, to whose stratigraphical notes and information regarding the local beds the writer is greatly indebted.  

It has also been found necessary to refigure a number of Waagen's types that had generally been misinterpreted by workers who had to rely merely on the idealised or restored figures. The adequate illustration of J. de C. Sowerby's species of 1840 is, of course, equally essential.
The writer, at first, had no intention of including in his revision of the Kachh Cephalopoda the few known belemnites and nautili, chiefly because he had at his disposal only the originals figured in the first four plates of Waagen’s memoir and not his whole material. On examination of these types, however, it became evident that here again the illustrations were occasionally misleadingly restored by Waagen’s artist. It seemed advisable, in any case, to direct attention to errors and to refigure some of the specimens; but it is hoped that future collectors will not neglect the belemnites, which even if always fragmentary, according to Mr. J. H. Smith “swarm” in many of the beds of the well-known Kachh exposures. Moreover, the generic nomenclature required revision and it was also considered advisable to add notes on the belemnites in the Blake Collection in the British Museum and, further, references to subsequent geological literature dealing with the Indian species or their allies, especially from other Asiatic or African localities. The same applies to nautili, the literature of which group is similarly assuming considerable dimensions. Nautili, again are few, and only the Dhosa Oolite yields numbers, which, however, according to Mr. Smith, are either too tightly embedded or else break up on weathering.

It may be convenient to follow Waagen in taking first the belemnites and nautili and then the ammonites. With regard to general classification, the writer still “favours for the fossil forms of Cephalopoda, the division into three main orders, without reference to gills” (1919, p. 223). The Belemnoidea have lately (Naef, 1922) received exhaustive treatment and the Kachh material is too scanty to throw much additional light on this Order. The classification of post-Triassic Nautiloidea, on the other hand, has been revised in the present memoir. With regard to Ammonoidea, the writer pointed out previously that his classification of the Kachh genera was merely provisional. The abundant material now available has permitted him to offer what he ventures to think is a more satisfactory scheme, but our knowledge of many groups is as yet far from complete.

To avoid lengthy synonymies and footnotes, references are given with only the name of the author followed by the date, and if necessary a letter (to distinguish several papers of the same year). The “list of works referred to,” given at the end of the volume, will enable the reader who is not familiar with the literature to obtain the full reference. The measurements given in the specific descriptions of the ammonites are always:

- (1) Diameter in mm;
- (2) height of the outer whorl;
- (?) thickness of the same;
- (4) width of the umbilicus; the last three being in percentages of the diameter.

Where two diameters are given, the figure in brackets indicates the size at which the percentages were determined.

The addition of aff. (affinis) to a specific name indicates affinity but not identity with a certain species in the case of definitely recognisable forms; but cf. (conformalis) is used when the specimen is too poorly preserved to decide whether its resemblance to a given species is due to genetic affinity or is merely superficial. The letters G.S.I., B.M., M.P.G., with numbers,
refer to specimens preserved in the collections of the Geological Survey of India, the Geological Department of the British Museum (Natural History), and the Museum of Practical Geology (Geological Survey), London. The Zones provisionally used in the specific descriptions below, and pending revision in the concluding chapter of this memoir, are those listed in 1924 (Mem., Geol. Surv. India, Pal. Indica, New Series, vol. ix, No. 1, p. 21) for the Callovian to Argovian, and 1925 (Monogr. Hunterian Mus., vol. i, No. 7, p. 158) for the Kimmeridgian and later beds.

A. Order : BELEMNOIDEA.

Super-family : BELEMNITIDAE d'Orbigny, 1845.

The fourteen species of belemnites listed by Waagen and three additional forms are here referred to the following families and genera:—

Family BELEMNOPSIDAE : Naef emend.

Genus BELEMNOPIS, Bayle.

B. calloviensis (Oppel).
B. grantana (d'Orbigny)
B. kuntkotensis (Waagen).
B. tanganensis (Futterer).
B. orientalis (Waagen).
B. sp. ind.

Genus HIBOLITES (Montfort), Mayer-Eymar.

H. jumarensis (Waagen).
H. cf. hastatus (Blainville).
H. cf. semisulcatus (Münster).
H. fusticulus (Waagen).
H. stoliczkanus (Waagen).
H. blakei sp. nov.
H. katrolensis (Waagen).
H. sp. ind. (sauvanausus Waagen non d'Orbigny).
H. (Hastites ?) claviger (Waagen).

Family DUVALIDÆ, Pavlow.

Genus CONOBELUS Stolley.

C. oldhamianus (Waagen).

Family PASSALOTEUTHIDÆ, Naef emend.

Genus MEGATEUTHIS Bayle.

M. sp. ind.?

The classification adopted is in the main that used by Naef (1922) and is based on Lissajous's work (1915) on Jurassic belemnites and on Stolley's (1911, 1919) researches on Cretaceous forms. Abel's (1916) classification of the belemnites on the basis of the so-called "embryonal rostrum" was rejected by Naef; and the more recent investigations by Christensen (1924) support
Naef's view. The scheme here adopted is somewhat artificial but those who have had to identify fragmentary belemnites from unknown Jurassic formations, will appreciate the difficulty of determining generic position or in many cases even approximate age. With ammonites a small fragment of a single individual may often suffice for the initiated to pronounce a definite opinion as to the age of the beds from which it was derived. In the case of belemnites a large number of more or less complete specimens are often necessary before one can be reasonably certain of dealing with the fauna of one stage rather than another. It is not surprising therefore that workers on the Jurassic have always pinned their faith to ammonites rather than belemnites. On the other hand, this led to a comparative neglect of the latter and the lack of definite knowledge of the belemnites of, for example, the uppermost Jurassic has been felt and deplored by several recent workers.

In this connection it is interesting to note that there has as yet been found in Kachh only a single phragmocone that may belong to what the writer would take to be the typical massive, widely sulcate *Belemnites gerardi* Oppel (1865, pl. lxxxvii, figs. 1-3), as interpreted by Uhlig (1910, p. 386). This is well illustrated in the latter author's figs. 5 and 7 (pl. xciii), and thus restricted as before me in (Tithonian?) examples from the Niti Pass and Laptet in the Himalayas, as well as from the Salt Range, whence came the majority of Oppel's originals in the Schlagintweit Collection. The latter, however, were stated to be associated with numerous ammonite fragments of the families *Planulati* and *Macrocephali*, referred by Uhlig to the Oxfordian stage. There appears to be no doubt that at the base of the Spiti Shales, in the Himalayas, as well as in the Salt Range, *gerardi*-like forms, possibly identical with Futterer's *Bel. tanganensis*, occur, together with *Mayaites* and other Argovian forms; and the writer has previously (1924, p. 10) recorded from Kalabagh, *i.e.*, Oppel's type locality, a *Subkossmatia* (group of *Ammonites opis*, J. de C. Sowerby). The matrix of this example is different from that of the specimens from the Chichali Hills (Salt Range, near Kalabagh) which are preserved in a greenish sandy limestone, like Oppel's types; and from Wynne's (1880, pp. 39 and 47) and Koken's (1903, p. 439) accounts it appears that even Cretaceous belemnites have been collected in this area. Again Uhlig stated that *Belemnopsis gerardi* was distributed throughout the Lower and Middle divisions of the Spiti Shales and appeared to occur even in the highest stage, which he attributed to the Neocomian. If thus the Argovian examples differ at all from the Kimmeridgian and later so-called *Belemnopsis "gerardi"* the distinctive features must be too subtle to have been noticed by Uhlig or other authors.

Moreover, G. Boehm (1907) described and figured a number of belemnites from the Sula Islands of which at least two (*Belemnites taliabaticus* and *B. sularum* G. Boehm) may be identical with Oppel's species. *Belemnopsis ulfurica* (G. Boehm) the writer would, with Uhlig, consider to be distinct; but *B. moluccana* (G. Boehm) corresponds to the typical Spiti "*Belemnites sucatus* Miller", so often referred to in geological literature down to Crick (1904, p. 64), and may be the true *B. gerardi* in the restricted sense, characterised.
by a short, thick, and depressed guard. Boehm himself was prepared to com-
prise in Oppel’s “Belemnites gerardi” in the widest sense not only his own
earlier B. taliabuticus, B. sularum, B. moluccanus and B. alfuricus, but even Dac-
qué’s Belemnites cf. tanganensis, Futterer. The last, to judge by Dacqué’s
figure (1910, pl. ii, figs. 5-6), is probably close to Futterer’s East African
type; and both are indistinguishable from the perhaps slightly more widely
sulcate Belemnites alfuricus. Similarly the New Zealand Belemnites aucklandi-
cus, Hauer (1864, p. 99, pl viii, figs. 2-3), according to a series of specimens
before me, includes a corresponding, more narrowly-sulcated equivalent, in
addition to forms almost identical with Oppel’s species; and it is thus also
referable to the group of Belemnopsis gerardi. The two Kachh species, Bele-
mnopsis kuntkotensis and B. orientalis (Wagen) which were doubtfully included
by Uhlig in this gerardi group, are more easily distinguishable by their pecu-
liar shape; but Tate’s Belemnites africanus from the Neocomian Uitenhage
Beds, which according to the original example before me (refigured by G. Boehm,
1909, p. 564, figs. i, ii) is distinct on account of its comparatively short ventral
sulcus, cannot be included in the same group. Nothing like this is known
from Spiti or would have been included by such an experienced palaeontologist
as Uhlig in even a ‘Neocomian mutation’ of Belemnopsis gerardi.

Now it is important to note that if only the association of belemnites
with the more useful ammonites, or else the matrix suggesting this associa-
tion enable us to give even an approximate identification, G. Boehm (1913,
p. 136) indeed, was right in stating that little could be done with the in-
different forms of this gerardi group. He particularly questioned Uhlig’s uti-
lation of this group as a principal faunal characteristic of the Himalayan
Province. The writer has repeatedly voiced his scepticism regarding Uhlig’s
marine provinces, simply because these were based on the comparison of faunas
that were really of widely different ages.

We cannot claim for belemnites the same restricted vertical distribution
that makes the ammonites such useful time-indexes; but attention must be
drawn to the fact that hitherto any canalicate belemnite from the Himalayas,
from Everest’s (1833, pl. ii, fig. 17) early form to Blanford’s (1864, 1865)
and later authors’ “Belemnites sulcatus”, has automatically been referred to
Belemnites gerardi. It must be admitted that with the material at present
available this species is practically indistinguishable from the New Zealand
Belemnites aucklandicus; and that Belemnites tanganensis from East Africa,
Madagascar and Somaliland may be identical with the Sula Island form “Bele-
mnites alfuricus,” also recorded from Spiti. But if the type of belemnite figured
by Uhlig on e.g., pl. xciii, figs. 13a, b, i.e., the typical restricted B. gerardi
—which from external resemblance alone we might feel inclined to identify with
G. Boehm’s Belemnites moluccanus—from the Spiti Shales of Jandu, Shink
River, should prove to be characteristic of the beds with Virgatosphinctes
haydent, Uhlig (1910, pl. lxii, figs. 2a-d) and allies, it would be clear at once
why this belemnite has not been recorded from Africa or Madagascar. For
the only localities whence similar Virgatosphinctid faunas have so far been recorded
are Tufa in Somaliland (Spath, 1925, p. 158) and New Zealand (Spath, 1922, p. 302) and from the former locality there are no belemnites. Similarly the Madagascar belemnites (Rhopaloteuthis, see below, p. 17) before the writer from the Andranosamonta Marls may be unknown from Kachh merely because they are peculiar to a fauna characterised by numerous Haploceras elimatum (Oppel) and other ammonites, a fauna which is not represented in the fragmentary Kachh succession.

It is probable therefore that our knowledge of the zonal distribution of belemnites in the Upper Jurassic is as yet far too incomplete, and that the apparent replacement of the Callovian Belemnopsis grantana by the later tanganensis-gerardi group is as hasty a generalisation as Uhlig's view of the horizontal distribution of this group. Considering that belemnites are said to be so common in some of the Kachh strata, it may seem surprising that so discriminating a collector as the late Prof. J. F. Blake only accumulated about seventy-five examples, half of which are too badly preserved to be recognisable. Mr. J. H. Smith, however, now informs me that he has "long ago given up belemnites as hopeless," because he only obtained fragments without the phragmocone. As the Katrol group forms especially are poorly represented, the absence of Belemnites gerardi from Kachh (with the possible exception of the phragmocone already referred to) may be only accidental and due to collection failure; and palaeogeographical speculations based on the distribution of this species in the present state of our knowledge are valueless. Similarly the writer considers it of little significance that the number of Kachh species identical with European forms has been still further reduced in the present revised list.

Family BELEMNOPSIDÆ Naef emend.

Genus BELEMNOPSIS Bayle 1878.

BELEMNOPSIS CALLOVIENSIS (Oppel).

(Pl. I, fig. 7).
1873. Belemnites calloviensis, Oppel; Waagen, p. 14, pl. ii, figs. 4a-d.
1878. Belemnites latesulcatus (d'Orbigny); Bayle, pl. xxx, fig. 9.
1887. Belemnites calloviensis, Oppel; Bukowski, p. 85.
‡1893. Belemnites latesulcatus, d'Orbigny; Riche, p. 327, pl. ii, figs. 13-17.
†1902. Belemnites latesulcatus d'Orbigny; de Loriol, p. 8, pl. i, figs. 8-11.
1908. Belemnites calloviensis d'Orbigny; Reuter, pp. 30 and 40.
1912. Belemnites latesulcatus (d'Orbigny); Lissajous, p. 15, pl. ii, figs. 7-8.
1915. Belemnopsis latesulcatus (d'Orbigny); Lissajous, p. 25.
1920. Belemnitopsis latesulcati, (d'Orbigny), Couffon, p. 226, pl. xviii, figs. 5-5a.
1923. Belemnites latesulcatus, d'Orbigny; Roman, p. 9.
†1924. Belemnites calloviensis, Oppel, Brinkmann, p. 495.
1925. Hibolites semihastatus (Blainville) Lissajous (Roman), p. 66.

Waagen's illustration of this species is incorrect, and the holotype is therefore here refigured (pl. I, fig. 7). The ventral suicus, as in Quenstedt's
type figure (1849, pl. xxix, figs. 14a-c) is much more conspicuous than in Waagen's illustration and the missing apex of the guard has been unsuccessfully restored by the artist, so that the shape appears less hastate than in the original. Waagen's fig. 4d represents the cross-section of the guard at the broken apical end.

Five immature specimens from the "Top of the Kelloway Rock," Wantra (B. M. Nos. C. 19950-53a) characterised by being compressed throughout, may belong to a new species or perhaps represent only the young of the present depressed form.

Kilian's (1888, p. 118) identification of Oppel's form with Hibolites semihastatus (Blainville, 1827, pl. ii, figs. 5, 5a, b) is inadmissible, but serves to show the general similarity of belemnites which are here referred to separate genera. With regard to the adoption, by Lissajous and Couffon, of d'Orbigny's nomen-num "Belemnites latesulcatus" in preference to Oppel's B. calloviensis, it ought to be mentioned that even if it is held that Phillips's (1866, p. 46, pl. v, fig. 14) B. latisulcatus, on account of the difference of one letter, does not invalidate B. latesulcatus, the latter species really only dates from 1878 (Bayle); for as de Loriol has pointed out, d'Orbigny's plates to his "Paléontologie Universelle" never appeared. Riche's form ("B. semisulcata", s.s.) does not seem sufficiently distinct.

**Horizon.**—Callovian (anceps zone).

**Localities.**—Waagen cited this species from North of Kumaguna and from Khera Hill. A specimen in the Blake Collection (B. M. No. C. 19927) is from Jumara (bed not named).

**Belemnopsis grantana** (d'Orbigny).

(Plate, I, fig. 6; pl. II, fig. 5; pl. III, fig. 3).

1840. Belemnites canaliculatus? (Schlotheim); J. de C. Sowerby, in Grant, pl xxiii, fig. 2.
1850. Belemnites grantanus, d'Orbigny, p. 326.
1873. Belemnites subhastatus, Zieten; Waagen, p. 14, pl. ii, fig. 1.
1908. Belemnites subhastatus, Zieten; Crick, p. 22.
1912. Belemnites grantianus, d'Orbigny; Smith, p. 1351.
1913. Belemnites subhastatus, Zieten; Smith, p. 420.
1915. Aulacoteuthis granti (d'Orbigny); Lissajous, p. 26.
1922. Belemnites grantianus (d'Orbigny); Naef, p. 245.
1925. Aulacoteuthis grantiana (d'Orbigny); Lissajous, p. 94.

D'Orbigny's specific name is here used since it is not certain that the Kachh form illustrated by J. de C. Sowerby (here refigured in pl. II, fig. 5) and that depicted by Waagen are identical with Zieten's type, even if they should agree with e.g., Bukowski's (1889, p. 85) Belemnites subhastatus. The species is less hastate than Belemnopsis calloviensis and has a wider ventral groove, resembling that found in B. tanganensis (Futterer) (= B. alfurica? G. Boehm sp.). In fact the present species appears to lead directly to the later
forms and in the *athleta* zone example here figured (pl. I, fig. 6) only the slightly contracted shape and groove of the alveolar end of the guard allow of separation from the Spiti form of *B. alfurica*, illustrated by Uhlig (1910, pl. xciii, fig. 6). The East African *Belemnopsis tanganensis* (Futterer) with which the writer would include Waagen's *Belemnites gerardi* (non Oppel, as here restricted) also differs from the form now discussed in being more cylindrical and less hastate. It would be possible, however, to pick out from the Upper Argovian East African material (where *B. tanganensis* occurs associated with *Pseudobelus coquandi* (d'Orbigny) and other forms unknown from Kachh), as well as from the abundant Kimmeridgian Bihendula (Somaliland) collections, individual examples that could not be separated morphologically from the present species.

**Horizon.**—Callovian (*macrocephalus, anceps* and *athleta* zones).

**Localities.**—To the five localities mentioned by Waagen may now be added the Ler-Hamundra Ellipse (Smith); South Maujal (bed No. 2 of Blake=*athleta* zone), Wandra (bed No. 2 including the example figured plate i, fig. 6), Charwar (bed No. 2, probably also *athleta* zone). An example from bed No. 9. Khera (base of Middle Chari Group) is here also figured (pl. iii, fig. 3). Mr. J. H. Smith recorded the species as having been identified by Mr. F. H. Stone from Sumatra and erroneously attributes to R. D. Oldham the statement that Waagen had overlooked the present species, whereas Oldham (1893, p. 224) had only pointed out that *Belemnites grantianus* (mistakenly identified with *B. kuntkotensis*) was not listed among the Umia Cephalopods. A Fakirwadi example collected by Mr. Smith is associated on the same slab with other belemnite fragments and a large *Alectryona* (sub-*anceps* beds”).

**BELEMNOPSIS KUNTKOTENSIS** (Waagen).

(Pl. I, figs. 1a, b; Pl. II, fig. 4).

1873. *Belemnites kuntkotensis*, Waagen, p. 3, pl. i, fig. 3.

1879. *Belemnites grantianus*, d'Orbigny; Medlicott and Blanford, pl. xii, fig. 2.

1893. *Belemnites grantianus*, d'Orbigny; Oldham, p. 222, pl. to p. 224.

1908. *Belemnites kuntkotensis*, Waagen; Crick, p. 22.


Waagen's type is here refigured since the front view given by that author (pl. i, fig. 3a) is somewhat misleading. There are a number of fairly complete examples in the Blake Collection, but when only fragments are available, the separation of Waagen's species from allied forms may be exceedingly difficult or impossible. Waagen himself had stated that *Belemnopsis kuntkotensis* had its nearest relation in *Belemnites aucklandicus*, Hauer (1864, p. 29, pl. viii, figs. 2-3), but the former is far more elongated than the New Zealand form and as Waagen pointed out, the ventral groove of *Belemnopsis kuntkotensis* reaches almost to the apex, whereas it is slightly shorter in *Bel. aucklandica*, as represented by a number of typical specimens in the British Museum and
Geological Society Collections. Again the related *Bel. gerardi* (Oppel) and *Bel. tanganensis* (Futterer), (= ? *Bel. alfurica* G. Boehm sp., 1907, pl. viii, figs. 4, 5, 7, 11) can easily be distinguished from the present species by their less elongated and less conical shape. *B. grantana*, with which the present species had been identified by Medlicott and Blanford and later by R. D. Oldham, also has a different, more hastate, shape.

**Horizon.**—Upper Argovian to Middle Kimmeridgian.

**Localities.**—To the seven localities mentioned by Waagen may perhaps be added Khera. Blake’s example (labelled bed 7, which would be in the anceps zone) was considered indistinguishable from the numerous Kantcote examples in his collection (one of these, the most complete, here illustrated on pl. I, fig. 1a) and the writer agrees, but Blake added: “I suspect mismatching of labels.” The immature example of probably the present species figured on pl. II, fig. 4, is from the “Crimson Bed,” North of Wamka. Its resemblance to the young *B. tanganensis* of pl. I, fig. 4 is close.

**BELEMNOPSIS TANGANENSIS** (Futterer).

(Pl. I, figs. 3a, b, 4).

1873. *Belemnites gerardi*, Oppel; Waagen, p. 13, pl. ii, fig. 3.
1893. *Belemnites gerardi* Oppel; Oldham, plate to p. 224.
1907. *Belemnites galoi* (=pars) G. Boehm, p. 72, pl. x, figs. 5a, b only.
1910. *Belemnites cf. tanganensis* Futterer; Tipper, p. 337, pl. xxxv, figs. 2, 3.
1914. *Belemnites cf. alfuricus*, Boehm; Zwierzycki, p. 18, pl. i, fig. 1.
1921. *Belemnites tanganensis*, Futterer; Morand, p. 158.
1925. *Belemnites tanganensis*, Futterer; Weir, p. 94.

G. Boehm (1909, p. 566) and Uhlig (1910, p. 385) already had questioned whether Waagen’s *Belemnites gerardi* really corresponded with the Himalayan species, since the canal of the Kachh form was rather narrow, at least in Waagen’s figure. The illustration, of course, was unsuccessful, both in the representation of the ventral furrow, which is only slightly less conspicuous than that of Waagen’s *Belemnites subhastatus* (fig. 1b. [=a]) of the same plate, and in the restoration of the missing apex. Waagen’s holotype is therefore here refigured (pl. I, fig. 3a) and it will be seen that it cannot be distinguished from, for example, Somaliland specimens of Futterer’s species, one of which (B. M. No. C. 25870) is here depicted (pl. I, fig. 3b), or the Tanganyika form referred to above and compared with G. Boehm’s *Belemnites alfuricus*. De Loriol’s *Belemnites cfr. beaumontianus*, d’Orbigny (1896, pl. i, fig. 4) with a more massive shape and a narrower groove, is a less closely comparable Euro-
pean form. It should here be added that there is, on Waagen’s example, a distinct if shallow antero-dorsal groove, observed also in some of the Somaliland and Mombasa examples before the writer. Mr. Whitehouse (1924, p. 11) who compared a Bajocian form of Belemnopsis from Australia to Futterer’s species, has pointed out that the faintness of the antero-dorsal groove in these forms of Belemnopsis and the presence or absence even in the same species prevent their inclusion with Boehm’s genus Dicoelites.

Some immature examples of Belemnopsis from the Katrol Group in the Blake Collection (e.g., No. C. 19925 from No. 2, Katrol Hill, here figured, pl. I, fig. 4) while agreeing in shape with the present species, have a slightly less pronounced ventral groove. In this respect they are comparable to Belemnopsis sp. ind. (pl. IV, fig. 5) and Belemnites redivivus Mayer (Favre, 1876, pl. I, figs. 12a, 12b), which was considered by Kilian (1888, p. 118) to be close to Belemnites gerardi, Oppel. The latter, however, as here understood, has a still deeper and wider sulcus and a more massive shape. Futterer had been under the impression that his species was not closely comparable to any Indian belemnite and Mr. Tipper stated that by direct comparison with Waagen’s types he had been able to satisfy himself that such was the case. The fragments he figured, however, seem scarcely complete enough to support this view, and Oppel’s (1865, pl. lxxviii, figs. 1, 2) two smaller examples may yet turn out to be identical with Futterer’s species.

The large phragmocone from the Katrol Beds of Fakirwadi, already referred to (p. 4), agreeing with Uhlig’s figs. 1—2 (1910, pl. ciiiA), may perhaps belong to the restricted Belemnopsis gerardi Oppel.

Horizon.—Argovian (Dhosa Oolite) and Kimmeridgian (Katrol Group).

Localities.—To the numerous localities listed by Waagen we may add Badi (bed 3, with Argovian ammonites, recorded previously).

Belemnopsis orientalis (Waagen).

(Plate I, fig. 8).

1873. Belemnites orientalis, Waagen, p. 5, pl. i, fig. 4.

The differences of this form from Belemnopsis sulcata (Miller) are slight but probably sufficient for specific separation. They seem to be confined, however, to whorl shape and proportions, for in the example of Waagen’s form from the Blake Collection (B. M. No. C 19910, from the Dhosa Oolite of Valakhavas) here figured (pl. I, fig. 8) the axis is more excentric even than in B. sulcata.

A developmental series from Bel. sulcata through Bel. orientalis to Bel. kunktotensis, as suggested by Waagen, does not seem to be probable, though the three species form somewhat of a morphological sequence with increasing elongation and pointing of the guard.

Horizon.—Dhosa Oolite (Argovian, perarmatus zone).
Localities.—Waagen's type came from Wanda, but in the Blake Collection the species is also represented from Walakhavas, bed I (the example figured on pl. I, fig. 8); from W. of Kotai (associated with an Aspidoceras of the group of *A. perarmatum*, Waagen non Sowerby sp.); from bed 20 at Jikadi; and from W. Soorka (associated with Peltoceratoides of the arduennensis type), Holcothyloceras pascoei (pl. VI, fig. 2d), and various Virgatospininctes of the Tithonian.[?]

**Belemnopsis** sp. ind.

(Pl. IV, fig. 5).


Waagen recorded the presence, in the Katrol Beds of Kachh, of another species of 'Belemnites' of the group of *B. blainvillei*, d'Orbigny, with a cylindrical, slightly depressed guard and a long ventral canal which "begins as a very shallow and broad groove a short distance above the apex." This characteristic, in addition to the significant comparison of Waagen's fragments with Cylindroteuthids, makes it probable that Waagen had in mind a Katrol form that is also represented in the Blake Collection. It differs from the example of *Belemnopsis* above compared to *B. tanganensis* and *B. rediviva* (pl. I, fig. 4) by its flattened groove which, as in Tate's *Belemnites africanus*, begins only some distance away from the apex; but the material, unfortunately, is insufficient for a more detailed description of this probably new species. *Belemnopsis latesulcata* (d'Orbigny), as figured by de Loriol (1902, pl. i, figs. 8-11) is too depressed in cross section, but closely similar. On the other hand comparison with the specimen from the "Crimson Bed," north of Wamka, figured on pl. II, fig. 4, in a better state of preservation, suggests that at least some of these immature specimens may be young *B. kuntkotensis*, with the ventral groove not reaching to the apex.

**Horizon.**—Kimmeridgian (Katrol group).

**Localities.**—Katrol Hill (bed 2 of Blake) may be added to the three localities mentioned by Waagen.

Genus *Hibolites* (Montfort) Mayer-Eymar 1883.

**Hibolites jumarensis** (Waagen).

1873. *Belemnites jumarensis*, Waagen, p. 12, pl. ii, figs. 5a-d.


The differences between this species, based on a single specimen, and *H. hastatus* (Blainville) are very slight indeed. The guard being somewhat worn, the shape is not reliable and, as in a number of Waagen's figures, the apparent asymmetry is due merely to faulty joining of the separate fragments. The ventral sulcus is much more distinct than represented in Waagen's fig. 5a, but reaches less than half-way down the guard. Whether the faintness of the lateral lines and the "circular" cross-section are sufficient and constant
enough for specific separation could be determined only on the examination of abundant material. Waagen’s measurements indicate that the thin end of the guard is compressed and the thickest part depressed, much as in the Oxford Clay examples of *H. hastatus* figured by Phillips (1870, pl. xxviii) or in typical French specimens before the writer (B. M. Nos. 73939a-e, from Vaches Noires, Normandy). On the other hand in Blainville’s species the lower end of the guard typically does not exceed twice the thickness of the thin upper end, as it does in *H. jumarensis*.

**Horizon.**—Callovian (*macrocephalus* zone).

**Localities.**—Jumara and Jara (?). The species is not represented in the Blake collection.

**Hibolites sp. nov. cf. hastatus** (Blainville).

(Pl. III, fig. 1).

1840. *Belemnites* sp. J. de C. Sowerby, in Grant, pl. xxiii, fig. 3.
1878. *Hibolites hastatus* (Blainville); Bayle, pl. xxx, figs. 6-8.
1902. *Belemnites* (*Hibolites*) *hastatus*, Blainville; P. de Loriol, p. 5, pl. i, fig. 1.
1907. *Belemnites hastatus*, Blainville, Simionescu, p. 6, fig. 1.
1916. *Belemnopsis hastata* (Blainville); H. Douvillé, p. 68.
1920. *Hibolites hastatus* (Blainville); Couffon, p. 225, pl. xviii, figs. 2-4.
1921. *Belemnopsis* sp. (*hastatus* group); Morand, p. 159.
1922. *Hibolites hastatus* (Blainville); [Bataller], p. 99.
1924. *Hibolites hastatus* (Blainville); Christensen, pp. 145, 6, pls. iv, v, figs. 6, 14-16, 18, 19, 22.
1925. *Hibolites hastatus* (Blainville) Lissajous, p. 36, fig. 23.
1925. *Belemnopsis* sp. ind.; Spath. 1925b, p. 23.

Waagen doubtfully referred to this species a number of fragments which, however, have not been seen by the writer. Since Waagen included in the synonymy of Blainville’s species also Quenstedt’s *Belemnites semihastatus rotundus* (1848, pl. xxix, fig. 8), it is possible that his material included examples that do not belong to the true *H. hastatus*, but to its companion species *H. semihastatus*.

The Blake Collection in the British Museum does not include a single well-preserved example that shows the depressed guard of the true *H. hastatus* or the even more flattened and more widely grooved *H. semihastatus*. The fragment figured by J. de C. Sowerby, from Chari, illustrates the type of guard that seems commonest, having a perfectly circular cross-section and a shorter ventral groove than *H. hastatus*. One might be tempted to include these examples in *H. jumarensis*, but the club-shape of the guard and the contraction of the alveolar end are more pronounced in this species. As the present form, on the discovery of more material, may turn out to require a new specific name, a Jumara example is here figured (Pl. III, fig. 1).
In addition to these Callovian forms there are in the Blake Collection doubtful fragments of *Hibolites* of the *hastatus* type from the Katrol Group. They may comprise fragments of *H. cf. semisulcatus* (Münster), discussed below, and of a new form of *Hibolites* which may be named *H. flemingi* sp. nov. This is before me in typical examples from the Chichali Hills, near Kalabagh, Salt Range, from Somaliland and from Andranosamonta, Madagascar, the last locality having yielded the holotype, here figured (pl. I, fig. 2). This is the *Belemnites hastatus* recorded by Mr. R. B. Newton (1889, p. 334), and it is characterised by its short ventral sulcus. One of the fragments, figured by G. Boehm (1907, pl. viii, fig. 19 only) as *Belemnites aff. lagoicus* and, like the Indian examples associated with *Belemnopsis gerardi* (Oppel) and *B. alfurica* (G. Boehm), probably represents a *Hibolites* like *H. flemingi*, but the type of Boehm's *Belemnites lagoicus* (pl. viii, fig. 12) has a different shape and de Loriol's *B. girardoti* (1902, pl. i, fig. 2, typus) with which the Taliabu species was compared, has not only a less hastate shape and longer groove but a depressed cross-section.

**Horizon.**—Callovian (Middle Chari Group) to Kimmeridgian (Katrol Group).

**Localities.**—Stoliczka collected Waagen's *Belemnites* cf. *hastatus* from pre-athlete beds at Wanda; the example figured on pl. III, fig. 1 is also from the *anceps* zone (bed 3) of Jumara. To the three localities mentioned by Waagen, where *B. cf. hastatus* occurred in the *athlete* zone, we may now add South Maujal (No. 2) and Wantra (“Top of Kelloway Rock”). Waagen recorded this species also from three Dhosa Oolite localities, but small fragments in the Blake Collection that may represent similar forms are too doubtful.

The fragments of Katrol forms that may belong to the species above separated as *H. flemingi* came from bed 2, Katrol Hill (Middle Kimmeridgian). Doubtful examples of *Hibolites* with circular as well as depressed cross-sections in the Blake Collection came from the Middle Kimmeridgian (Belemnite Marls?) of North Jooran.

**HIBOLITES cf. SEMISULCATUS** (Münster).

(Plate III, fig. 2, pl. IV, fig. 1).

1868. *Belemnites cf. semisulcatus* Münster; Zittel, p. 37, pl. i, fig. 8.
1875. *Belemnites semisulcatus* Münster; Pillet and Fromentel, pl. i, figs. 1-3; pl. v, figs. 1, 2; pl. viii, figs. 12-15.
1876. *Belemnites cf. semisulcatus* Münster; Favre, p. 18.
1877. *Belemnites semisulcatus* Münster; Favre, p. 9, pl. i, figs. 3-6.
1880. *Belemnites semisulcatus* Münster; Favre, p. 21, pl. ii, figs. 1-3.

This species had not been recognised by Waagen but the example from the Blake Collection here figured (pl. IV, fig. 1), from "above zone I, Walakhavas" seems to be close to the specimens illustrated by Zittel and Favre (especially
1880, pl. ii, fig. 2a), and cannot be identified with any of Waagen's species, except possibly fragments referred to the last species. In *H. hastatus*, however, the shape is more elongated and more hastate, the guard is depressed and the ventral sulcus is longer, whereas in the form here separated as *H. flemingi* sp. nov. the section of the guard is similarly round or subquadrate in young individuals but the shape is different.

Blake labelled this specimen "Belemnites katrolensis" but Waagen's species has a more conical and less elongated shape and a longer ventral groove. A second specimen in Prof. Blake's collection (B. M. No. C19916) here figured (pl. III, fig. 2) referred by him to *Belemnites sauvanausus*, like comparable rostra of the more clavate *H. flemingi* from Somaliland, Madagascar, and the Chichali Hills, shows well the lateral lines, but is more elongated than the typical first example.

**Horizon.**—Katrol group (Kimmeridgian).

**Localities.**—Walakhavas (No. 1) and "above zone I" of the same locality, where it is associated with typical Katrol ammonites. Two doubtful fragments are from the "Small Bed," North Moondan, associated with *Virgatosphinctes* and *Haploceras* ("Uinia group").

**HIBOLITES FUSTICULUS** (Waagen).

1873. *Belemnites fusiculus*, Waagen, p. 9, pl. i figs. 2a-e.

†1906. *Belemnites cf. fusiculus*, Waagen; Lemoine, p. 117.

1925. *Belemnopsis fusiculus* (Waagen), Lissajous, p. 89.

Waagen's holotype appears to be still the only known Kachh specimen. Weithofer (1890, p. 758) compared with the present species and Waagen's *Belemnites stoliczkianus* his *B. persicus*, but if one may judge from Weithofer's and von dem Borne's figures (1891, p. 6, fig. 2) the Persian form is close to if not identical with *Belemnopsis tanganensis* (Futterer), though apparently possessing a shallower groove and a less depressed section. *Hibolites schoenbachi* Neumayr sp. (1871b, p. 362, pl. xviii, figs. 3, 4= non *Nannobelus? schoenbachi*, Mayer, 1866, p. 358, 1884) which according to its author includes Ooster's *Belemnites baculoides*, pars (1857, pl. ii, figs. 3, 4 only) is probably an allied species of *Hibolites*, as Waagen suggested. The type of Ooster's species (*Hibolites baculoides*, pl. ii, figs. 1-2 only) with apparently wrongly restored apex is also a comparable species, but Phillips's (1870, p. 121, pl. XXXii, fig. 81) *Belemnites strigosus* (erroneously labelled 'correctus' on the explanation to the plates) which has also been brought into comparison with these baculoid *Hibolites*, is a *Cylindroteuthis* of quite another stock.

**Horizon.**—Argovian (Kantcote Sandstone).

**Locality.**—Kantcote.

**HIBOLITES STOLICZKIANUS** (Waagen).

1873. *Belemnites stoliczkianus*, Waagen, p. 10, pl. i, figs. 1a-f.


The holotype of this species is somewhat corroded and the ventral groove is not visible after a distance of about 65mm from the alveolar end of the
FAUNA OF KACHH (CUTCH).

There is a suggestion, however, of ventral flattening as in the species previously discussed (H. fusticulus). The cross-section of the lower end of H. baculoides (Ooster) does not shew this flattening of the ventral area and it has already been mentioned that in the writer's opinion the restoration of the apex in Ooster's figure 1 is entirely wrong, the complete specimen being probably as long again as the alveolar half represented.

The fragment of a Hibolites figured by Crick (1908, pl. xii, figs. 1a-c) as Belemnites cf. hastatus Blainville, may have belonged to an elongated species like the present, but is more depressed throughout its length.

Horizon.—Argovian (Kantcote Sandstone).
Locality.—Kantcote.

**HIBOLITES BLAKEI SP. NOV.**

(Plate II, fig. 7.)

This species is based on a fairly well-preserved example in the Blake Collection (B. M. No. C19932) from the ‘Oxfordian Clay’ of Wantra and may be described briefly as a compressed Hibolites of the hastatus type. Its dimensions are:

- Total length of guard = 66 mm.
- Diameter at top (dorso-ventral) = 8 mm.
- Diameter at top (lateral) = 6.75 mm.
- Diameter at lower third (dorso-ventral) = 9.25 mm.
- Diameter at lower third (lateral) = 8.5 mm.

Owing to its compression the guard is only slightly hastate. There is no trace of the phragmocone and the ventral groove is comparatively long and deep, though fine. The lateral lines are faint but distinct; the axis is central.

Blake had labelled this example “Bel. delta, may possibly be B. sauvanausus, but section is different.” An example of the latter species, from the Argo-vian of La Billode, Jura, figured by P. de Loriol (1902, pl. i, fig. 12) seems to resemble the form here described, but is depressed rather than compressed and like the type of d’Orbigny (1842, pl. xxi, figs. 1-3) with its short and unsymmetrical guard, does not even belong to the same group of Hibolites as H. hastatus and the present form. On the other hand among the examples from Andranosamonta, Madagascar, identified by Mr. R. B. Newton (1889, p. 334) as Belemnites sauvanausus, there is a compressed form, somewhat resembling Duvalia ensifer (Oppel) Zittel sp. (1868, pl. i, figs. 9-11) which the writer has also found in the Tithonian (?) of Bihendula, Somaliland. Lemoine (1906, p. 145) included Newton’s Belemnites sauvanausus tentatively in a new species, B. lacombei but this still remains a nomen nudum, and the doubtful compressed Madagascar form in any case is not identical with the present species.

Among the compressed forms figured by Favre (1876, pl. i) several are comparable to H. blakei, e.g. H. voironensis (Favre), H. monsalvensis (Gilliéron), and H. neyrivensis (Favre). They all differ in having shorter sulci and different
shapes, whereas *H. dionysii* (Favre, 1876, pl. iv, figs. 1-3) is also considerably more hastate. The compressed form figured by Quenstedt (1849, pl. xxix, fig. 37 only) and wrongly included in *H. argovianus* (Mayer) however, shows great resemblance to the present species.

**Horizon.**—Upper Callovian (athleta beds?)

**Locality.**—Wantra.

**Hibolites katrorensis** (Waagen).

1908. *Belemnites katrorensis*, Waagen; Crick, p. 22.
non 1912. *Belemnites katrorensis*, Waagen; Smith, p. 1351.

Waagen's figures of both lectotype (pl. ii, figs. 7a-e) and paratype (8a-c) show a comparatively long ventral canal whereas, in reality, this is less than half the length of the guard. The lateral lines also are not visible, at least to the writer, and the tapering of the apex in fig. 8a is drawn incorrectly, the conical shape of the paratype being the same as that of the larger lectotype. Waagen stated that the only species with which *Belemnites katrorensis* was somewhat closely allied was d'Orbigny's *Belemnites sauvaunausus*. Considering that the present species is cylindrical, instead of hastate, as Waagen himself points out, the affinity is not very close; moreover it is stated below that Waagen's interpretation of d'Orbigny's *Belemnites sauvaunausus* is open to criticism, the shape of the type being rather different from that of the Indian form.

*H. semisulcatus* (Münster) is far less conical in shape than Waagen's species, and *H. voironensis* Favre (1876, pl. i, figs. 10a-c), with only a slightly hastate form, is compressed.

**Horizon.**—Katrol Group (Kimmeridgian) and perhaps Umia Group.

**Localities.**—Waagen quoted this species from numerous localities, the figured specimens being from the Katrol Range and from Lodai. The record of this species from the Callovian of Samatra, which made Mr. Smith assume that *H. katrorensis* had its origin earlier than was previously known, may be based on a misidentification.

**Hibolites sp. ind.** (*Belemnites sauvaunausus*, Waagen non d'Orbigny).

(Plate I, fig. 5).

1873. *Belemnites sauvaunausus*, non Orbigny; Waagen, p. 8, pl. ii, figs. 6a-f.
non 1878. *Hibolites sauvaunaus*, (d'Orbigny); Bayle, pl. xxix, figs. 5-7.
non 1889. *Belemnites sauvaunausus*, (d'Orbigny); Newton, p. 334.
non 1900. *Belemnites (Hibolites) sauvaunaus*, (d'Orbigny); de Loriol, p. 6, pl. ii, fig. 2.
non 1902. *Belemnites (Hibolites) sauvaunaus*, (d'Orbigny); de Loriol, p. 9, pl. i, fig. 12.
non 1912 ? *Belemnites sauvaunausus*, (d'Orbigny); Smith, p. 1351.

Waagen's larger example (pl. ii, figs. 6a-d) shows little resemblance either to d'Orbigny's type figure (1842, pl. xxi, figs. 1-3) or to any of the forms
recorded under this specific name by later authors. The specimen is here refigured (pl. I, fig. 5) since Waagen’s illustration is somewhat misleading, showing a long and faint ventral groove instead of a narrow but deep sulcus in the upper half, which has already disappeared 30mm. from the apex. The lateral lines also are not visible on this particular specimen D though they are seen on the fragment figured by Waagen in his fig. 6e. This, however, cannot now be definitely identified as belonging to the same species and, in any case, is too cylindrical for d’Orbigny’s form.

Although the writer believes that Waagen’s form is entirely different from d’Orbigny’s species and the examples figured by Favre, de Loriol, and other authors, the form cannot be attached to any other described belemnite and until further material becomes available is left without a specific name.

A typical Bel. sauvanausus (d’Orbigny) from Var, France, in the Astier Collection (B. M. No. 74060), with its lateral grooves, supports the view that this species should be separated generically from the typical Hibolites. The Madagascar examples recorded by Mr. Newton as Belemnites aff. sauvanausus and considered by Lemoine (1906, p. 145) probably to belong to his “B. la-combei” also come within the genus Rhopaloteuthis, but Waagen’s examples are probably true Hibolites and thus must be kept entirely apart from d’Orbigny’s species.

It may be added that the Indian form seems to the writer to be allied to H. argovianus (Mayer) as figured by Quenstedt (1849, pl. xxix, fig. 36 only) and Favre (1876, pl. i, fig. 7), but unfortunately there is lack of comparable material.

Horizon.—Argovian (Dhosa Oolite).

Localities.—Waagen recorded this species, which he stated to be ‘not very rare,’ from five localities including “South of Samtra.” Mr. Smith’s record of Belemnites sauvanausus from lower beds (Callovian) of Samatra may need rectification.

Hibolites (Hastites?) claviger (Waagen).

1873. Belemnites claviger, Waagen, p. 6, pl. ii, figs. 2a-c, e-h.
1906: Belemnites cf. claviger, Waagen; Lemoine, p. 147.
1915. Hastites claviger (Waagen); Lissajous, p. 22.
1921. Belemnites (Hastites) claviger, Waagen; Morand, p. 159.
1925. Hastites claviger (Waagen); Lissajous, p. 71.

Waagen’s figure of the holotype of this species is restored, the original being scraped on one side (where Waagen thought he could detect “very distinct, vascular impressions”) and so corroded on the other that shape alone has to be relied on in maintaining this species. Waagen stated that the upper end of the post-alveolar region was squarish in the present form but round in H. pistilliformis (Blainville). The small fragment figured by Waagen (pl. i, figs. 2f-h) may show this subquadrature cross-section, but if it really belongs to the species here discussed the absence of a ventral groove is significant. Lissajous, it may be noted, had attached Belemnites claviger and B. pistilliformis
to the genus *Hastites* and their generic separation from the *hastatus* group seems advisable.

A specimen from Kalabagh in the Salt Range (B. M. No. 9378, Geol. Soc. Collection) may belong to the present species, but it is even more clavate than Waagen's type. There is no close resemblance to specimens of *H. (Hastites ?) pistilliformis* from the South of France or from Madagascar and the alveolar end of the guard, owing to the two lateral depressions and flattening of the front and back, has a far more distinctly quadrate section than Waagen's smaller fragment (pl. ii, figs. 2f-h).

**Horizon.**—Katrol Group (Kimmeridgian) and Umia Group (?).

**Localities.**—The various Katrol localities mentioned by Waagen include Jurun, whence the writer recorded Middle Kimmeridgian ammonites from Prof. Blake's "Belemnite Marls." His collection, however, includes, besides the ammonites, only two indeterminable *Hibolites* from this locality, erroneously compared by Blake to *Conobelus oldhamianus* (Waagen).

**Family DUVALIDAE,** Pavlow.

**Genus CONOBELUS,** Stolley.

**CONOBELUS OLDHAMIANUS** (Waagen).

1873. *Belemnites oldhamianus*, Waagen, p. 15, pl. i, figs. 5, 6.

1925. *Rhopaloteuthis oldhamianus* (Waagen); *Lissajous*, p. 114.

Waagen considered that this species, the earliest known form of *Conobelus*, was distinguishable from its later ally, *C. conophorus* Oppel sp. (in Zittel, 1868, p. 34, pl. i, figs. 4, 5, non 1, 2 ?) by its deeper canal and less rounded section. The flattening of the sides of the guard of the present species, however, resulting in a subquadrate section, is not very apparent, at least in what the writer proposes to take as the lectotype, namely the original of Waagen's figs. 6a-e, whereas the paratype, which might be only a *Conobelus*-like modification of some form of *Hibolites (Rhopaloteuthis)* of the *sauvanaeusus* group, is still less "squarish" in section. For the dorsal position of the sulcus in both examples, Waagen's word must be taken. The specimens have been split and mended, which also accounts for the depth of the narrow groove.

The latter is similarly deep in some *Bihendula* (Somaliland) examples, probably identical with Oppel's *Belemnites conophorus* but with the phragmocones missing (B. M. Nos. C.25915-6). On the other hand, Waagen's larger example (figs. 5a-e) on account of its asymmetrical guard has considerably more resemblance to *Belemnites sauvanaeusus* (d'Orbigny) than to *B. argovianus*, Mayer especially the examples figured by Favre (1876, pl. i, figs. 4-6 and 7), though it is shorter and less hastate than either. Its dorsal groove, however, if correctly observed, would separate it from *Hibolites (Rhopaloteuthis)*, even if it does not agree with the less elongated and less hastate lectotype.

**Horizon.**—Callovian (Middle Chari Group—anceps zone).

**Localities.**—The three localities given by Waagen are Nurrha, Khera Hill and Samatra. There is no example of this species in the Blake Collection.
FAUNA OF KACHH (CUTCH).

Family **PASSALOTEUTHIDAE**, Naef emend.

**Genus** **MEGATEUTHIS** Bayle.

**MEGATEUTHIS** sp. ind.?

(Plate II, fig. 2.)

The natural longitudinal section of a belemnite in a piece of yellowish-brown crystalline limestone in the Blake Collection (B. M. No. C. 19961) shows a conical guard with the phragmocone—replaced by calcite—penetrating it to more than half its length. This specimen is very interesting, for it is entirely different from any of the belemnites recorded by Waagen and similar brevirostra are not known in any of the Jurassic genera described above, whilst *Pachyteuthis* (family *Cylindroteuthidae*) has a different young stage.

A specific identification of the present specimen is of course out of the question and even the generic reference is tentative, for *Brachybelus* (group of *Belemnites breviformis* Voltz) includes similar conical guards. A slight irregularity in part of the boundary of the phragmocone might suggest that mineralisation has obscured the structure, but the guard is certainly entire and even the traces of a few septa in the rock beyond the alveolar end are discernible.

The sectional view given in pl. II, fig. 2 shows perhaps closest resemblance to the diagrammatic drawing of an example of *Megateuthis* figured by d’Orbigny (1842, pl. xiv, fig. 2) as *Belemnites giganteus* (Schlotheim) pars. This is not placed by Lissajous (in Roman, 1925, p. 90) and both he and Naef (1922, p. 303), represent *Megateuthis* (and *Brachybelus*) as becoming extinct in the upper Bajocian.

**Horizon.**—Putchum Group (“Putchum Dolomite”), Bathonian?

**Locality.**—Andhm. The matrix is different from that of any of Waagen’s ammonites from the Putchum Group.

**B. order NAUTILOIDEA.**

Waagen described six species of nautili from Kachh of which only one (*Nautilus calloviensis*, Oppel) was identified with a European form. Even this, however, was listed as a separate form by Loesch (1914, p. 107). Waagen divided these six species into five groups, pointing out that since nautili were not very common in mesozoic formations, excepting a few species, our knowledge regarding them increased but slowly.

This is as true to-day as when Waagen wrote and the scarcity of nautili in, for example the well searched Kimmeridgian (Lower Tithonian) has again been directed attention to by Toula (1907, p. 10). It was not till 1883 that Hyatt made an attempt to subdivide *Nautilus* itself, as it was then understood by all palæontologists, separating from it the genera *Cenoceras* (genotype: *Nautilus intermedius*, Sowerby in d’Orbigny, 1845, pl. xxvii=N. orbignyi. Prinz 1906, p. 213) and *Cymatoceras* (genotype: *Nautilus pseudo-elegans*, d’Orbigny 1842, pl. viii). The genera *Hercoglossa*, Conrad (1856, genotype: *Nautilus danicus* Schlotheim)—to which Hyatt erroneously added *Enclimatoceras* (genotype:
Nautilus ulrichi, White)—and Pseudonautilus, Meek 1876 (genotype: Nautilus geinitzi Oppel) had previously been separated on account of their ‘goniatitic’ septal sutures, and in Aturia, Bronn 1838 (type: Nautilus aturi, Basterot) the peculiar dorsal siphuncle had early led to generic recognition. Hyatt, however, was the first to base his genera on what have always been considered satisfactory characters only in the subdivision of ammonites, such as whorl-shape and ornamentation. It has to be admitted, however, that at the present day, after more than forty years, the genus Cenoceras, which, moreover, may be difficult to separate from Montfort’s Bisiphytes, is still unused in geological literature, though it is listed in Zittel-Broili’s “Grundzüge” (1921, p. 513). In 1894, Hyatt separated from Nautilus two more groups, namely Digonioceras (genotype: Nautilus excavatus, Sowerby in d’Orbigny, 1845, pl. xxx) and Eutrephoceras (genotype: Nautilus dekayi, Morton). The latter genus and Cymatoceras Hyatt, have been adopted by various authors including the writer (1921a); the former genus (Digonioceras) is identical with Prinz’s (1906, p. 201) Nautilus which in any case would be inadmissible owing to prior use.

As Pia (1914, p. 47) pointed out, Hyatt’s knowledge of Mesozoic Nautiloids cannot have been very extensive, although in his embryology (1872) Hyatt had made some interesting observations on several species of Nautilus. It is not surprising that Cenoceras, for the group of Nautilus intermedius Sowerby, has been universally rejected, since Hyatt left in Nautilus s.s. other members of the same group such as Nautilus striatus. Separation evidently could not be based on the somewhat more quadrate whorl-shape of Nautilus intermedius as compared with the rounded whorls of Nautilus striatus, Sowerby; for the two groups agree in ornamentation, position of the siphuncle, presence of an annular lobe, and chiefly in the course of the septal suture. Since later (1894, p. 550) Hyatt limited Cenoceras to forms with a trigonal ananepionic, a subquadragonal metanepionic, and a dorsally sulcate nepionic stage, it is listed below as a genus separate from Bisiphytes. Without seeing Hyatt’s type, however, it is impossible to decide whether Hyatt overrated the importance of the groove found in young Bisiphytes or, perhaps, even was misled by the normal line of Nautilus lineatus. Similarly Prinz’s two divisions of Lower Liassic nautili, namely those with reticulate and those with longitudinally striated (strigate) ornamentation, cannot be accepted as natural groups, any more than Quenstedt’s striati and simplici, and the inner whorls of every well-preserved Nautilus examined by the writer have reticulate ornamentation as well as a perforate umbilicus.

Further subdivision of Jurassic and Cretaceous forms of Nautilus, however, seems necessary and the few genera already mentioned, with Tithonoceras, Retowski 1893 (genotype: Tithonoceras zitteli, Retowski, p. 223, pl. xiii, figs. 2a-c) and Carinonautilus Spengler, 1910 (genotype:—C. ariyalurensis, Spengler, p. 149, pl. xiv, figs. 1a-c) to which may be added Angulithes Montfort, 1808 (genolectotype:—Nautilus triangularis, Montfort; in d’Orbigny, 1842, p. 79, pl. xii) are quite insufficient to accommodate the variety of Mesozoic nautilid material now available. It is therefore now proposed to group post-Triassic nautili into five
families and twenty-eight genera of which 16 are new. The following is a tabular summary:

Family **NAUTILIDÆ** Owen, emend.

<table>
<thead>
<tr>
<th>Genus</th>
<th>Family</th>
<th>Subfamily</th>
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<th>Type</th>
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Family **CYMATOCERATIDÆ**, nov.

Genus **Cymatoceras**, Hyatt, 1883 (Cretaceous).

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<td>asper (Oppel)</td>
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<td>Zittel, 1868, pl. iii, fig. 1.</td>
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<td><strong>Syrionautilus</strong></td>
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<td>libanoticus</td>
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<td>Foord and Crick, 1890, p. 404, fig. 6.</td>
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<td>undulatus</td>
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<td>J. Sowerby, 1813, pl. xl, upper fig.</td>
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<td><strong>Eucymatoceras</strong></td>
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Genotype.—*Nautilus plicatus*, Fitton, 1835, p. 129.¹

Family *PARACENOCERATIDÆ*, nov.
Genus *Paracenoceras*, nov. (Jurassic).
Genotype.—*Nautilus hexagonus*, J. de C. Sowerby, 1826, pl. dxxix, fig. 2.

" *Tithonoceras*, Retowski 1893 (Upper Jurassic).
Genotype.—*T. zitteli*, Retowski, 1893, p. 223, pl. xiii, figs. 2a- (= *Nautilus "theodosianus"* Loesch, 1914, p. 127).

" *Somalinautilus*, nov. (Jurassic).
Genotype.—*Nautilus antiquus*, Dacqué 1910 = *N. bisulcatus*, Dacqué, 1905, pl. xvi, figs. 3a, b.

" ? *Heminautilus*, nov. (Cretaceous).

" *Aulacononautus*, nov. (Upper Jurassic).
Genotype.—*Nautilus sex-carinatus* Pictet, 1867, pl. x, figs. 1a-c

" *Carinonautus*, Spengler 1910 (Cretaceous).
Genotype.—*C. ariyalurensis*, Spengler, 1910, pl. xiv, figs. 1a-c.

Family *HERCOGLOSSIÆ* nov.
Genus *Pseudanaides*, nov. (Jurassic).
Genotype.—*Nautilus kutchensis*, Waagen, 1873, pl. iii, fig. 4.

" *Hercoglossa*, Conrad 1866 (Upper Jurassic-Eocene).
Genolectotype.—*Nautilus danicus* Schlotheim; Foord, 1891, p. 181. (= *Enclimatoceras*, Hyatt, 1883 (Cretaceous).
Genotype.—*Nautilus ulrici*, White, 1884, p. 17, pls. vii-ix).

" *Hercoglossoceras* nov. (Jurassic).
Genotype.—*Hercoglossa ['gravesiana (d'Orbigny) var.'] kochi* (Prinz); Pia, 1914, p. 33, pl. v, fig. 3.

" *Pseudonautilus*, Meek 1876. (Upper Jurassic).
Genotype.—*Nautilus geinitzi*, Oppel, in Zittel, 1868, p. 45, pl. 11, figs. 1-7.

" *Paraturia* nov. (Cretaceous-Eocene).

" *Deltoideaonautus* nov. (Eocene).
Genotype.—*Nautilus soverbyi*, Wetherell, 1836 in J. de C. Sowerby, 1843, p. 35, pl. dcxxvii, figs. 1-3.

Family *ATURIDÆ* nov.
Genus *Aturia*, Bronn 1838 (Tertiary).
Genotype.—*Nautilus aturi*, Basterot, 1825, pp. 12, 17. (= *Sphenaturia*, Ihering 1921.
Genotype.—*S. brüggeri*, Ihering, 1921, p. 471, pl. to p. 472, figs. 2, 5.]

¹ *Nautilus plicatus*, Zwierzycki (1914, p. 24, pl. ii, figs. 3, 4) non Fitton= *unduliformis*, n. n. is a *Cymatoceras*, not an *Anglonautus*. 
The genealogy of Liassic nautili given by Prinz (1906, p. 234) has already been rejected by Pia, but considering the present unsatisfactory state of our knowledge of the earliest Liassic and Rhaetic nautili it is difficult to link up Nautilidae in the restricted sense with any of the Triassic families. “Grypoceras cf. mesodiscum” (Hauer) recorded by Dr. Trechmann (1913, p. 181) from the Upper Trias (Carnian, bed C) of the Hokonui Hills, New Zealand, is indistinguishable from typical Bisiphytes, with their strong strigation, especially on larger whorls, annular lobe and only slightly sinuous septa. If this example is really of Triassic age, Bisiphytes has an earlier origin than is generally suspected; but the New Zealand specimen is not a Grypoceras and there is more probability of Bisiphytes being an involute, globose, development of the family Syringonautilidae, Mojsisovics, with annular lobe.

What strikes the observer first on examining median sections of typical Bisiphytes, e.g. B. striatus (J. Sowerby), B. intermedius (J. Sowerby), B. astacoides (Young and Bird), and others of that group, is the beaded siphuncle. This is similarly distinct in Digonioceras excavatum, in Paracenoceras hexagonum, in Cymatoceras bouchardiænum (d'Orbigny), in Eutrephoceras centralis and E. imperialis (J. Sowerby) but in a number of Inferior Oolite forms, like Bisiphytes ? polygonalis (J. de C. Sowerby) the tubular siphuncle of Nautilus s.s. is already developed. In the species just mentioned the annular lobe also disappeared at an early stage, as it did in Nautilus glaber (Foord and Crick), in which there is not even the strigation of the other forms of the lineatus group to suggest reference to Bisiphytes. Yet Hyatt (1872, p. 95) has shown, that in ‘Nautilus lineatus’ the siphonal cæcum occupied a different position from that of Nautilus pompilius, and in the Cretaceous it is equally difficult to find a species that can be referred to Nautilus s.s., though the Eocene Nautilus urbanus J. de C. Sowerby and N. regalis J. Sowerby, seem to be more strictly comparable to the recent forms. The Inferior Oolite Nautilus lineatus (J. Sowerby) above mentioned was referred by Prinz (1906, p. 207) to the group of Nautilus astacoides, Young and Bird = group of N. intermedius of Tagliarini (1901, p. 189), containing the typical Bisiphytes. Foord and Crick (1890, p. 274) however, have shown that ‘Nautilus lineatus’ covers a number of forms and in N. pseudolineatus (Foord and Crick, p. 297), in any case, the siphuncle is still beaded. No undoubted Bisiphytes therefore seem to survive the Inferior Oolite and strigation alone cannot be relied on as a generic character, for it is found e.g. in Tagliarini’s and Prinz’s groups of Nautilus “sinuatus” J. Sowerby (should be N. subsinuatus, d’Orbigny), e.g. N. tukeryi, Gemmellarо, and N. crassisinuatus, Crick (1898, p. 127), which may be included in Pseudaganides, although the lateral saddle, above the umbilicus, is yet low. It may also be mentioned here that strigation is neither confined to evolute forms as Quenstedt (1858, p. 72) thought, nor is it altogether absent in the recent Nautilus (e.g. N. umbilicatus).

Further subdivision of the Oolitic forms may be possible, but for the present the writer would prefer to leave such inflated, non-ornamented forms without annular lobe, as Nautilus obesus (J. Sowerby) in the genus Eutrepho-
although this genus may have to be restricted to Cretaceous and Tertiary forms as suggested in Zittel-Broili, 1921, p. 513. The nautili with Bellerophon-like whorls and radial costation in the adult are referred to Procyomatoceras, while still others, like Nautilus fuscus, Crick (including N. clausus, non d'Orbigny?, in Foord and Crick, 1890, p. 223, and 'Nautilus bajociensis' d'Orbigny, in coll.) belong to Somaliceras. The last, however, has nothing to do with the group of Nautilus clausus of Tagliarini and Prinz.

This last species as well as Nautilus lineatus, Sowerby, were included in Hyatt's emended Cenoceras, but as has already been mentioned, it seems doubtful whether this genus is more than merely a convenient group to include the quadrate-whorled but otherwise Bisiphytes-like nautili of the Lias and Inferior Oolite. It is at least used in this sense by the writer, who would include here especially the smooth forms of the type of Nautilus inornatus, d'Orbigny (1845, pl. xxviii) and N. pseudotruncatus, Crick (1920, p. 245).

It should be added in this connexion that Foord (1891, p. 180) 'had expressed the opinion that the dorsal (annular) lobe which was present in many species, had a tendency to become obsolete in the adult shell and was of no classificatory importance. Mojsisovics (1902, p. 203) on the other hand, considered the presence or absence of this lobe an excellent systematic characteristic. There seems to be no doubt that this annular lobe cannot be used, by itself, for the classification of Jurassic or Cretaceous nautili, for it disappears early in Bisiphytes and may persist in forms that otherwise cannot be separated from Eutrephecera. Hyatt (1872, p. 91) also made a far too sweeping generalisation when he deduced "decided acceleration of development in the modern Nautilus" from the examination of the first septum of a Bisiphytes which resembled a Carboniferous form and showed only a dorsal saddle, and from the resemblance of the third suture of "Nautilus atratus" to the first of N. pompilius. Moreover, Mojsisovics's own classification of Clydonautilidae (non Hyatt 1900) cannot be accepted. Clydonauli, Proclydonauli, Styronauli, Mojsisovics, and Cosmonauli, Hyatt and Smith, form a well-defined group, but Paranauli and Indonauli, Mojsisovics, though equally devoid of an annular lobe, must perhaps be referred to a separate family distinct also from Grypoceratidae. Gonionauli, Mojsisovics emend., again, which has not even a dorsal lobe, and Callonauli, Kiesling probably belong to neither of these families.

Spheronauli represents a special development peculiar, as Pia (1914, p. 83) stated, in its Arcestes-like shape. Digoniocera and Angulithes are sufficiently characterised by the umbilical rim and sharpened venter respectively, and Pseudocenocera is easily distinguished from its Cretaceous contemporaries by its steep umbilical edge, truncated whorl-shape, entomarginal siphuncle and reclined septal edges. Ophionauli which probably includes Nautilus zitteli Gemmellaro in Tagliarini (1901, p. 187, pl. vi, figs. 1-4) and perhaps also the Upper Liassic N. schwalmi, Prinz (1906, pl. iii, fig. 1, p. 225) is characterised by its open coiling.
As regards the family Cymatoceratidae, Spengler in 1910 had suggested several divisions within Cymatoceras, Hyatt, by him still considered to be a subgenus of Nautilus. The typical ornamentation of Cymatoceras, of course, may be only feebly developed, as in C. bouchardianum (d'Orbigny 1842, pl. xi) or in C. ovoideum (Crick, 1907, p. 222). The ribbing in the genera Syrionautilus reminiscent of Clydonautilidae, in Anglonautilus and in Eucymatoceras is sufficiently distinct for generic separation of their respective groups. Paracymatoceras with its modified final stage differs from the more typical Cretaceous forms. Whether Tagliarini’s group of ‘Nautilus toarcensis, d’Orbigny,’ with N. marii, Gemmellaro in Tagliarini (1901, pl. vi, figs. 5-6) leads up to the somewhat similar Procymatoceras subtruncatus and P. baberi (Morris and Lycett, 1850, pl. i, figs. 1, 2) with their costate Bellerophon-like outer whorls cannot yet be stated. Similarly it is uncertain whether Procymatoceras is a descendent of the Inferior Oolite Nautilus polygonalis (J. de C. Sowerby) which species had been considered by Brauns (1869, p. 100) to be possibly identical with P. subtruncatum.

The genera comprised in the family Paracenoceratidae are characterised by differentiation of the periphery, generally associated with increase of the sinuosity of the suture-line, and a ventral lobe. Though including offshoots of various stocks within the restricted Nautilidae, the present family is far less polyphyletic than, for example, Pleuronautilidae. Somalinautilus has already been referred to as probably a direct development of those Bisiphytes with flattened venter that Hyatt had separated as Cenoceras. In Paracenoceras the siphonal area becomes sulcate in the more specialised forms. Nautilus rhodani Roux (in Pictet and Roux, 1847, pl. i, fig. 4) appears to be the latest (Albian) species at present known, but it has been compared by its author with Pseudocenoceras largilliertianum (d’Orbigny). Tithonoceras and Heminautilus, the latter of which already has a distinctly hercoglossid suture-line, but may perhaps be a Cymatoceratid, are further developments of the same tendency. Aulaconautilus, with four keels and a sulcate venter, and Carinonautilus Spengler, are sufficiently distinct from all the other groups for generic independence.

The family Hercoglossidae includes various developments of normal Nautilidae in which the suture-line has become ‘goniatitic,’ chiefly by the appearance of a distinct saddle on the inner lateral area. Pseudoganides, which comprises the early ‘aganitici,’ like Somalinautilus, has its origin in ‘Cenoceras,’ and includes, for example, the large subsinuatus group of the Inferior Oolite, as already mentioned. The typical Hercoglossa (compare H. danica in Foord and Crick, 1890, p. 407, fig. 8) have a far more pronounced lateral saddle and generally a second lateral lobe, and “Enclimatoceras” ulrichi, White, which in view of the ambiguity surrounding the original “Nautilus orbiculatus, Tuomey” might well have been chosen as lectotype of Hercoglossa in the place of H. danica (Schlothoem), illustrates the typical features of this genus. The Upper Jurassic forms of the type of N. franconicus Oppel and N. oppelli Zittel are provisionally retained in this genus Hercoglossa but probably form an indep-
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endident development. About fifteen forms of this group from the Upper Jurassic have lately been described by Loesch (1914), but though they include different types of whorl-section, umbilicus, position of siphuncle, etc., they seem to be a fairly homogeneous group and difficult to separate from the Upper Cretaceous and Eocene Hercoglossa. The forms with more angular sutures and an entomarginal siphuncle, like Nautilus parkinsoni Edwards, Hercoglossa paucifer (Cope) Whitfield (1892, p. 246, pl. xxxix, fig. 1), both of which are genoparatypes of Hercoglossa, further Nautilus Schweinfurthi (Zittel MS) Quaa are here referred to the new genus Paraturia. Foord and Crick (1890, p. 391) listed Nautilus parkinsoni as “Hercoglossa” but in 1891, Foord (p. 181) referred this species to Aturia, though Geinitz (1887, p. 56) had pointed out that it was generically distinct on account of the higher position of its siphuncle.

Pseudonautus and Hercoglossoceras represent specialised developments, the former of a group of Hercoglossa, with differentiation of the suture-line on the ventral area, the latter of compressed Pseudaganides. Deltoideautilus in whorlshape resembles the Cretaceous Angulithes, and d’Archiac, and Foord (1891, p. 327) had compared Deltoideautilus deluci (d’Archiac) with Angulithes triangularis. The latter, however, with its less sinuous suture-line, is more closely allied, via Ang. fleuriausianus (d’Orbigny) with the regular Nautilid stock that produced Pseudocenoceras in the Cretaceous, as it had given rise before to the less specialised Paracenoceras of the calloviensis type.

Aturidae are separated as a special family on account of their dorsal, funnel-shaped siphuncle. Ihering’s Sphenaturia may have been founded in the belief that “European Aturia” resembled the diagrammatic figure reproduced by that author. The differences even between the Miocene Aturia aturi, Basterot, and the typical Eocene forms of the zigzag group are in the writer’s opinion not more than specific.

Family PARACENOCERATIDÆ, nov.

Genus Paracenoceras nov.

Paracenoceras Kumaguinense (Waagen).

(Pl. IV, figs. 2, 3a, b.)

1873. Nautilus Kumaguinensis, Waagen, p. 19, pl. iii, figs. 1 a, b.
1896. Nautilus giganteus, d’Orbigny; Noetling, pars, p. 8.
1912. Nautilus Kumaguinensis, Waagen; Smith, p. 714.

This species was described by Waagen as being easily distinguishable from Nautilus hexagonus J. de C. Sowerby, by its smaller umbilicus and the less prominent ridges on the external angles. Noetling, on the other hand, after examining Waagen’s holotype, could see no points of difference between the two species. Whilst agreeing with Noetling that the size of the umbilicus in Waagen’s immature (and restored) specimen is misleading and that the ventral aspect also is that of N. hexagonus, the writer has yet retained Waagen’s species,
the holotype of which is here refigured. Some day the discovery of more abundant material will confirm or disprove the opinions here expressed regarding these two species and their close allies N. giganteus, d'Orbigny and N. ennianus, Dacqué. With the few Kachh specimens available at present it seems that the Callovian Paracenoceras kumagunense has a tabulate, sub-sulcate, periphery at a diameter (up to 30 mm.) where the Argovian P. hexagonum is still rounded ventrally though grooved in at least two, probably pathological, specimens.

At a later stage the only difference between the two forms may consist in the slightly less pronounced sulcation of some of the Corallian shells, but there are some perfectly typical specimens in the British Museum, including one of Sowerby's paratypes (No. 46494) that show very good agreement with the Kachh form in all characters, including the small umbilicus. Examples, however, from the Oxfordian of Dives, Calvados, France (B. M. Nos. 37026a-c) that were included by Dr. Foord in his Nautilus hexagonus and that probably will have to be referred to either Waagen's species or to N. sinuosus, Roemer (1836, pl. xii, fig. 5), have a still more distinctly tabulate and sulcate venter at a diameter of less than 20 mm., whereas the Oxford Clay and Coral Rag forms, including the example figured by Damon (1888, pl. v, fig. 10) as Nautilus hexagonus, have less distinct ventral ridges at the size of the Kachh species. It is probable that if Waagen had had before him for comparison a comprehensive series of hexagonus material, the present species would not have been created.

Nautilus ennianus, Dacqué (1905, p. 144, pl. xvii, fig. 5) similarly differs from Paracenoceras kumagunense, apart from the doubtful width of the umbilicus, merely in having the venter still tabulate and non-sulcate at a considerably larger diameter even than P. hexagonum. D'Orbigny's 'Nautilus giganteus' also does not acquire sulcation until a considerable diameter is reached; but according to what the writer would interpret as typical examples, including the Wiltshire specimen (B. M. No. 32563) referred to by Blake (1905, p. 35), d'Orbigny's species is a less robust and more elegant shell than the Abyssinian form. At the diameter of Noetling's large example of 'Nautilus giganteus' the periphery of d'Orbigny's species is also already neatly concave; and it appears therefore that the Baluchistan form is closer to Dacqué's Nautilus ennianus, and it certainly cannot be identified with Paracenoceras kumagunense or P. hexagonum.

Crick's (1908, p. 11, pl. ii, fig. 2) Arabian Nautilus cf. hexagonus, though crushed, is also undoubtedly closer to the two species of Paracenoceras just mentioned than to the Abyssinian P. ennianum. The small Madagascan specimen doubtfully referred by the writer to the present species, has a distinctly sulcate periphery already at a diameter of 20 mm. and thus seems to be less close to P. hexagonum than to Waagen's form.

Nautilus dorso-excavatus, Parona and Bonarelli (1897, p. 114, pl. ii, fig. 1) which has been compared by its authors to the present species, is easily distinguished by its concave sides.
The independence of the present species from *P. hexagonum* is suggested by the example figured on pl. IV, figs. 3a, b, from the Blake Collection (No. C. 19829) which, however, is unfortunately crushed; for in this the siphuncle is central and the periphery does not continue to widen as it does in *P. hexagonum*. This specimen is undoubtedly more compressed than the type and larger examples from the *athleta* beds of Fakirwadi, and the umbilical rim is less conspicuous, whilst the peripheral angles are not so abrupt *i.e.*, more rounded than in the type of *P. kumagunense* or in Sowerby's species. *P. granulosum* (d'Orbigny) is flatter on the sides and has merely a tabulate periphery and also a ventro-centr al siphuncle, but otherwise shows some resemblance to this figured example.

*Horizon*:—Callovian, *macrocephalus* to *athleta* zones, also Dhosa Oolite (Argovian). Mr. J. H. Smith, who kindly informed me that nautili are rare except in the Dhosa Oolite i.e. stated that "*N. Kumagunensis*" was the usual kind, "in beds higher than Waagen named."

*Localities*.—North of Kumaguna, Lodai (see J. H. Smith, 1915, p. 797) and Fakirwadi. A fragment in the Blake Collection (No. C. 19830) from the Upper Bed, Nucula Flag, North of Gadhada, is doubtfully included here. It is part of a shell as large as Noetling's Baluchistan form, but the venter is more distinctly sulcate, and while it is certainly not *P. giganteum*, it may have belonged to a large *P. hexagonum* or even *P. enni anum*. Close to the former species in shape is also a *Fakirwadi* (*athleta*-bed) specimen of 200 mm. diameter with almost complete body chambers. The example figured on pl. IV, figs. 3a, b, is from the Dhosa Oolite ("Higher Beds") of Gangta Bet. Two crushed specimens with unusually sharp ventral edges are unfortunately unlocalised.

**Paracenoceras hexagonoides** sp. nov.

(Pl. IV, figs. 4a, b.)

A slightly crushed cast in the Blake Collection (B. M. No. C. 19826), with remnants of the test preserved, has at 110 mm. a whorl-thickness of 77 per cent. of the diameter. This considerably exceeds the thickness of *P. hexagonum* (J. de C. Sowerby) which form the specimen otherwise resembles. The periphery is distinctly sulcate but the edges are rounded and not abrupt or definitely angular as in Sowerby's species or in *P. kumagunense* (Waagen). Moreover, the suture-line is not projected forwards and the umbilicus is practically closed. The position of the siphuncle is unknown, the anterior portion of the shell belonging already to the body-chamber.

*Nautilus schusteri*, Loesch (1912, p. 90, pl. vii, figs. 1-4) which differs from young and similarly pathological specimens of *Paracenoceras hexagonum* in the British Museum (No. C. 8867) and in the writer's collection, merely in being slightly more inflated, shows resemblance to the species here described, but like Sowerby's species it has a more projected suture-line.

*Nautilus moreausus*, d'Orbigny (1845, pl. xxxix, figs. 1-2) from the Upper Kimmeridgian (Virgulian) which, however, according to Loesch (1914, p. 132).
is incompletely known, seems to have a steeper umbilical wall and less sinuous sutures across the periphery. In the present form these are provided with a fairly deep ventral sinus, as in Paracenoceras hexagonum, and d'Orbigny's form also is non-sulcate. The example of Nautilus moreanus [moræanus] figured by de Loriol (in de Loriol, Royer and Tombeck, 1872, p. 28, pl. iii, fig. 5) differs in shape as well as in suture-line from the Kachh form here described.

Nautilus cf. calloviensis (Oppel) described by de Loriol (1896, p. 38, pl. v, fig. 3) as probably close to d'Orbigny's Callovian type (= N. hexagonus, d'Orbigny non Sowerby, pl. xxxv, figs. 1-2) but according to Loesch (1914, p. 140) an immature form of the later giganteus group, also has a more projected and more sinuous suture-line, though no ventral sinus. Its thickness also is only 71 per cent of the diameter and the peripheral sulcus is inconspicuous.

Paracenoceras ennianum (Dacqué), apart from having the suture-line of the hexagonum group, is also less inflated than the present species and devoid of a peripheral groove. On the other hand, P. sattleri (Krenkel, 1910, pl. XXII, fig. 16, pl. XXIII, figs. 1-2) and P. latifrons (Zwierzycki, 1914, p. 29, pl. I, fig. 9) are considerably more depressed. In spite of the fact that the species here described is represented by a single example, the creation of a new name may thus be justified.

A fragment in the British Museum (No. C. 7394) from the Kimmeridgian of Bihin, Somaliland, consisting of the casts of only two air-chambers, probably belonged to a similar depressed and sulcate form.

Horizon.—Tithonian ("Umian" Group.)

Locality.—N. Moondan (No. 5), associated with Ptychophylloceras tithonicum, Waagen; Holocophylloceras sp. ind., and various Virgatosphinctes.

Paracenoceras cf lorioli (v. Loesch).

(Pl. II, figs. 6a, b.)

1872. Nautilus giganteus d'Orbigny; de Loriol, in de Loriol, Royer and Tombeck, p. 29, pl. iii, fig. 4.


The inner whorls, somewhat worn, of a large shell with dorso-centrally siphuncle resemble Paracenoceras kumagunense or P. hexagonum, but the periphery at a diameter of 100 mm. is merely truncate, without sulcus or well-defined edges. The example may represent the centre of a 'giganteus'-like form of Paracenoceras, such as have also occasionally been described as 'Nautilus calloviensis.' The name giganteus (d'Orbigny, 1842) seems permissible, for though Loesch (1914, p. 134) pointed out that d'Orbigny's Nautilus gigas of 1825 was not the same form, Zieten's N. giganteus of 1830, even if it should turn out to be a new form, would belong to the genus Bisiphytes, not to Paracenoceras. The typical example of P. giganteus, however, referred to above (p. 27) from Wiltshire, with sharp edges of the concave periphery in the adult, at the diameter of the present example is scarcely truncate.
Waagen's *Nautilus calloviensis* (non Oppel) with similar whorl-shape, has the siphuncle in the outer third of the septum, according to Waagen, though the figured example itself does not show it. D'Orbigny's type of *N. calloviensis* (= *N. hexagonum*, d'Orbigny non Sowerby) which according to de Loriol (1896, p. 139) was probably incorrectly figured, is far more depressed than the present form and Blake's (1905, p. 36, pl. ix, fig. 13) *N. calloviensis*, in the writer's opinion merely the young of *N. truncatus*, Sowerby, does not show the projected suture-line. Foord and Crick's (1890, p. 289, fig. 18, p. 290) *N. calloviensis* is closer to *Paracenoceras granulosum* (d'Orbigny, 1845, pl. xxxv, figs. 3-5), *P. mjatschkoviensis* (Loesch, 1914, p. 106, pl. xiii, fig. 3) and to *P. volgensis* (Nikitin, 1888, p. 127, pl. vi, figs. 33-4) which probably includes Lahusen's (1883, p. 42, pl. iii, figs. 28-9), Michalski's (1885, p. 299), Borissjak's (1908, pl. i, fig. 1) and Krenkel's (1915, pl. xxii, figs. 8-11) *Nautilus calloviensis*.

*Nautilus* sp. (group of *N. giganteus*) figured by Loesch (1914, p. 144, pl. xv, fig. 1) has a wider umbilicus than the Kachh form or de Loriol's specimen from the Astitarian of the Haute Marne. The latter author at a later date (1896, p. 38) pointed out that the young of *N. giganteus* differed from *N. calloviensis* in being less inflated and in having a larger umbilicus. The allied *N. dorsatus*, Roemer (1836, p. 179, pl. xii, figs. 4a, b) with almost closed umbilicus but truncate whorl-section, has only feebly sinuous suture-lines. *N. seminflatus*, Etallon (1864, p. 414) which cannot be so close to Roemer's species as Loesch (1914, p. 141) thought, has a whorl-thickness of nearly two-thirds of the diameter.

*Nautilus rolieri* Loesch (1914, p. 103, pl. xv, figs. 3a-c) and *N. arduenensis* (d'Orbigny MS) Loesch (ib., p. 108, pl. xv, fig. 4) examples of which, in the British Museum (Nos. 70859 a-c) had been included by Foord in *N. hexagonus*, are more inflated than the present species. Similarly Dacqué's *N. ennianus* is not only more inflated, but has a wider umbilicus with a well-defined rim.

*Horizon.*—Dhosa Oolite, Argovian.

*Locality.*—Charwar (No. 1), with typical Argovian *Perisphinctes*.

**Paracenoceras wandaeense** (Waagen).

(Pl. III, fig. 4).

1873. *Nautilus wandaeensis*, Waagen; p. 17, pl. iv, figs. 3a, b.

Noetling figured a larger example of this species which, however, does not show the high and perpendicular umbilical wall, at least on the body-
chamber. In Waagen's front view (fig. 3b) the whorl-height appears too great and the sides are drawn too flat, but the figure, if restored, at least conveys the peculiar shape of the present species, though if Noetling's identification is correct, larger examples are far more rounded. In spite of Noetling's objections, the writer believes that Waagen was right in considering the present species closely allied to the form he figured as *Nautilus calloviensis*. It differs therefrom in its thicker whorls and larger umbilicus with far higher and more well-defined walls, but it will be mentioned below that the original of Waagen's *N. calloviensis*—not a fragment, as Noetling states—is indistinguishable from the paratype of *N. jumarensis*.

Crick apparently misread the affinities of the present species when he considered his Arabian *Nautilus cf. hexagonus* to be closer to *N. wandaensis* than to *N. kumagunensis*, to which it may belong.

**Horizon.**—Dhosa Oolite (Argovian).

**Locality.**—Wanda.

**Paracenoceras cf. calloviense** (Oppel).

(Pl. II, figs. 1a, b; Pl. III, fig. 5.)

1840. *Nautilus hexagonus* ?, J. de C. Sowerby, in Grant, p. 329, pl. xxiii, fig. 4.
1845. *Nautilus hexagonus* ?, J. de C. Sowerby; d'Orbigny, p. 161, pl. xxv, figs. 1, 2.
1873. *Nautilus calloviensis*, Oppel; Waagen, p. 18, pl. iii, figs. 2a, b.
1873. *Nautilus jumarensis*, Waagen (pars), p. 21, pl. iv, figs. 2a, b.
1878. *Nautilus hexagonus*, J. de C. Sowerby; Mallada, pl. iv, fig. 9. (Copy of d'Orbigny).
1897. *Nautilus calloviensis*, Oppel; Parona and Bonarelli, p. 114.
1913. *Nautilus calloviensis*, Oppel; Smith, p. 420.
1920. *Nautilus calloviensis*, Oppel; Couffon, p. 165 (17), pl. xvii, figs. 6—6b.

Sowerby's original example here reproduced (pl. II, figs. 1a, b) is preserved in a matrix different from that of Waagen's specimen (refigured on pl. III, fig. 5) which, however, agrees more in mode of preservation with two other examples in the Blake Collection (B. M., Nos. C. 19824 [and 25 ?]) and with the immature form figured by Waagen (pl. iv, fig. 2) as the young of *Nautilus jumarensis* and referred to below. The five examples may not belong to the same species, especially that from the lowest bed, referred to below under *P. ? jumarensis*; and none is quite so inflated as d'Orbigny's type or even shows the siphuncle, so that specific identification must remain doubtful. Loesch had already listed Waagen's form as a species different from Oppel's type, but all the Kachh examples now available are entirely septate and therefore only the inner whorls of larger specimens. In view of the uncertainty expressed below as to the affinities of *Nautilus jumarensis* it seems advisable to refer them provisionally
to the present more or less universal species, pending the discovery of more satisfactory material.

It might be added that the thickness of the Kachh examples varies from 64 per cent. to 70 per cent. of the diameter (the latter in Sowerby’s type here refigured) and that, as de Loriol (1896, p. 39) has pointed out, d’Orbigny’s figure is not exact.

*Nautilus calloviensis* of Krenkel (1915, p. 217, pl. xxii, figs. 8-11) which according to Popeljany examples before the writer (B.M., Nos. C. 7933-4) is probably referable to *Paracenoceras volgense* (Nikitin), is very slightly more compressed than the Kachh species, which is listed in the synonymy of Krenkel’s forms and shows good agreement, especially also in the suture-lines. Since the latter, in Waagen’s side-view (fig. 2a) are incorrectly drawn, his example is here refigured.

*Horizon.*—Callovian (upper *macrocephalus* and *anceps*? beds).

*Localities.*—Waagen recorded this species from Khera Hill, NW of Jumara and NW of Soorka; Mr. Smith from the Ler-Hamundra Ellipse. Sowerby’s example is marked in ink “Charee” and the two specimens in the Blake Collection are from beds 13a and 15a of Jumara. According to the sequence previously given (Spath, 1924, p. 22) this last may be from the yellowish-gray limestone, “directly below ‘Stephanoceras’ *macrocephalum* in the uppermost beds of the Patcham Group,” whence came Waagen’s *Nautilus jumarensis*, and it will be mentioned below that it might, perhaps, be referable to that species.

**Paracenoceras? jumarense** (Waagen).

(Pl. III, figs. 6a—c.)

1873. *Nautilus jumarensis*, Waagen, p. 21, pl. iv, fig. 1 only.

The affinities of this species must be considered to be as yet very doubtful, for, as will be seen from the illustrations of the holotype (pl. III, figs. 6a—c) the preservation is so unsatisfactory that Waagen’s restoration may conceivably be altogether erroneous. What this author took to be “broad, obtuse, tubercles” may be merely the result of corrosion. The traces of lateral costation have probably been accentuated by the weathering; but the ventral area is certainly completely worn away at the spot where three pairs of indistinct and unequal rib-like markings (see fig. 6b)—but not tubercles—are found. On the opposite side, where the septa can be followed at least near the end of the shell, almost up to the ventro-lateral edge, there is no ornamentation. Hence, Waagen assumed that this was “chiefly restricted to the shell whereas the cast showed very little of it.” In any case it will be admitted that the restoration attempted by Waagen is highly problematical and does not even show the likeness to Neumayr’s *Nautilus mojsisovicsi* (1870, p. 151, pl. vii, fig. 1) that might possibly exist. For the periphery in Waagen’s fig. 1b is entirely diagrammatic and has been added by the artist. The ventral area, preserved only at the end of the shell, is corroded even there and naturally could not show the ribbing that may
have existed, especially at an earlier stage, where the lateral ornamentation appears strongest.

If the discovery of further material should prove that what Waagen thought to be ornamentation is indeed ribbing of a cymatoceratid type, as found in, for example, *Procymatoceras subtruncatum* (Morris and Lycett), the comparison with Neumayr's species may have been more apt than appears from Waagen's figure. But *Nautilus mojisovici* has been considered by Couffon (1922, p. 164) to be a synonym of Guéranger's *N. juli* (1864, p. 189, pl. iii), the genotype of *Cymatonautilus* (see supra, p. 21). The young of this is sulcate and ribbed already at a small diameter, and if Waagen's paratype (pl. iv, figs. 2a, b) of *Nautilus jumarensis* belong to the same species as the holotype (pl. iv, figs. 1a, b) there can be no connexion between these and Neumayr's species as Waagen thought. For the smaller of the latter author's two specimens is indistinguishable from the forms above recorded under *Paracenoceras* cf. *calloviense* (Oppel), which also includes Sowerby's original *Chari* specimen. Waagen was aware of this close affinity, for whilst he described the young of *Nautilus jumarensis* as being scarcely distinguishable from *N. lineatus* (J. Sowerby), his *N. calloviensis* was stated to be "closely allied" to the same species.

The Jumara examples of *Paracenoceras* cf. *calloviense* also agree with the holotype of *Nautilus jumarensis* in the hard, yellowish-gray, limestone matrix and peculiar weathering, and Waagen may have had no better grounds for referring his smaller example to the same species than their association in the same bed. On the other hand it must be admitted that the example in the Blake Collection from the lowest bed (15 A—uppermost Patcham Group ?) though crushed, shows a tendency to concave lateral areas, not found in the (larger) example figured by Sowerby. The whorl-shape of the holotype of *N. jumarensis* is also laterally distorted by crushing, but it is probable that even if the species turn out to be entirely unrelated to *Cymatonautilus* and to be a *Paracenoceras* close to Oppel's *P. calloviense*, it can be distinguished from that (later) species, by a narrower ventral area and slightly concave sides.

*Horizon.—*Uppermost Patcham Group (lower *macrocephalus* beds).

*Locality.—*Jumara.

Family *CYMATOCERATIDÆ*, nov.

Genus *Procymatoceras* nov.

*Procymatoceras? intumescens* (Waagen).

(Pl. II, fig. 3).

1873. *Nautilus intumescens*, Waagen, p. 20, pl. iii, figs. 3a, b.
1896. *? Nautilus intumescens*, Waagen; Noetling, p. 9, pl. iii, figs. 1, 1a.

Waagen's holotype and a second example in the Blake Collection (pl. II, fig. 3) are here doubtfully referred to *Procymatoceras* since they are believed to be more closely allied to *P. baberi* (Morris and Lycett, 1850, pl. i, fig. 1) than to *Eutrephoceras? subinflatus* (d'Orbigny—*Nautilus inflatus*, d'Orbigny. 1545, pl.
with which species Waagen had compared his Kachh form. The holo-
type only shows the striation, with a deep peripheral sinus, on two small shell-
fragments of the ventral area, and faint impressions of this ornamentation, with
a normal line, are preserved on the cast. The inner whorls of Blake's example
however, show the reticulate pattern, with radial ribbing dominant, as clearly
as the Cymatoceras figured by Crick (1918, pl. ix, fig. B) as a young Nautilus
(? elegans, J. Sowerby) from the Cenomanian of Kent. This type of ornamenta-
tion, of course, is also found in immature Bisiphytes, in which it changes to
stirigation with increase in size, and by itself, unfortunately, is of no diagnostic
value. On the other hand, on the very thick shell round the umbilicus of
Prof. Blake's specimen, there are shown a few irregular pleats that suggest com-
parison with the Bathonian species above referred to.

Whether Noetling's large example from Baluchistan belongs to the present
species seems uncertain. Waagen's holotype does not show the position of the
siphuncle, but in Prof. Blake's example it is subventral, as in d'Orbigny's Nautilus
subinflatus, not dorso-centran, as in Noetling's example. The latter also shows
a rounder whorl section and a large umbilicus and in this respect is considerably
less like the inflated Bathonian species with which Procymatoceras intumescens
is here brought into comparison. On the other hand it must be admitted that
the Kachh form resembles Nautilus subinflatus also in the absence of an annular
lobe, although the lateral lobe is considerably deeper, a feature that is not
apparent from Waagen's otherwise perfectly satisfactory figures. N. subinflatus
has been erroneously considered by Etallon (1864, p. 414) to be synonymous
with N. moreausus, d'Orbigny; but whether this turn out to be a Paracenoceras
of the hexagonum group or whether it be more correctly referable to Eutre-
phoceras, the Andine forms recorded by Steuer (1897, p. 78) and Haupt (1907,
p. 188) at any rate are considerably later in date than the species here dis-
cussed. On the other hand, Eutrephoceras douvillei, n. n. (=Nautilus desertorum,
Douvillé, 1916, p. 71, pl. IX, fig. 2), non Zittel [MS] Quaas, 1902) is considerably
more compressed than the present species and its siphuncle is dorso-centran.

Horizon.—Lower Chari Group (macrocephalus zone).

Locality.—NW of Jumara. Blake's example (B.M., No. C. 19827) labelled :
"Nautilus sp. (? nov.)" is from Khera (No. 10 = upper macrocephalus beds).

Family HERCOCLOSSIDÆ, nov.

Genus PSEUDAGANIDES, nov.

PSEUDAGANIDES KUTCHENSIS (Waagen).
1873. Nautilus kutchensis Waagen, p. 20, pl. iii, figs. 4a, b.
1885. Nautilus kutchensis Waagen; Michalski, p. 299.
1887. Nautilus kutchensis Waagen; Bukowski, p. 96.
1912. Nautilus kutchensis (?) Waagen; Smith, p. 714.
1924. Nautilus kutchensis (?) Waagen; Premik, p. 372.

This species was very ably discussed by Bukowski who noticed the granu-
lation on the test of the inner whorls of one of his Polish specimens. Since-
Waagen did not describe the ornamentation—preserved on a few fragments of the test of his unique example—it may be mentioned that at the beginning of the outer whorl, i.e. at a diameter of about 20 mm. the granulation is distinctly visible on the periphery. Here the striae of growth are intersected by fine longitudinal strigation, but near the end of the shell, on a few remnants of test, only the former striae are seen, forming a deep sinus on the ventral area. With Bukowski the writer considers that notwithstanding the presence of this ornamentation the present species must be referred to the 'Aganitici,' not to *Paracenoceras* of the 'calloviensis' group.

*Pseudaganides aganiticus* (Schlotheim) as figured by Loesch (1914, pl. xv, fig. 1) has considerable resemblance to the present species, but is more compressed. On the other hand *P. schlotheimi*, Loesch (= *Nautilus* [Hercoglossa] *aganiticus*, Foord and Crick, 1890, p. 394, fig. 1), the siphuncle of which, in spite of Loesch's doubts, is quite distinctly "situated a little below the centre," has not only a less sinuous suture-line, but an entirely different whorl-section. *Nautilus tubingensis*, Loesch (1914, pl. xv, fig. 5) which, on account of its distinct lateral saddle I would include in *Pseudaganides* rather than in *Paracenoceras*, has the ventro-central siphuncle and truncated whorl-shape of the present species, but a shallower lateral lobe. *Pseudaganides? girardoti* (de Loriol, 1903, pl. xv, fig. 1), as Loesch (1914, p. 103) pointed out probably wrongly drawn, differs from the present species in its small lateral saddle. *P.? subbiangulatus*, d'Orbigny sp. (= *Nautilus biangulatus*, d'Orbigny, 1845, pl. xxxiv, figs. 1—3) recorded by Couffon (1920, p. 163[15], pl. xvii, figs. 7—7b) and Roman (1923, p. 11, pl. i, fig. 2), is also a more compressed form than *P. kutchensis*. A Habye example of the latter, at 100 mm. diameter, has the body chamber nearly complete and is then sulcate, like d'Orbigny's form or *P. ammon*, Loesch (1914, pl. xiii, figs. 1—2).

*Nautilus* sp. in Krenkel (1915, p. 218, pl. xxiii, figs. 1—2) which has been described as possibly related to the present species, in the writer's opinion is probably referable to *Paracenoceras mjatschkowense* (Loesch, 1914, p. 106, pl. xiii, figs. 3a, b).

**Horizon.**—Middle Chari Group (anceps zone).

**Locality.**—Wanda (Waagen), Fakirwadi, Habye, (Smith "sub-anceps beds").

C. Order AMMONOIDEA.

**Family PHYLLOCERATIDÆ Zittel.**

When discussing this family on previous occasions the writer (1923, p. 19; 1924, p. 4) objected to a splitting up of the fundamental genus *Phylloceras*, but the study of considerable additional material, including over a hundred examples from Kachh, makes it appear desirable to adopt independent generic names for some of the old established groups. It has been shown by Prof. Salfeld (1919, p. 5; 1924, p. 3) that the internal lobes often retain primitive characters and permit of the recognition of genetic connexions. Comparing the dorsal lobes of, for example, *Ptychophylloceras feddëni* (Waagen) here figured (pl. VII, fig. 3) with
those of Holcophylloceras zignodianum (d'Orbigny) as represented in Salfeld (1919, p. 2, text—fig. 1), it will be seen that the second dorsal saddle is much more primitive (monophyllitid) in the Kachh form, indicating that the differences between the two genera are greater than appears from an examination of the external features alone. The ornamentation of the shell in the two groups is also quite different.

Prinz (1904, p. 30) who reviewed Neumayr's groups of Phylloceras, stated that the classification of Phyllocerates must always be more or less artificial. This may certainly be said of the division into Diphyllites and Triphyllites, suggested by Jullien (1911, p. 129). His classification has not been accepted by any recent author and with Kilian (1913, p. 332) the writer would reject it.

Prinz's group of Phylloceras capitanei (Catullo) includes the subgroup of Ph. capitanei—which may not be synonymous with Calliphylloceras nov., established below for the group of Ph. disputabile, Zittel—and the subgroup of Ph. ultramontanum, Zittel, corresponding to the genus Holcophylloceras, nov., created for Ph. mediterraneum Neumayr.

The group of Phylloceras tatricum (Pusch) again is probably synonymous with the genus Ptychophylloceras nov., as type of which is here taken P. feddeni Waagen. This genus is characteristic of the Upper Jurassic but begins already in the Bajocian and ranges into the Neocomian, the last forms, generally referred to P. semisulcatum (d'Orbigny), being known from the Barremian. The Tithonian Ptychophylloceras inordinatum (Toucas) may, perhaps, represent the stock from which sprang Hoplophylloceras (=group of 'Phylloceras' strigile [Blanford] Uhlig).

From the group of Ph. heterophylum (J. Sowerby) (=Phylloceras s.s.) the genus Partschiceras (Fucini, 1923, p. 95) has since been separated. Phylloceras ranges from the Lower Lias into the uppermost Cretaceous, but is poorly represented in Kachh. With Partschiceras, Phylloceras, s.s. is now referred to the sub-family Phylloceratinae, which also includes Phyllopachyceras, created for Phylloceras infundibulum, d'Orbigny, and a similar development in the Upper Jurassic, Macrophyloceras gen. nov., created for Phylloceras ptychostoma Benecke (MS). Zittel (1868, p. 68, pl. vii, figs. 3—4) which Neumayr (1871, p. 318) already had considered to be a lateral offshoot of Phylloceras, and which differs from the somewhat similar Phyllopachyceras in its high external lobe.

On account of their monophyllic internal and diphyllic external saddles, combined with an open umbilicus, it may be convenient to separate as Rhacophyllitinae the other genera listed below. This classification, in a way a return to the Diphyllitids and Triphyllitids of previous authors, is, of course, arbitrary; for included in Rhacophyllitinae there is e.g., the genus Geyeroceras, Hyatt, with three monophyllic internal saddles, yet associated with a closed umbilicus. The large number of genera now recognised may, however, justify their separation into these subfamilies. Tragophylloceras, separated from Phylloceratinæ already in 1914 (Spath, p. 339) was then erroneously grouped with Psiloceratids, Pleuracanthites, and Ectocentrites, now referred to three separate families. On account of its subdivided internal lobe Tragophylloceras may be referred, with Amphiceras Gemmellaro, to the family Amaltheidae.
The Triassic *Discophyllites*, Hyatt (proposed for *Lytoceras patens*, Mojsisovics, 1873, p. 34, pl. xvi, fig. 13; pl. xix, fig. 17) the writer would now also separate from Phylloceratinae s.s., and group with it *Diphyllites*, Jullien (for *Phylloceras neojurensis*, Quenstedt, but emended to include also, *Triphyllites debilis* Hauer sp. of Jullien) and *Tragorhacoceras*, gen. nov. (for *Phylloceras occultum* Mojsisovics, 1873, p. 38, pl. xvi, figs. 3–6). *Rhacophyllites*, Zittel restricted to Liassic forms by Mojsisovics (1900, p. 115), is characterised by its modified body-chambers, and as typical was taken (Spath, 1914, p. 355, 1923b, p. 291) the group of *Rh. transylvanicus-diopsis*. The genera *Procliviceras*, *Fucini*, *Meneghiniceras*, Hyatt, and *Dasyceras*, Hyatt, are likewise characterised by their ornamentation; *Schistophylloceras*, Hyatt, by its ventral sulcus and *Harpophylloceras*, gen. nov. (for *Ammonites eximius*, Hauer, 1854, p. 863, pl. ii, figs. 1–4, as represented by No. 1382, L.F.S. Coll.) by its continuous keel. This last genus, with its falcoid ribbing, is of fundamental importance in connection with the replenishment of the keeled families of the Falciferi. The genus *Kochites*, Prinz (1906, p. 239), though originally a synonym of *Schistophylloceras*, may also be retained in Fucini's (1923, p. 105) sense, for *K. limatum* (Rosenberg), i.e., the Domerian equivalents of the Hettangian *Paradasyceras*.

The genus *Calliphylocerites*, separated off from Rhacophyllitinae already in the Psiloceratan, with *C. togatum* (Neumayr, 1879, p. 21, pl. i, figs. 16, 17) is clearly not a derivative of *Phylloceras*, s.s.; and *Holcophyllocerites* and *Psychophyllocerites* similarly are more closely connected with Rhacophyllitinae than Phylloceratinae, so that it may be best to separate these genera, with *Hoplophyllocerites*, in a sub-family *Calliphyloceratinae*. To this is also referred *Salfeldiella* gen. nov. (for *Phylloceras guettardi*, d'Orbigny sp.) referred to below (p. 38), but *Hypophyllocerites*, Salfeld (1924, p. 6) on account of its non-lituid internal saddles and obvious transitional characters to Desmoceratidae, again has to be grouped in a separate sub-family.

The various genera of the former family Phylloceratidae, Zittel, may then be classified as follows. It is advisable not to include them with Monophyllitidae comprising the genera *Palaeophyllites*, *Monophyllites*, *Ussurites*, *Leiophyllites*, and *Mojsvarites*) in one super-family Phylloceratidae, as was done by Hyatt (1900, p. 566) and the writer on a previous occasion (1914, p. 359). The Triassic genera are being dealt with in the writer's Catalogue of Triassic Ammonoidea in the British Museum, now in course of preparation.

**Family PHYLLOCERATIDÆ**, Zittel emend.

**Sub-family DISCOPHYLLITINÆ** nov.

**Genus Discophyllites** Hyatt (genotype: — *D. patens* Mojsisovics sp.).

*Discophyllites*, Jullien (genotype: — *D. neojurensis* Quenstedt sp.).

*Tragorhacoceras* nov. (genotype: — *T. occultum* Mojsisovics sp.).
Sub-family RHACOPHYLLITINÆ nov.

Genus Paradasykeras, Spath (genotype: —P. vermaæense Herbich sp.).

Geyeroceras Hyatt (genotype: —G. cylindricum J. de C. Sowerby sp.).
Kochites Prinz emend. Fucini (genotype: —K. limatus Rosenberg sp.).
Schistophylloceras Hyatt (genotype: —S. aulonotum Herbich sp.).
Procliciceras Fucini (genotype: —P. proclive Rosenberg sp.).
Dasyceras Hyatt (genotype: —D. rakosense Herbich sp.).
Rhacophyllites Zittel emend. (genotype: —R. diopsis Gemmellaro sp.).
Meneghiniceras Hyatt (genotype: —M. lariense Meneghini sp.).
Harpophylloceras nov. (genotype: —H. eximium Hauer sp.).

Sub-family PHYLLOCERATINÆ Prinz emend.

Genus Phylloceras Suess (genotype: —P. heterophyllum J. Sowerby sp.).

Partschiceras Fucini (genotype: —P. partschi Stur sp.).
Macropophylloceras nov. (genotype: —M. ptychostoma Benecke sp.).
Phyllopachyceras Spath (genotype: —P. infundibulum d’Orbigny sp.).

Sub-family CALLIPHYLLOCERATINÆ nov.

Genus Calliphylloceras nov. (genotype: —C. disputabile Zittel sp.).

[? Xeinophylloceras S. Buckman (genotype: —X. xenus S. Buckman sp.)].
Ptychophylloceras nov. (genotype: —P. feddeni Waagen sp.).
Haplophylloceras Spath (genotype: —H. strigile Blanford sp.).
Holcophylloceras nov. (genotype: —H. mediterraneum Neumayr sp.).
Sowerbyceras Parona and Bonarelli (genotype: —S. tortisulcatum d’Orbigny sp.).
Salfeldiella nov. (genotype: —S. guettardi Raspail sp.).

Sub-family HYPOPHYLLOCERATINÆ nov.

Genus Hypophylloceras Salfeld (genotype: —H. onoense Stanton sp.).

Only the following five genera and eighteen species are represented from Kachh.

Phylloceras aff. latzei Loczy.
P. sp. juv. ind., cf. kunthi Neumayr.
P. sp. nov? cf. plicatum auct. non Neumayr
Ptychophylloceras feddeni (Waagen).
P. vicarium (Waagen).
P. jaraense (Waagen).
P. insulare (Waagen).
P. ptychocicum (Quenstedt).
P. titonicum sp. nov.
Calliphylloceras aff. disputabile (Zittel).
The large but fragmentary specimen in the Blake Collection, previously recorded, seems to be referable to Loczy's species rather than to the closely allied *P. kudernatschi*, Hauer, discussed recently (Spath, 1920, p. 312). The outline whorl-section here figured (pl. VII, fig. 6) shows that the sides are convex and the periphery evenly arched as represented by Loczy (text-fig. 10, p. 285). *P. kudernatschi* has not only flattened sides but a larger umbilicus and the dimensions of the present specimen (whorl-height = 130 mm.; thickness = 76 mm.) correspond with the percentages (60 and 35) given by Loczy for one of his examples (No. 5) of var. *b*, considered by him to represent perhaps the female of this species.

The suture-line resembles that figured by Loczy so far as can be seen from his very poor illustration (text-fig. 9, p. 285) and it differs from that of *P. kudernatschi* figured by the writer (1920, pl. v, fig. 1c); but its first lateral saddle can scarcely be termed tetraphyllic. Fig. 5 of pl. V represents a tracing of this saddle from the actual specimen and it will be seen that the outer of the three terminal leaflets is very unequally bifid. This type of suture line is probably also found in large examples of *P. kudernatschi* and separation of the two species may have to be based on whorl-section and dimensions only. The present example is not definitely identified with Loczy's form—and not figured—on account of its fragmentary condition; it is also probably of earlier age. *P. kunthi*, Neumayr, the first lateral saddle of which, as drawn by its author (1871a, pl. xii, fig. 6), shows a remarkable similarity to that of the present example here figured, is characterised by its compressed whorl-section. The Callovian form here recorded as *P. sp. nov. cf. plicatum* (auct. non Neumayr) is distinguished from the example now discussed by its falcoid plication.

Horizon.—Lower Callovian (Macrocephalitan).
Locality.—Jumara (bed No. 13a).
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REVISION OF THE JURASSIC CEPHALOPOD

PHYLLOCERAS sp. juv. ind., cf. KUNTHI, Neumayr.

1875. Phylloceras cf. kunthi, Neumayr; Waagen, p. 25, pl. v, figs. 2a-c.
1877. " kunthi, Neumayr; Gemmellaro, p. 8, pl. ii, figs. 3-4.
1892. " cf. kunthi, Neumayr; Neumayr and Ublig, p. 33.
1920. " cf. kunthi, Neumayr; Spath, p. 316, pl. v, figs. 3a-c.
1921. " kunthi, Neumayr; Riche and Roman, p. 160.
1923. " sp. ex aff. kunthi, Neumayr; Stehn, p. 98.

The immature specimen recorded by Waagen cannot be definitely identified with Neumayr's species, discussed in detail by Dr. Till and the writer. Unfortunately no additional material is available. The East African example figured by the writer, with dimensions 19—59—36—05 as against 18—61—39—06 in Waagen's original, seems to be indistinguishable from the Indian specimen. In spite of the apparent differences in the drawings the suture-lines of the two forms show good agreement, the first lateral saddle being similar to but less complex than that figured by Neumayr (1871a, pl. xii, fig. 6). The triphyllic and comparatively simple first lateral saddle of the form described below as P. sp. nov. ? cf. plicatum, auct. non Neumayr prevents its comparison to the present immature example in spite of similarity in whorl-shape. On the other hand the young of Calliphyllloceras disputabile (Zittel) at a similar diameter, show already constrictions.

Loczy considered the Indian example probably to belong to Phylloceras riazi, de Loriol (1898, p. 29, pl. viii, figs. 8-12) and thus to be closely related to his Ph. hatzegoi. But the former is of later date, and the latter species, which was described as intermediate between Ph. kudernatschi and Ph. kunthi, is difficult to compare with Waagen's form on account of difference in size, being the largest known ammonite of the rich Callovian fauna of Villany in Hungary. The example here referred to P. hatzegoi is much more inflated than the typical P. kunthi.

Horizon.—Callovian (athleta zone).

Locality.—Leir (Leir).

PHYLLOCERAS sp. nov. ? cf. Plicatum auct. non Neumayr.

(Pl. V, fig. 3).

1915. " plicatum, Neumayr; Loczy, p. 283, text-figs. 6-8.
1924. " cf. plicatum, Neumayr; Spath, p. 24.
non 1871. " plicatum, Neumayr; (a) p. 313, pl. xii, figs. 7a-c.
non 1886. " plicatum, Neumayr; Nætling, p. 14, pl. ii, figs. 2, a, b.
non 1893. " cf. plicatum, Neumayr; Choffat, p. 10. pl. xvi, figs. 1, 2.
non 1922. " cf. plicatum, Neumayr; Grossouvre, p. 314, pl. xv, fig. 11.

A septate fragment in the Blake Collection (B. M., No. C 22358) is somewhat intermediate between P. kudernatschi (Hauer) and P. plicatum auct. non
Neumayr. It resembles the former in whorl-shape and slightly sigmoidal costation and the suture-line, so far as can be seen, is of the type of that previously figured (Spath, 1920, pl. v, fig. 1c) with the first lateral saddle more definitely triphylllic than in \textit{P. hatzegi} (pl. V, fig. 5). On the other hand, in addition to the fine lineation and independent of this, there is blunt plication on the lateral area, as in \textit{P. plicatum} and allies, e.g. \textit{P. prepasterium} (Fontannes, 1876, p. 38, pl. vi, figs. 1, 2), \textit{P. plicatus}, Uhlig (1903, p. 4, pl. ii, fig. 5) or \textit{P. sub-plicatus}, Burckhardt (1912, p. 40, pl. viii, figs. 1-6), represented by a number of Mombasa examples in the British Museum. In these forms, however, which are also of later date, the direction of the striae is radial or even reclined, and they are not projected forward. The internal lobes are partly visible in the dorsal area of the Kachh fragment and are here figured (pl. V, fig. 3) for comparison with those of the true \textit{P. plicatum}, as represented by Neumayr. The second saddle is seen to be subdiphylllic, almost as in \textit{Holcophylloceras signodianum} (d'Orbigny in Salfeld, 1919, p. 2, text-fig. 1) or in \textit{Calliphyllloceras disputabile} (Zittel in Neumayr, 1871a, pl. xiv, fig. 7) and is quite different from that of Neumayr's figure of \textit{Phylloceras plicatum}. If the latter be correctly drawn it is probable that the present form is indeed merely a heterochronous homomorphism of \textit{P. plicatum} and should more appropriately be compared to the group of \textit{P. kudernatschi}. One of the examples of this species figured by Popovici-Hatzeg (1905, pl. ix, fig. 1) indeed shows incipient plication, but as Dr. Till pointed out, the whorl-section is peripherally less arched and laterally more flattened in \textit{P. kudernatschi}. With the help of additional material future workers will no doubt be able definitely to separate the present species, both from \textit{P. kudernatschi} and the later true \textit{P. plicatum}.

The suture-lines of the Hungarian examples, figured by Loczy, are scarcely distinct enough for comparison and in any case quite unlike those of the Indian example here discussed.

\textit{Phylloceras plicatum}, Fucini (1923, p. 97), a form of the Italian Middle Lias, may be renamed \textit{P. preplicatum}, nom. nov.

\textit{Horizon.}—Callovian (probably \textit{athleta} zone).

\textit{Locality.}—S. Maujajal, Nodule Beds (loose). The preservation is like that of the other \textit{athleta} zone fossils previously (1924, p. 24) recorded from this locality, rather than of those marked "Base of Oxfordian."

\textbf{Genus Ptychophylloceras nov.}

\textit{Genotype.}—\textit{Phylloceras feddeni}, Waagen, 1875, pl. vii, figs. 1a-c.

\textit{Diagnosis.}—Smooth, involute shells, with broadly rounded venter, crossed by periodic labial ridges, generally present even on casts. Umbilicus occasionally surrounded by strongly prorsiradiate, curved, short constrictions, not reaching to middle of very convex sides. Suture-line with \textit{L} generally lower than \textit{E}, bifid external and subtrifid first lateral saddles, tending to tetraphyllic terminations.
Observations.—To the six species mentioned by Neumayr (1871, p. 322) as constituting his 'Formenreihe' of *Phylloceras tricicum* (Pusch) and the five additional forms here recorded, may be added *Phylloceras* sp. described and figured by Prof. Dacqué (1910, p. 35, pl. v, fig. 2, text-fig. 16) from the Callovian of Tanganyika. Its relatively narrow venter, traversed by close, feeble, ridges, makes it probable that, as its author states, it represents a new species. *Phylloceras aff. euphyllum* Neumayr, Till (1910, p. 258, pl. xvi, figs. 6-7) from the Callovian of Villany in Hungary, *P. inordinatum* (Toucaé) and *P. geminum* (Benecke emend.), all referred to below, are other forms of the present genus.

**PTYCHOPHYLLOCERAS FEDDENI** (Waagen).

(Pl. VII, figs. 2, 3).


1909. ,, feddeni, Waagen ; Dacqué, in Dacqué and Krenkel, p. 177.

1910. ,, feddeni, Waagen ; Dacqué, p. 8.

1910. ,, feddeni, Waagen ; Lemoine, p. 6, pl. i, figs. 5a, b.

1911. ,, euphylloides var., Till, p. 256, pl. xvi, figs. 4-5 only.

1914. ,, feddeni, Waagen ; Spath, p. 563.

1915. ,, euphylloides Till, var. B ; Loczy, p. 34, fig. 12 ; pl. ii, fig. 2.

1923. ,, cf. vicarium Waagen ; Spath, p. 22 (Jumara, No. 10).

Waagen stated that this species differed from *P. euphyllum*, Neumayr (1870, pl. xxiii, figs. 1-2 ; 1871a, pl. xvi, figs. 7-9) in its simpler suture-line, and considered it to be more closely comparable to *P. flabellatum* (Neumayr, 1871a, pl. xvi, figs. 5-6). In the writer's opinion *P. feddeni* differs only slightly from *P. euphyllum*, and it could be doubted whether they are really distinct species. On the other hand Till has now described an inflated variety of his 'Phylloceras euphylloides' that probably is identical with the species here described. The example figured by Till in pl. xvi, figs. 1-3 (=*P. vicarium*, Waagen) differs from *P. feddeni* merely in its less tumid whorl-section, and *P. vicarium* var. compressa, nom. nov. (=Loczy's fig. 13, p. 35= var. B of "Phylloceras euphylloides") seems still further removed from the Indian species. The suture-lines of all these forms, however, are almost identical; in Waagen's drawing (1c) the outer terminal leaflet of the lateral saddle is represented not only too large but undivided. The figures in Loczy (figs. 14 and 15, pp. 35-6) are unfortunately too poor to be of any use, and certainly do not show how the suture-line of *P. euphyllum* indicates a considerably higher stage of development than that of *P. euphylloides*. On examination of Neumayr's original drawing (fig. 8) which differs very slightly from Till's fig. 2, and scarcely at all from Waagen's fig. 1c (with terminal leaflets corrected) it is clear that the separation of both *P. vicarium* and of the more inflated *P. feddeni* from *P. euphyllum* has to be based largely on the greater whorl-height, even the thickness being similar in the case of *P. vicarium*. The number of peripheral ridges is also the same and, according to Loczy, the presence of an umbilical 'rosette' in two of his examples also indicated close relationship of the two species which, moreover, are connected by transitional forms.
Since Waagen's peripheral view (fig. 1b) is wrongly restored, another illustration is here given. The erroneous figure probably accounts for Till's statement (p. 258) that \( P. \text{feddeni} \) differed clearly from all the Villany forms of the 'taticus-group.' From the two fragmentary examples listed below it is also clear that whorl-height and thickness amount to 56 and 48 per cent. of the diameter respectively. Through a slip Waagen gave the thickness as only 24 mm. or 22 per cent. of the diameter as I pointed out thirteen years ago. The internal portion of the suture-line of the Jumara example is here also figured (pl. VII, fig. 3). The external half agrees, so far as can be seen, with that figured by Till (figs. 2 and 5) for \( P. \text{euphylloides} \) and its variety (B of Loczy), here referred to the present species, although the subtetrephyllic termination of the external and lateral saddles is more pronounced and the inner terminal leaflet of the lateral saddle may be scarcely divided.

The Madagascar example of \( P. \text{feddeni} \) figured by Lemoine, with the typical whorl-thickness of 48 per cent. of the diameter, appears to have grooves on the inner lateral areas, indicating the presence of an umbilical ' rosette,' another feature that suggests close relationship with \( P. \text{euphylloides} \) as well as \( P. \text{euphylloides}. \) The three Indian examples available, unfortunately, are not well enough preserved to show these grooves.

To illustrate Waagen's treatment of his Kachh material in general, it may here be recalled that after coming to the erroneous conclusion that the present species was of Dhosa Oolite age, he considered that it was more nearly allied to \( P. \text{flabellatum} \) than to \( P. \text{psychoicum} \) "because its geological age was only a little younger than that of the first, but much older than that of the second one." Unfortunately ammonites are not nearly so well-behaved as this statement implies; and since \( P. \text{feddeni} \) and \( P. \text{euphylloides} \) are evidently both of Middle Callovian age, it might equally logically be argued that they must be identical.

**Horizon.**—Middle Callovian (anceps zone).

**Localities.**—Road from Juria to Dhosa; Jumara (bed No. 10) B. M., No. C 19970, Blake Coll., and Sumatra. (Coll. F. H. Smith.)

Lemoine stated his Madagascar example to occur in association with \( \text{Phylloceras lodaeense} \), but it has already been pointed out (Spath, 1925, p. 7) that Lemoine's determination of the Madagascar example of the latter species is incorrect.

**PTYCHOPHYLLOCERAS VICARIUM** (Waagen).

1875. *Phylloceras vicarium*, Waagen, p. 26, pl. v, figs. 4a-c.
1910. " *euphylloides*, Till, p. 256, pl. xvi, figs. 1-3 only.
1915. " *", Till, Loczy, pars., p. 34, pl. i, fig. 5.

The proportions of this form as given by Waagen, namely 60—56—43—08 agree with those of \( P. \text{euphylloides}' \) (Till), but in the sectional view (Waagen's fig. 4b) the umbilicus appears rather too open. In the var. *compressa* of the present species (Loczy's fig. 13, p. 35) the whorl-thickness is less, and in \( P. \text{flabellatum} \), which Waagen had considered to be the most nearly allied species,
in addition to the flattened periphery, there is less distinct sub-division of the terminal leaflets of the saddles, i.e., they are nearly diphylllic. *P. euphyllum*, as mentioned above, can be distinguished from the other forms here discussed merely by its smaller whorl-height, as unsatisfactory a character as the 'sub-triphyllic' termination of its lateral saddle. Waagen stated that *P. euphyllum* possessed much more complicated lobes than the present species. This is incorrect, for the first lateral saddle of the latter is subtetraphyllic, i.e., as subdivided as that of Till's type of *Phylloceras euphylloides* (fig. 2, pl. xvi) and Waagen's figure also gives a wrong impression of the perfectly symmetrical, subtetraphyllic external saddle. Since the holotype, moreover, is slightly corroded, the suture-lines may have been even slightly more complex than they are now, i.e., here again the distinction from Neumayr's *P. euphyllum* rests merely on the undivided inner terminal leaflet of the lateral saddle. As was pointed out in the case of *P. feddeni*, if we believe *P. vicarium* (i.e., *Phylloceras euphylloides*) to be a descendant of the so-called 'Bathonian' *P. flabellatum* and the ancestor of *P. euphyllum* (which was erroneously stated to range from the upper Callovian to the beds with *Cardioceras cordatum*), the eye of faith may see differences in the complication of the suture-line that are hidden to ordinary observers. The present species is based merely on an imperfectly preserved fragment and there is lack of comparable material of Neumayr's species, but it seems advisable, at least provisionally, to retain Waagen's *P. vicarium* as an independent species, and to unite with it Till's *Phylloceras euphylloides*, which is characterised by similar dimensions and a similar subtetraphyllic division of the terminal leaflets of its lateral saddle.

**Horizon.**—Lower Callovian (*macrocephalus* zone).

**Locality.**—N. W. of Jumara.

*Ptychophylloceras jaraense* (Waagen).

1875. *Phylloceras jaraense*, Waagen, p. 28, pl. v, fig. 6.

1914. """"""; Spath, p. 563.

*non* 1910. """"""; Lemoine, p. 5, pl. i, fig. 3.

This species was well characterised by Waagen when he expressed his belief that it represented *P. flabellatum* in India, in a higher layer. The differences from the presumed earlier species are confined to the whorl-section and suture-line. The former is more compressed in the Indian form; the latter is characterised by a tetraphyllic external saddle and a subtetraphyllic first lateral saddle, as distinct as that figured by Till for his *Phylloceras euphylloides* (see *supra*, pp. 42-4). *P. flabellatum* has now been recorded in doubtful examples from the Callovian of Villany in Hungary (Loczy, 1915, p. 33) and in presumably typical specimens from the *athleta* beds of Daghestan (Neumayr and Uhlig, 1892, p. 34). The suture-line of an undoubtedly early form, figured by Popovici-Hatzeg (1905, p. 12, text-fig. 1), already indicates, however, the beginning subdivision of the terminal leaflets of the saddles, more advanced in the present form. *P. flabellatum*, on the other hand, has no umbilical rosette on the test, but only on the cast.
P. euphyllum and P. vicarium differ from the present species in whorl section. On the other hand the Madagascar example figured by Lemoine has fewer and wider umbilical sulci and agrees in this respect with some pre-Callovian examples of P. 'hommairi,' auct. from Chaudon, Basses-Alpes, in the British Museum (Nos 73522 a, b., Astier Coll.). D'Orbigny himself (1848, p. 476) recorded this species from the same locality, but with Neumayr (1871a, p. 324) the writer would hold that d'Orbigny's species must be restricted to the Crimean form for which it was first intended. It seems advisable therefore to separate the Chaudon form with only seven constrictions and the similar Madagascar example both from P. hommairi and the species here described, but until the Crimean form is definitely known, the doubtful new species cannot be named. P. semisulcatum (d'Orbigny) differs from it chiefly in whorl section and greater projection of the grooves of the umbilical 'rosette,' but whether these are present on the test as well, as in P. jaraense, is at present unknown.

The dimensions of Waagen's holotype (46—59—48—09) are slightly different from the measurements he recorded, but both side and peripheral views are tolerably well represented in Waagen's figures.

Fischer (1915, p. 228) compared his "Phylloceras hafisi" to the present species, but it is doubtful, from his figures, whether the Persian ammonite is even a Ptychophylloceras.

Horizon.—Dhosa Oolite (Argovian).

Locality.—N. W. of Jara.

Ptychophylloceras insulare (Waagen).

(Pl. V, fig. 2).

1875. Phylloceras insulare, Waagen, p. 29, pl. ix, figs. 3a-c.

1913. " " " ; Spath, p. 563.

non 1924. " " " ; Spath, p. 4.

Waagen's fragmentary holotype of this species is considerably and possibly correctly restored, though more than his figures would lead one to believe. By its comparatively simple suture-line, this species can be at once distinguished from P. ptychoicum and its allies. The whorl-thickness is slightly greater than that indicated by Waagen (48 per cent. of the diameter) and the umbilicus is only 10 per cent. at most, not 15 per cent. The three examples in the Blake Collection, that I referred to the present species before seeing Waagen's type, cannot now be included here, and Waagen's statement that the lobes of P. insulare are very much like those of P. ptychoicum will, of course, be seen to be misleading on comparison of fig. 2, pl. V, with the suture-line represented in Zittel's (1870) pl. i, fig. 11, copied in Neumayr (1871a, pl. xvi, fig. 10). P. vicarium, of presumably earlier age, has a similar suture-line but a smaller whorl-thickness. P. feddeni, on the other hand, which agrees in thickness, has a slightly simpler suture-line. On the whole, however, the present species is closer to the Callovian euphyllum group than to the
later *ptychoicum* group, and it is felt that if Waagen's view as to its late age should prove incorrect, as it has done in other cases, *P. insulare* would not have been compared to *P. ptychoicum*. It may also be mentioned that Waagen apparently only had one fragmentary young example and that his statements as to the aspect of large examples may have been surmises based on the fancied resemblance to *P. ptychoicum*. In the circumstances, and since no additional material is available, it seems best to regard *P. insulare* as a species of doubtful affinities or value.

Horizon.—Kimmeridgian (?) (Upper Oxfordian ? in Waagen, p. 29; Kantcote Sandstone (Katrol Group) on p. 216).

Locality.—Gangta Bet.

**Ptychophylloceras ptychoicum** (Quenstedt).

1875. *Phylloceras ptychoicum* (Quenstedt); Waagen, p. 30, pl. vii, fig. 2.
1876. .. .. .. ; Gemmellaro, vii, p. 184.
1886. .. .. .. ; Nicolis and Parona, p. 65.
1890. .. .. .. ; Toucas, p. 575, pl. xiii, fig. 3 only.
1907. .. .. .. *semi-sulcatum* (d'Orbigny), Pervinquière, pars, p. 12.
1907. .. .. .. *ptychoicum* (Quenstedt); Toula, p. 14.
1909. .. .. .. *sub-ptychoicum*, Dacqué, in Dacqué and Krenkel, p. 181.
1910. (?) .. .. .. *sub-ptychoicum*, Dacqué, p. 7, pl. ii, fig. 1.
1913. .. .. .. *sub-ptychoicum*, Dacqué; Spath, p. 562, pl. liii, fig. 1.
1922. .. .. .. *ptychoicum* (Quenstedt); M. Gemmellaro, pp. 76, 78.
1924. .. .. .. *insulare* (non Waagen) Spath, p. 4.

The Kachh forms of *Ptychophylloceras* of the *ptychoicum* group, of which there are over twenty before me, can be apparently grouped into two divisions, namely compressed forms, agreeing with the Tunisian example recorded by the writer in 1913 (p. 5112, pl. liii, fig. 1), and inflated forms, comprising the *Phylloceras insulare* listed in 1924. One of the latter is here figured (pl. V, fig. 4) as *P. tithonomicum* ep. nov.; the former are represented by Waagen's *Phylloceras ptychoicum* for which Dacqué in 1909 proposed a new name, *Ph. sub-ptychoicum*. It may be held that the East African example subsequently figured by Dacqué under the same name with more rounded whorl-sides and greater thickness (48 per cent.) does not agree with the Indian form; but a Mombasa toptype of Dacqué's form, in the British Museum (No. C 8137) is scarcely distinguishable from Waagen's original—allowing for differences in the mode of preservation—except, perhaps, in the slightly less symmetrically tetraphyllic external saddle. The whorl-thickness in the Mombasa specimen before me is 46 per cent., in Waagen's form probably about 43 per cent. and in the (badly worn) Tunisian example figured by the writer only 42 per cent. The lateral flattening, however, which according to Dacqué characterises Quenstedt's species, is also found in these compressed forms, if not in Dacqué's original, and it may be doubted whether even the latter individual is separable on this account from the typical *P. ptychoicum*. The width of the umbilicus in this species, given as .05 by Zittel and Neumayr, seems to be rather variable, especially in the case of
the usually poorly preserved material of the Alpine "acanthicus zone." The presence of a complex inner branch of the first lateral saddle (wrongly drawn by Waagen as regards detail) also is not confined to P. 'subptychoicum,' but was indicated already in Zittel's typical suture-line of P. ptychoicum in 1870 (I. i, fig. 11) though not in Quenstedt's type (1847, pl. xvii, fig. 12), the drawing of which, however, is poor. Moreover, in separating the two species, Dacqué was influenced by the supposed Upper Oxfordian age of P. subptychoicum, as compared with the Kimmeridgian-Tithonian P. ptychoicum. This view was echoed by the writer in 1913 (p. 563); for P. subptychoicum, as restricted to the Mombasa types, somewhat resembles the older forms of Ptychophylloceras. There is now reason to believe, however, that the East African form might be of Kimmeridgian age (see Spath, 1925, pp. 159, 161), like the forms of the Indian Katrol Group or the Tunisian example. Since probably not only Quenstedt's original of P. ptychoicum but Catullo's Amm. latidorsatus (= A. zignii) and at least some of Zittel's 'Tithonian' forms are of Kimmeridgian ("acanthicus zone") age, apparently all the objections to an identification of Waagen's form with Quenstedt's species are disposed of.

Quenstedt's original figure of this species, like Catullo's Amm. zignii does not represent the true whorl-shape, though they are both compressed; but some Tithonian types of P. ptychoicum, e.g., Zittel's largest example (1868, pl. iv, figs. 6a, b), stated to be the original of Oppel's resuscitated Amm. zignii, Catullo, show similar lateral compression. Oppel's (1865, p. 550) reference is to Catullo's (1846) pl. vii, fig. 2, and he definitely excludes pl. xii, fig. 3 (1847). Since this was published before the appearance of Quenstedt's figure in 1847, it may be held that Catullo's name will have to be used for the Kimmeridgian compressed type, with radial folds, especially since Zittel, and after him other authors, in various text-books, figured the probably Tithonian form with sinuous ridges (P. geminum, Benecke sp.) as a typical P. ptychoicum. Italian authors, however, have also long since adopted Quenstedt's name for the Kimmeridgian form described by Catullo and it seems unnecessary now to change the name of this well-known species. It should be added that Oppel's distinction of Amm. ptychoicus from Catullo's Amm. zignii, was said to be based merely on the larger size of the latter.

Waagen's figures are somewhat diagrammatic but tolerably accurate, although the left half of the front view (2b) is restored. The whorl-section, however, with its gently rounded umbilical slope, is probably more correctly represented in Waagen's than in Zittel's figure, the lateral flattening also being exaggerated in the latter. Dacqué, who must have had at his disposal the abundant material in the Munich Museum, considered that Waagen's rounded form did not fit in with the laterally compressed P. ptychoicum; yet the flattened aspect of the evenly rounded side is not unsuccessfully represented in Waagen's lateral view (2a). In examining Zittel's apparently excellent illustrations of pl. iv we must also bear in mind what Loesch (1914, p. 118) revealed with regard to the restoration of some of the Stramberg Nautili.
The Indian form is still entirely septate at a diameter of 90 mm. and thus was larger than the Stramberg type, provided with the mouth-border. There is no trace of an umbilical ‘rosette’ on the cast, but according to Zittel (1868, p. 60) the typical Trentino examples also often do not show these sulci. 

_P. jaraensc_ and _P. insulare_ have the terminal leaflets of the saddles subdivided, like the earlier _P. vicarium_ (= _P. ‘euphylloides’_), but the suture-lines are still considerably simpler than in the present species. _P. geminum_ (Benecke) as here restricted (lectotype Zittel, 1868, pl. iv, figs. 5a, b) is distinguished from _P. ptychoicum_ by having more curved constrictions, with sinuous, not radial, peripheral ridges. _P. tithonicum_ described below has a more neatly tetraphyllic first lateral saddle already at a small diameter and a more circular whorl-section; on the other hand _P. angelini_ (Oppel) Retowski sp. (1893, pl. ix, fig. 3), the uppermost Tithonian companion species of _P. inordinatum_ (Toucas), differs from the present form chiefly in its compressed whorl-section, a character by which it can also be distinguished from the equally flexisulcate _P. geminum_.

**Horizon.**—Middle Kimmeridgian, Katrol beds (beckeri zone).

**Localities.**—Waagen’s type came from ‘East of Ler [Lair]’, and one of the examples collected by Mr. J. H. Smith is also marked ‘E. Ler.’ Fifteen of his specimens are from the Katrol Beds of Fakirwadi, one is unlocalised. Of the former, one example, in the same piece of matrix, bears impressions of two forms of _Torquatisphinctes_ and a doubtful young _Waagenia_.

**PTYCHOPHYLLOCERAS TITHONICUM sp. nov.**

(Pl. V, fig. 4.)

1924. _Phylloceras insulare_, Waagen; Spath, pars, p. 4.

This species is based on two examples of a form, unknown to Waagen, from the Umia beds, which is so obviously different from what is here taken to be the true _P. ptychoicum_ (from the Katrol beds) that specific separation is necessary. The examples may possibly be identical with the rounded-whorled Stramberg specimen figured by Zittel (1868, pl. iv, fig. 4 only) and, owing partly to the confusion of Kimmeridgian and Tithonian beds, included by that author in the far too comprehensive _P. ptychoicum_.

A brief diagnosis of the present species is as follows:—

Coiling pachygyral, angustumbilicate; whorl-section almost circular, slightly higher than wide; umbilicus deep, funnel-like; sides highly convex, smooth; rounded venter with peripheral radial ridges (in holotype); short, comma-shaped constrictions (‘umbilical rosette’) in young (paratype). Suture-line highly complex, as in _P. ptychoicum_, with saddle-endings tetraphyllic already at a small diameter.

The measurements of the two examples are:—

(a) holotype (pl. V, fig. 4) . . . . 84 ·56 ·53 ·08
(b) paratype . . . . . . . . . 40 ·58 ·54 ·06

1 Since writing the above, the British Museum has received a number of Stramberg examples of this species which are indistinguishable from the Kachh types.
With regard to these dimensions it should be pointed out that owing to
the obliquity of the terminal surface of the front-view, represented in pl. V,
fig. 4b, the whorl-thickness at the end appears too great for the corresponding
height; but the circular outline, if exaggerated, well illustrates the principal
difference of the present species from the true P. ptychoicum, with consider­
ably more flattened and compressed whorl-section. It should also be mentioned
that in small examples of P. ptychoicum from the Katrol Beds of Fakirwadi,
with the suture-lines well preserved, the terminations of the saddles are dis­
distinctly less neatly tetraphyllic than in the paratype of the present species at
the same diameter (about 20 mm.).

The former view regarding the identity of the Cretaceous P. semisulcatum
(d'Orbigny) with the Tithonian forms, recently restated by Pervinquière (1907,
p. 12) and Gignoux (1921, p. 94) was proved to be incorrect by Toucas (1890,
p. 575). There is some doubt, however, as yet with regard to the exact age
of P. geminum (Benecke) especially since its author considered it not impro­
bable that it was confined to the lower layers of the Diphyia Limestone. Through
the courtesy of Professor Dacqué of Munich, the British Museum has
been able to acquire in exchange a representative series of Stramberg and
Alpine forms of Ptychophyloceras that confirm the conclusions arrived at from a
study of the literature.

Horizon.—Tithonian, Umia Group, transitorius zone?
Locality.—North Moondan (bed No. 5).

Genus Calliphyloceras, nov.

Genotype.—Phylloceras disputabile, Zittel; Waagen, 1875, p. 31, pl. vi, fig. 3
only.

Diagnosis.—Smooth, involute, compressed shells, with rounded venter and
periodic, sigmoidal, constrictions on cast, with or without corresponding ridges
on (lineate) test, especially on periphery. Suture-line with L generally lower
than E, bifid external saddle, high trifid lateral saddle, tending to subquad­
rifid terminations in later forms.

Observations.—Calliphyloceras, with such dominant groups as those of the
Domerian C. capitanei (Catullo) and the Toarcian C. nilssoni (Hébert), is
known already from the lowest beds of the Lias. Jullien (1911, p. 131) se­
parated Phylloceras (' Triphyllites ') disputabile from P. capitanei and P. nil­
ssoni, but his views are not accepted by the writer. Calliphyloceras hetero­
phyloides (Oppel) which is generally considered to be the fore-runner of C.
disputabile, converges somewhat towards Phylloceras s.s., as do C. supraliasicum
(Pompeckj) and C. empedocles (Gemmellaro), but on the whole the resemblance
of the Bajocian and Upper Jurassic forms that were at one time included in the
species "Amm. calypso" is remarkably close, as Loczy (1915, p. 41) has
again pointed out.
"Xeinophyloceras zeinus" S. Buckman (1921, pl. cclxvi) was originally determined as Phyloceras vulpum, de Gregorio, a species that is quite unrecognisable from the figures, but that was stated to show "a trace of carination." The affinities of Buckman's genus are thus very doubtful.

CALLIPHYLLOCERAS aff. disputabile (Zittel).

1875. Phyloceras disputabile, Zittel; Waagen (pars), p. 31, pl. vi, fig. 3 only.
1905. " " " " Simionescu, p. 18, pl. i, figs. 2 (3, 4 ?).
1912 ? " ex aff. disputabile, Zittel; Tsytovitch, p. 196.
1914. " disputabile, Zittel; Smith, p. 179.
1916. " " " Douville, p. 12, pl. iii, figs. 2-3.
1924. " " " Spath, pp. 4, 22.

Dr. Till, in 1910 (p. 259) considered C. disputabile to be an ill-defined species, and he stated that probably many identifications of this form were due to confusion of similar species. The writer also pointed out in 1920 (p. 318) that the many references in geological literature to C. disputabile probably included a variety of forms of the capitanei group; and from a later discussion of the present species, the following passage may be quoted (1925, p. 6):—"The species represented by Waagen's figs. 1-2 differs from the typical Ph. disputabile in showing greater compression and more numerous constrictions, which in the not very successfully drawn original of fig. 1 are [slightly] wider than in the example of fig. 2. The constrictions are also more conspicuous across the venter in this flattened form than in the original of Waagen's fig. 3, and the striation is finer. There are transitional forms, however, including the two Phyloceras disputabile recorded by myself (1924, p. 22) from bed No. 14 (of the Lower Chari Group) at Khera, Kachch, and it seems inadvisable at the present stage to separate the two forms."

There are now altogether ten distinct and three doubtful Kachch examples available and it seems possible to separate them into two groups, although on account of defective preservation the Indian forms can for the present merely be provisionally referred to the two species C. disputabile and C. demidoffi (Rousseau). The former, as represented by Kudernatsch's type (1852, pl. i, figs. 1, 2) has a whorl-thickness of 36—41 per cent. of the diameter and, though typically pre-Callovian, may be assumed to have ranged up into the macrocephalus beds. The ridges of the test corresponding to the posterior margin of its five or six constrictions are variable, and though distinct in the forms figured e.g., by Kudernatsch, Waagen (pl. vi, fig. 3 only), and Pompeckj (1893, pl. iii, fig. 3), they may be almost absent in other specimens, e.g.,
“*Xcinophylloceras zeinus*” S. Buckman (1921, pl. cclxvi) was originally determined as *Phylloceras vulpum*, de Gregorio, a species that is quite unrecognisable from the figures, but that was stated to show “a trace of carination.” The affinities of Buckman’s genus are thus very doubtful.

**Calliphylloceras aff. disputabile** (Zittel).

1875. *Phylloceras disputabile*, Zittel ; Waagen (pars), p. 31, pl. vi, fig. 3 only.
1905. ', ', ' Simionescu, p. 18, pl. i, figs. 2 (3, 4 ?).
1912 ?, ', ' ex aff. disputabile, Zittel ; Tsytovitch, p. 196.
1914. ', ' disputabile, Zittel ; Smith, p. 179.
1916. ', ', ', Douvillé, p. 12, pl. iii, figs. 2-3.
1924. ', ', ', Spath, pp. 4, 22.

Dr. Till, in 1910 (p. 259) considered *C. disputabile* to be an ill-defined species, and he stated that probably many identifications of this form were due to confusion of similar species. The writer also pointed out in 1920 (p. 318) that the many references in geological literature to *C. disputabile* probably included a variety of forms of the capitanei group; and from a later discussion of the present species, the following passage may be quoted (1925, p. 6):—“The species represented by Waagen’s figs. 1-2 differs from the typical *Ph. disputabile* in showing greater compression and more numerous constrictions, which in the not very successfully drawn original of fig. 1 are [slightly] wider than in the example of fig. 2. The constrictions are also more conspicuous across the venter in this flattened form than in the original of Waagen’s fig. 3, and the striation is finer. There are transitional forms, however, including the two *Phylloceras disputabile* recorded by myself (1924, p. 22) from bed No. 14 (of the Lower Chari Group) at Khera, Kachh, and it seems inadvisable at the present stage to separate the two forms.”

There are now altogether ten distinct and three doubtful Kachh examples available and it seems possible to separate them into two groups, although on account of defective preservation the Indian forms can for the present merely be provisionally referred to the two species *C. disputabile* and *C. demidoffi* (Rousseau). The former, as represented by Kudernatsch’s type (1852, pl. i, figs. 1, 2) has a whorl-thickness of 36—41 per cent. of the diameter and, though typically pre-Callovian, may be assumed to have ranged up into the *macrocephalus* beds. The ridges of the test corresponding to the posterior margin of its five or six constrictions are variable, and though distinct in the forms figured *e.g.*, by Kudernatsch, Waagen (pl. vi, fig. 3 only), and Pompeckj (1893, pl. iii, fig. 3), they may be almost absent in other specimens, *e.g.*,.
Popovici-Hatzeg’s excellently illustrated Rumanian material. The variable whorl-thickness is shown in the following table of measurements:

<table>
<thead>
<tr>
<th></th>
<th>Waagen (1875, pl. vi, fig. 3)</th>
<th>Neumayr’s (1871a, p. 332) example a</th>
<th>Neumayr’s (1871a, p. 332) example b</th>
<th>Neumayr’s (1871a, p. 332) example c</th>
<th>Gemmellaro (1872, p. 13), No. I</th>
<th>Gemmellaro (1872, p. 13), No. II</th>
<th>Gemmellaro (1872, p. 13), No. III</th>
<th>Popovici-Hatzeg (1905, p. 13), No. I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>67</td>
<td>59</td>
<td>120</td>
<td>255</td>
<td>66</td>
<td>61</td>
<td>106</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>.55</td>
<td>.51</td>
<td>.54</td>
<td>.61</td>
<td>.56</td>
<td>.54</td>
<td>.58</td>
<td>.55</td>
</tr>
<tr>
<td></td>
<td>.39</td>
<td>.31</td>
<td>.35</td>
<td>.40</td>
<td>.56</td>
<td>.34</td>
<td>.34</td>
<td>.40</td>
</tr>
<tr>
<td>Horizon:-</td>
<td>Lower Callovian (macrocephalus beds).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Neumayr’s figures might well be taken to show that in the earlier forms, with almost unconstricted young and five sulci on the outer whorls, the whorl-thickness increases with age; whereas in the later and more compressed forms here referred to C. demidoffi, the inner whorls are relatively thicker than the outer. Popovici-Hatzeg’s figures on the other hand show the thickness of the earlier whorls to be as great and as variable as that of C. aff. demidoffi, but they are characterised by a very large umbilicus in the young. Future material may enable us to separate the species more satisfactorily and, in any case, they agree in suture-lines. If the writer, however, does not follow Waagen in including all the Indian examples in the one species, C. disputabile, it is because in spite of the occurrence of transitional forms, the true C. disputabile (before me in typical examples from the Klaus Alpe) and the Kachh forms figured by Waagen and referred below to C. demidoffi, are almost certainly specifically different.

The Madagascar examples recorded by the writer, like Grussouvre’s (1915, pl. iii, figs. 2, 3) and Gemmellaro’s (1872, pl. vi, figs. 2, 3) apparently more compressed specimens, probably belong to the present form, perhaps also Lemoine’s Phylloceras lodaense, which has less sigmoidal constrictions than the Kachh types of the latter “species”. On the other hand the writer’s (1920, p. 318, pl. v, fig. 4) and Daqué’s (1910, pl. v, figs. 3a-c) East African forms, like the doubtful Villany examples recorded by Till (1910, p. 259), may be immature specimens of other species, notably C. demidoffi.

Loczy’s (1915, p. 37) inclusion of the present species with C. demidoffi (Rousseau) described below and the Argovian C. manfredi (Oppel) cannot be admitted, but the differences are not obvious enough with badly-preserved material for accurate specific determination, and all the three species are similarly variable.

Horizon.—Lower Callovian (macrocephalus beds).
Localities.—Waagen’s example came from Khera Hill. The two examples in the Blake Collection, from the same locality (bed No. 14) were associated with typical "macrocephalus" forms.

**Calliphyloceras aff. demidoffi** (Rousseau).

(Pl. VII, fig. 8).

1875. *Phylloceras disputabile*, Zittel; Waagen, pars, p. 31, pl. vi, figs. 1-2 only.
1910. " cf. puschi (Oppel); Till, p. 259, pl. xvi, fig. 8.
1913. " sp. (disputabile?) Smith, p. 211.
1915. " lajouzense, de Loriol; Petitclerc, p. 89.
1915. " demidoffi (Rousseau), Loczy, p. 37, pl. i, fig. 2, pl. ii, figs. 3-5.
1924? " sp. (204); Spath, p. 23 (No. 22, Jikadi).

It has already been mentioned that the compressed form with seven or eight sigmoidal constrictions that Waagen included in *C. disputabile* seems to be separable specifically. Whether, however, its reference to *C. demidoffi* is correct cannot be decided without examination of the Crimean types. Neumayr (1871a, p. 334) stated that d’Orbigny’s *Amm. tatricus* (renamed by Oppel *Amm. puschi*) belonged to Rousseau’s species, and he also included (after d’Orbigny) in *Phylloceras demidoffi* Rousseau’s *Amm. ponticuli* and *Amm. hustiana*, although judging by the original figures (1841, pp. 781-3, pl. i [Mollusca], figs. 3, 4, 6) the last is a *Sowerbyceras* and *Amm. ponticuli* a *Phylloceras s.s.* To avoid further confusion, it seems advisable to accept this view, i.e., to take d’Orbigny’s example (1848, pl. clxxx) as type of *C. demidoffi* and to drop the name "*Phylloceras puschi* (Oppel)" altogether, Neumayr’s specimen having been renamed by P. de Loriol (1900, p. 11) "*P. lajouzense*", though here considered to be identical with *Amm. manfredi* Oppel. D’Orbigny’s figures unfortunately are not reliable, and it is probable that the absence of peripheral ridges on the test, insisted on by some authors, is not to be taken as proved. On the other hand, d’Orbigny included in this species, described as having from 4—7 constrictions, examples from various localities in the South of France, and in the Astier Collection in the British Museum there are specimens, labelled "*Amm. tatricus*", that can scarcely be distinguished from the forms under discussion except, perhaps, by their less sigmoidal constrictions.

The measurements of some of these are given in the following table for comparison with those of the species previously described:

<table>
<thead>
<tr>
<th>Description</th>
<th>Length</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waagen’s pl. vi, fig. 1</td>
<td>106</td>
<td>-58</td>
</tr>
<tr>
<td>&quot;</td>
<td>2</td>
<td>(at) 114</td>
</tr>
<tr>
<td>&quot; Pl. vii, fig. 8</td>
<td>(at) 23</td>
<td>-57</td>
</tr>
<tr>
<td>&quot;</td>
<td>(at) 32</td>
<td>-57</td>
</tr>
<tr>
<td>&quot;</td>
<td>(at) 46</td>
<td>-57</td>
</tr>
<tr>
<td>d’Orbigny, pl. clxxx</td>
<td>98</td>
<td>-57</td>
</tr>
<tr>
<td>&quot; (text)</td>
<td>390</td>
<td>-59</td>
</tr>
<tr>
<td>Loczy (1915, p. 38), No. 1</td>
<td>109</td>
<td>-58</td>
</tr>
<tr>
<td>&quot; No. 10</td>
<td>32</td>
<td>-56</td>
</tr>
<tr>
<td>? B. M., No. 73511 (Astier Coll.)</td>
<td>50</td>
<td>-58</td>
</tr>
<tr>
<td>? No. 37489 (Tesson Coll.)</td>
<td>50</td>
<td>-57</td>
</tr>
</tbody>
</table>
The two French specimens here listed, apparently identical with Loczy's fig. 1, pl. iii, are not so well preserved as those from Kachh and it is impossible to separate them satisfactorily from the preceding species or e.g., Gemmellaro's Phylloceras disputabile - (1872, pl. vi, figs. 2-3) which was considered by Till (1910, p. 259) to be probably referable rather to "P. puschi" (Oppel). There is undoubtedly great similarity of the two species, and since the suture-lines are also nearly alike it is comprehensible that Loczy recently proposed to unite in one species with the present form not only "Phylloceras puschi", but also the true C. disputabile and the Argovian C. manfredi (Oppel), which last includes de Loriol's Phylloceras lajouxense and perhaps Waagen's P. lodaense.

The inner whorls of a larger example here figured (pl. VII, fig. 8) show only five constrictions; on the fragmentary outer whorl, however, corresponding to Waagen's fig. 1, these sulci are considerably closer and, perhaps, more sigmoidal. The large fragment from the athleta beds of Jikadi, recorded by the writer in 1924, is still septate at a diameter of probably about 170 mm. In Waagen's large figure, the last three constrictions may have been drawn too conspicuous, the cast is corroded and the sulci are quite indistinct. The smaller figure (2a) representing the inner whorls of a specimen slightly larger than Waagen's fig. 1, shows the curve of the constrictions more correctly, but the seventh at the end of the shell was omitted by the artist. In this example also the outer whorl, still septate at 114 mm. diameter, is corroded and without noticeable constrictions.

**Horizon.**—(Macrocephalus, anceps and athleta zones).

**Localities.**—Waagen's two examples came from Khera Hill and Mr. J. H. Smith's similar forms from his bed No. 6. These were recorded by him in 1913 and one of them is here figured (pl. VII, fig. 8) but a fragment from bed 1 is neither the "hair-ribbed" nor the "weather-worn" specimen recorded by the same author from this horizon. The fragment from bed No. 22 of Jikadi is scarcely recognisable and a still more indefinite example was collected by Mr. J. H. Smith at Samatra.

**Calliphyloceras lodaense** (Waagen).

1875. Phylloceras lodaense, Waagen; p. 32, pl. v, figs. 5a, b; pl. vi, figs. 4a, b.
1924. " lodaense, Waagen; Spath, pp. 4, 21, 23, 25.

This species was considered to be well represented in the Blake Collection and there are now additional specimens available. It is, however, only on account of the distinctness of the constrictions in what may be chosen as the type of the species, namely the original of Waagen's pl. vi, fig. 4, that the writer now retains that author's name, instead of including all the examples in C. manfredi (Oppel), which is taken to cover also the forms described by P. de Loriol (1900, p. 11) and Neumann (1907, p. 11) as Phylloceras lajouxense. Loczy (1915, p. 294) justly remarks that "P. lajouxense" and "P. puschi" of the "cordatus zone" cannot be distinguished from C. manfredi of the trans-
versarius zone: and Waagen himself pointed out that his species might be identical with *C. manfredi*. There are examples either weathered or with the test preserved that cannot be distinguished from Neumayr's figure of Oppel's species (1871a, pl. xiv, fig. 8). A large example from the Habye Hills, already recorded by Mr. J. H. Smith, agrees well with de Loriol's "*Phylloceras lajouxense*", septate to a similar diameter, but the constrictions of the inner whorls, of course, are not visible, and even with smaller examples it is not always possible to expose the "umbilical rosette."

On the other hand there may be further differences that are not obvious merely because the examples, with the exception of the holotype-cast, are not well preserved. For example Choffat (1893, p. 11), when describing a *Calliphyllloceras* of the group to which *C. lodaense* belongs, thought that *C. manfredi* and "*Phylloceras puschi*" (Oppel) in Neumayr (= "*P. lajouxense*" de Loriol) were distinguished from *C. disputabile* and *C. demidoffi*, above described, by their rectiradiate constrictions. The writer doubts whether this distinction really holds when considerable numbers of specimens of each "species" are available for examination and, in any case, the constrictions are more sigmoidal in the later forms. Choffat, moreover, stated that "*Phylloceras puschi*" differed from *C. manfredi* in having a tetraphyllic external and first lateral saddles, another distinction that may or may not be found to hold with abundant and well preserved material. Since the constrictions are not only unusually deep at the umbilical end, but have also more pronounced biconvexity in *C. lodaense* than in the two species previously described, there seems to be sufficient reason for keeping Waagen's species, at least provisionally, separate from *C. manfredi*.

Waagen considered the equally triphyllic termination of the first lateral saddle in *C. lodaense* to be another distinguishing feature. In the drawings he gave of the corresponding saddle endings in *C. disputabile* and the present species, this difference seems striking enough, but, unfortunately, it exists only in the illustrations.

*C. malayense* (Boehm, 1907, p. 78, restricted to pl. xii, fig. 7, with biconcave constrictions), as its author points out, is close to *C. lodaense*, but differs in having constrictions of uniform depth. The East African forms referred by Dacqué (1910, p. 6, pl. i, figs. 1-3) to this species, include not only *Holcophylloceras* (fig. 1) and *Phylloceras* s.s. (fig. 3), numerously represented in the Mombasa collections before me, but according to an example in the British Museum (No. C 8182) the only form of the capitanei group (= *Calliphyllloceras*), i.e., the original of Dacqué's fig. 2, does not belong to *C. malayanum* in the restricted sense. Its identification was confirmed by Professor Boehm, but in its original connotation 'Phylloceras malayanum' was too comprehensive and the East African example is closer to *C. "benacense"* (Herbich, 1878, p. 143, pl. iii, fig. 1) and, less so, to *C. gorgoneum* (Fontannes, 1876, p. 36, pl. v, fig. 1), both forms of the benacense group, with more subdivided saddle-endings than either *C. malayanum* or the present species.
It has already been mentioned that the Madagascar specimen figured by Lemoine (1910, pl. i, fig. 2) as 'Phylloceras lodaense' is probably closer to C. disputabile (Zittel), referred to above.

Horizon.—Argovian (perarmatum zone).

Localities.—Waagen's four examples came from Lodai, north of Dhosa, and west of Jumara. The "Phylloceras sp. ind.", previously recorded from bed No. 1 of Jumara (1924, p. 22) belongs to the present species, which was further listed from bed No. 1 of Khera, the upper zone of E. Badi, zone I of Wanda, and the upper zone of W. Jooria, probably wrongly also from bed No. 20 of Jikadi. This last example is poorly preserved, but more correctly referable to the species described below. Additional examples, from the collection of Mr. J. H. Smith, are from the Habye Hills and Fakirwadi, and one specimen is marked "D. O. W. K." (Dhosa Oolite, West Katrol?). In the Blake Collection there is also an example labelled "No. 1, Charwar Hills."

Calliphyloceras benacense (Catullo).

(Pl. VII, figs. 4a, b.)

1875. Phylloceras benacense (Catullo); Waagen, p. 53, pl. v, figs. 3a—c.
1878. """""""; Herbich, p. 142.
1886. """""""; Nicolis and Parona, p. 49.
1907. aff. benacense (Catullo); Toula, p. 15, pl. i, fig. 8.

The example figured by Waagen apparently agrees with thirteen specimens from the Katrol beds, collected by Mr. J. H. Smith, none of which, however, is sufficiently well preserved to allow of definite confirmation of Waagen's identification. In a specimen of 66mm. diameter, here figured (pl. VII, fig. 4a), the dimensions are as follows:—57—33—08, in Neumayr's much larger example (diameter=152 mm.) which has to be taken as type, they are:—58—33—10. The former agrees with a second, larger, specimen also figured (pl. VII, fig. 4b), which shows six of the typical biconcave constrictions, corresponding to peripheral ridges on the test. The first specimen, with probably only five constrictions (of which the later ones are scarcely visible) is important because it demonstrates not only that the constrictions really correspond to bulges on the test, as in C. canavarii (Meneghini) or C. empedocles (Gemmellaro), but also that there is a distinct change in the course of the constrictions, from the somewhat reclined type of the young, correctly figured by Waagen, to the prorsiradiate type of Neumayr's adult example. A somewhat similar change is observed in C. kochi (Oppel), if Zittel's illustrations (1868, pls. vi, vii, figs. 1, 2) are to be trusted, and in view of the smaller umbilicus and the number of constrictions, examples like that here figured might well be compared to this (Tithonian) species. The dimensions of the smaller examples (e.g., No. K. [22/103a]:—38—53—37—12), agreeing with Waagen's fragment, as well as of the figured specimens, are like those of the immature C. kochi; moreover the umbilical wall is rounded in all the Indian examples, not steep and sharply defined as in the adult C. benacense. On the other hand, in C.
REVISION OF THE JURASSIC CEPHALOPOD.

kochi, the constrictions are more projected peripherally, a feature noticeable also in the examples figured by Gemmellaro (1870, p. 27, pl. iv, fig. 1) and Favre (1880, p. 24, pl. ii, figs. 3a, b); and according to Neumayr its suture-line is more highly frilled than that of C. benacense. This last character was insisted on by Zittel and v. Sutner (in Canavari, 1896, p. 36) in keeping C. canavarii (Meneghini, 1879, p. 131, pl. x, figs. 1-3) distinct from C. kochi.

The ammonites figured by Favre (1877, pl. ii, figs. 1a, b) and Gemmellaro (1877, pl. xv, fig. 1) seem to have straighter constrictions than the typical C. benacense figured by Neumayr, although Catullo's example (1853, pl. iii, fig. 1) is remarkably like the examples here figured. Pervinquiere (1907, p. 13) when describing a similar ammonite from Tunis, doubted whether they were correctly referred to Catullo's species; and Parona and Bonarelli (1897, p. 116) doubtfully united Gemmellaro's form with the Callovian C. disputabile. It appears, however, from some of the medium-sized Kachh specimens that they all, and the Sicilian form, in particular, may well belong to the same species as the present, even if Neumayr's type of C. benacense shows a more abrupt umbilical wall at a larger diameter. On the other hand, in at least two of the Kachh specimens the constrictions are unusually wide. This, obviously, is insufficient for specific separation of these examples—moreover poorly preserved—and they all agree in suture-line with C. benacense. Waagen's identification may thus still be accepted, for the differences between C. benacense and the other known species of the same group, e.g., C. canavarii (Meneghini) or C. empedocles (Gemmellaro, 1872, p. 31, pl. ix, figs. 1-2; 1877, p. 179, pl. xvi, fig. 4) are so slight as to suggest they may be due to differences in the mode of preservation. The same applies to C. benacense (Herbich, 1878, p. 143, pl. iii, figs. 1a, b) with six constrictions and to the similar C. gorgoneum (Fontannes, in Dumortier and Fontannes, 1876, p. 36, pl. v, figs. 1, 1a) with seven constrictions and a very small umbilicus. The somewhat comparable Mombasa example above referred to (p. 54), except in umbilicus and peripheral aspect, is very close to the specimen figured in pl. VII, fig. 4b, with more numerous constrictions than the typical C. benacense.

**Horizon.**—Katrol Group; Kimmeridgian (beekeri zone).

**Localities.**—Waagen's figured specimen came from east of Rodur, his second example from the Katrol Range. In Mr. J. H. Smith's collection there are ten specimens from Fakirwadi ("Phylloceras disputabile" in his accounts, 1912, p. 714, and 1914, p. 179 [Katrol only]), one from East Ler, and one from near Moondan. The weathered specimen from bed No. 20 of Ji̇kadi, formerly (1924, p. 23) recorded as Ph. lodaense, may also belong to the benacense group.

**Genus Holcophylloceras, nov.**

**Genotype.**—Phylloceras mediterraneum, Neumayr, 1871a, p. 340, pl. xvii, fig. 2.

**Diagnosis.**—Compressed, involute shells with constrictions on the cast, radial or prorsiradiate on inner half of gently convex sides. The outer half, generally with a linguiform process at the angle, is rursiradiate and continuous across the periphery, sometimes with accompanying ridges. Corresponding constric-
tions also on test. Periphery between the constrictions generally costate; saddles diphyllic with the exception of the first lateral saddle which becomes triphyllic in later forms.

Remarks.—Holcophylloceras represents a rhacophyllitid stock, somewhat parallel with Sowerbyceras, but retaining throughout more discoidal whorls with greater involution. Neumayr included in his "Formenreihe des Phylloceras ultramontanum," which corresponds to the present genus, the following species:—H. ultramontanum (Zittel), which may include Phylloceras circe, Zittel non Héber sp. (1869, pl. xiii, fig. 1); H. zignodani (d'Orbigny), the inner whorls of which are said to have been described as Amm. circe Hébert (1866, p. 526), H. mediterraneum (Neumayr), the genotype; H. polyolcum (Benecke) H. silesiacum (Oppel) ; H. calypso (d'Orbigny); H. berriasiense (Pictet); and "Phylloceras" guettardi (Raspail). To these may be added: H. sp. cf. zignodani (d'Orbigny) Vacek, 1886, p. 66, pl. iv, figs. 8-11; pl. v, fig. 14) said to be closely allied to "Phylloceras" torulosum Tornquist (1898, p. 161, pl. xvi, fig. 3) and probably also to "Ph." neogaeum, Gottsche (1878, p. 9, pl. i, fig. 3), but it is doubtful whether these really belong to Holcophylloceras. The variety tauviskæ, Renz (1910, p. 599, pl. xx, fig. 4) of H. zignodani may also be added, further "Ph." friderici-augusti, Pompeckj (1893, p. 185, pl. ii, figs. 12-14). The Malay-Maori forms of the present genus include H. mamapiricum (Boehm, 1903, p. 7, pl. i, fig. 3; pl. ii, figs. 1, 2, text-fig. 1.), H. passati (Boehm, 1907, p. 82, pls. xv, xvi, xvii), H. insulindæ (Boehm, 1907, p. 83, pl. xvi, fig. 2), "Phylloceras" sp. (Boehm, 1911, p. 17), "Phylloceras" aff. mediterraneum (Neumayr) auct. (Spath, 1923, p. 294, pl. xiv, fig. 1), "Phylloceras" kawhia, Marshall (1908, p. 144, pl. xiva, fig. 2673, right hand fig.), and "Phylloceras" cf. polyolcum (non Benecke) Spath (1923, p. 296). The last however, may, now be included in Benecke's species described below.

The typical H. silesiacum (Oppel) as figured by Zittel (1868, pl. v figs. 4a-c, lectotype; and 6a, b) is allied to H. tauricum (Retowski, 1893, p. 231, pl. ix, fig. 5), also to H. calypso (d'Orbigny, 1841, p. 167, pl. lii, figs. 7-9 of the Valanginian, and the more doubtful H.? berriasiense (Pictet, 1867, p. 70, pl. xii, fig. 1). The three species have recently again been united by Gignoux (1921, p. 95), who described some Lower Cretaceous forms referred to the group of "Phylloceras ultramontanum." The latest comparable forms were believed to occur in the Aptian and to include the group of Ammonites guettardi (Raspail), recently discussed by Sayn (1921, p. 191). This was referred to the same "Formenreihe of Phylloceras ultramontanum" already by Neumayr, and includes those evolute forms resembling the earlier Rhacophyllitids and Sowerbyceras that were considered by the writer (1923, p. 33) to be ancestral to various waves of Desmoceratidae. Since Prof. Salfeld (1919, p. 4) has now shown that "Phylloceras" guettardi (Raspail) has no diphyllic internal saddles, it cannot be a descendant of the genus Holcophylloceras and the new name Salfeldiella gen. nov. (genotype: Amm. guettardi, Raspail, d'Orbigny, 1841, p. 169, pl. liii, figs. 1-3) is now proposed for it. According to an example dissected by the writer (B. M. No C. 2412a) the second of the five internal saddles
(at a diameter of only 16 mm.) has a flattened top, but the leaflets below are paired, as in *Sowerbyceras*, not unsymmetrical, as in *Phylloceras* sp. nov.? cf. *pletatum* (Pl. V, fig. 3).

'Phylloceras’ *trilabiatum* Prinz (1904, p. 48, pl. xxi, figs. 4-5) referred by its author to the 'group of *Ph. ultramontanum*’ is probably not a *Holcophylloceras*.

The complete *Holcophylloceras* figured by Haug (1890, p. 328, pl. iv) is now renamed *H. haugi*, nom. nov. It was referred by that author in 1892 (p. 73) to the upper Bajocian and there is a still larger example (taken as holotype of the species) in the Astier collection (B. M. No. C 26691) from the same formation of Les Blaches near Castellane, with, unfortunately, the peristome broken. Its forward sinus of the periphery and distinctive ribbing are found in a New Zealand form described by the writer (1922, p. 294) but do not occur in the later true *H. mediterraneum* nor in the contemporary (diphylllic) *H. zignodianum*. The latter species must be restricted to d’Orbigny’s larger example (pl. clxxxii, figs. 1-2), undoubtedly very close to *H. haugi*; the smaller form, which is also before me from Les Blaches (B. M., Nos. 73496 a, b; Astier Colln.) is said to be identical with the Argovian forms described by de Loriol (1900, p. 17). Strémooukhoff (1898, p. 389, pl. I) was wrong in assuming that examples with diphylllic and triphylllic first lateral saddles all belonged to this species, and the Bajocian form figured by Simionescu (1905, p. 11, pl. i, fig. 10) was correctly referred to *H. mediterraneum* rather than to *H. zignodianum*. In any case Loczy’s (1915, p. 43, pl. II, figs. 6-7) work proves that the two species, with inflated and compressed varieties, coexist in the Callovian, although transitions occur at all horizons, and truly diphylllic lateral saddles are rare after the Bathonian.

**Holcophylloceras mediterraneum** (Neumayr).

(Pl. V, fig. 1).

1875. *Phylloceras mediterraneum*, Neumayr; Waagen, pars, p. 34, pl. v, figs. 1a-b.


1897. " " " ; Parona and Bonarelli, p. 118.

1905. " " " ; Popovici-Hatzeg, p. 14, pl. iii, pars; text-fig. 6a, non b.

1910. *Phylloceras mediterraneum*, Neumayr; *“race indica”* Lemoine, p. 3, pl. i, fig. 1.

1910. " " " ; Till, p. 259.

1912. " " " ; Tsytovitch, p. 195.

1916. " " " ; H. Douvillé, p. 12, pl. iii, fig. 1.

1921. " " " ; Riche and Roman, p. 160.

1924. " " " ; "*race indica*,” Spath, pp. 4, 21, 22.

1924. " " " ; Roman, p. 45.

Of Waagen’s two figured examples, only the original of pl. v, fig. 1 belongs to Neumayr’s well-known species. Lemoine described a similar example from Madagascar and introduced for both the new name:—“*race indica*,” based on
slightly greater evolution than is shown by the European examples of this species. The dimensions of Neumayr's specimens compare as follows with those of Lemoine's Madagascan type and Waagen's original:

<table>
<thead>
<tr>
<th>Neumayr's (1871a, p. 340) example</th>
<th>129</th>
<th>54</th>
<th>36</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot; d.</td>
<td>102</td>
<td>53</td>
<td>35</td>
<td>11</td>
</tr>
<tr>
<td>&quot; holotype figure</td>
<td>115</td>
<td>48</td>
<td>30</td>
<td>12</td>
</tr>
<tr>
<td>Lemoine, pl. i, fig. 1 (at)</td>
<td>70</td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waagen, pl. v, fig. 1</td>
<td>110</td>
<td>48</td>
<td>34</td>
<td>17</td>
</tr>
<tr>
<td>Pl. v, fig. 1 (bed 7), Khera</td>
<td>197</td>
<td>52</td>
<td>32</td>
<td>12</td>
</tr>
</tbody>
</table>

Douville, who called this species "really rather variable" figured a pre-Callovian form, with an umbilicus of only about 8 per cent. of the diameter, but otherwise showing good agreement with Waagen's type; Popovici-Hatzeg's equally early examples show a decrease in the width of the umbilicus from 13 per cent. at 31 mm. diameter to 10 per cent. at 93 mm. There is also variation in the whorl-thickness from 33-36 per cent.; but the largest example figured by this author is again indistinguishable from the Kachh form except in the width of the umbilicus. Till, who recorded the measurements of 14 Callovian examples, found the thickness to vary between 29 and 36 per cent. and the width of the umbilicus between 9 and 13 per cent. of the diameter. There seems some reason, thus, for retaining Lemoine's 'race indica' for at least the two widely umbilicate Madagascar and Kachh examples figured by that author and by Waagen.

The large example, however, represented on pl. V, fig. 1, is an interesting passage-form between the Indian 'variety' and the species next described. It is worn, but a smaller specimen (Blake collection No. 88, previously recorded from "below Oxfordian" of Khera), also imperfectly preserved, shows an open umbilicus like the 'race indica'; on larger whorls there is slightly more lateral compression, the constrictions have longer inner portions, and are more numerous, the external lobe is also undercut by the first lateral lobe as in the younger species described below. To a diameter of 100 mm., there appears to be no difference between these Kachh examples and typical \( H. \text{mediterraneum} \) from Villany, Hungary, Swinitza, and Cernajka, in the British Museum (Nos. C 13468,9, etc.). The figured specimen, however, is still septate at nearly 200 mm. diameter, and since there are seven gradually more closely approximating constrictions on the last half whorl, the missing body-chamber must have shown close resemblance to \( H. \text{polyolcum} \) (Benecke). This is what takes place already in \( H. \text{haugi} \) at larger diameters, and it seems reasonable to infer that \( H. \text{mediterraneum} \) is the direct ancestor of the later species. This type of simple, progressive, evolution is comparable to the subdivision of the terminal leaflets in the suture-lines of later \( \text{Ptychophylloceras} \) and \( \text{Calliphylloceras} \). Holophylloceras berrissiense (Pictet) probably represents a somewhat homomorphous offshoot of the \( \text{silesiacum} \) group.

The Caucasian example figured by Neunayr and Uhlig (1892, p. 35, pl. i, fig. 1) and renamed by Renz (1910, p. 601) \( \text{Phylloceras signoi} \) (d'Orbigny) var. \( \text{caucasica} \), is obviously different from the Kachh forms. When the suture-line
is preserved, specific separation is not difficult, especially in the young, but it is
doubtful whether any systematic value can be attached to the differences
in the lateral bend of the ribs between, on the one hand, the sIgnodianaum
group, which apparently persists unchanged to the Argovian (de LorioL
1900, p. 15, pl. ii, figs. 10-11), and on the other, the mediterraneaum
group, which is said to begin already in the Lower Bajocian (Prinz, 1904,
p. 49). In the case of imperfect examples, however, it will often be im­
possible to employ the specific term mediterraneaum in more than an approxi­
mate, comprehensive, sense, and test and cast often show the two types of
constrictions.

It should be mentioned that a compressed example of the present species, with
only five constrictions at 125 mm. diameter, has now been found by Mr. J. H. Smith
in the Katrol Beds of Fakirwadi. Since there occur transitions to H. polyolcum
already in the Callovian, it will be seen that a new specific name for the forms
intermediate between H. mediterraneaum and H. polyolcum (in the number of
constrictions) would not even be of stratigraphical value.

Horizon.—Callovian (Middle Chari Group), anceps zone to Katrol Beds.

Localities.—Khera, Jara and Fakirwadi. Waagen's figured specimen was said
to have come from the ' macrocephalus shales ' north-west of Soorka. It is
preserved in a hæmatitic matrix, unlike the examples of H. aff. polyolcum,
described below from the same locality, which have a yellowish-brown limestone-
matrix.

Holocophylloceras aff. polyolcum (Benecke).

(Pl. I, figs. 1, 2a-f; pl. VII, fig. 5).
1865. Ammonites polyolcus, Benecke ; p. 182, pl. VII.
1875. Phylloceras mediterraneum, Neumayr ; Waagen, pars, p. 34, pl. vii, figs.
3a-c.

1875. Ammonites mediterraneus, Neumayr ; Favre, p. 19, pl. i, figs. 9, 11.
1876. Ammonites mediterraneus, Neumayr ; Favre, p. 33, pl. ii, fig. 12.
1877. Phylloceras mediterraneum, Neumayr ; Gemmellaro, p. 182, pl. xvii, fig. 2.
1877. Ammonites (Phylloceras) mediterraneus. Neumayr ; Favre, p. 15.
1877. , cf. silesiacus, Oppel ; Beyrich, p. 98.
1879. Phylloceras polyolcum (Benecke) ; Fontannes, p. 5, pl. i, fig. 6.
1886. , mediterraneum. Neumayr ; Nicolis and Parona, p. 66.
1889. , , , ; Kilian, p. 124.
1892. , , , ; Siemiradzki, p. 447.
1893. , , , ; Choffat, p. 12.
1896. , , , ; Canavari, p. 38.
1898. , , , ; de Riaz, p. 40, pl. xvi, figs. 9-10.
1907 , cf. mediterraneum, Neumayr ; Simionescu, p. 9.
1910. , malayanum (non Boehm). Dacqué, pars, p. 6, pl. i, figs. 1a, b,
only.
This species is represented by about thirty-five examples from the Katrol beds of which the original of pl. VI, fig. 1 may be considered typical. Waagen's fragmentary specimen from west of Soorka Hill (his pl. vii, fig. 3 only) probably also belongs to this species and its peripheral aspect is represented in pl. VI, fig. 2a, for comparison with that of the inner whorls (pl. VI, fig. 2b) of the large example from which the external and internal suture-lines figured in pl. VI, figs. 2e, f, were taken. Two immature examples are represented in pl. VI, fig. 2d, and pl. VII, fig. 5 and the dimensions of five of these specimens are as follows:

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Diameter (mm)</th>
<th>Width (mm)</th>
<th>Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pl. VI, fig. 1</td>
<td>145 (125)</td>
<td>53</td>
<td>34</td>
</tr>
<tr>
<td>Waagen's pl. vii, fig. 3</td>
<td>66</td>
<td>52</td>
<td>33</td>
</tr>
<tr>
<td>Pl. VI, fig. 2c</td>
<td>67</td>
<td>53</td>
<td>30</td>
</tr>
<tr>
<td>Pl. VI, fig. 2d (B. M., No. C 19974)</td>
<td>68</td>
<td>53</td>
<td>31</td>
</tr>
<tr>
<td>Pl. VII, fig. 5</td>
<td>50</td>
<td>54</td>
<td>30</td>
</tr>
</tbody>
</table>

There are now available a considerable number of large specimens, but it is difficult to separate immature examples of the present form from \textit{H. mediterraneum}. The writer, in 1913, considered that the Argovian forms seemed already distinct from the Callovian, true, \textit{H. mediterraneum}; but having only imperfect casts of inner whorls, he erroneously thought the smaller number of constrictions a distinguishing feature. The reverse, however, is now seen to be the case, for whereas \textit{H. mediterraneum} has seven to nine constrictions and does not (typically) grow to the comparatively large size of the present species, the latter may have the constrictions of the body-chamber varying from ten to thirteen or even more. At small diameters however, a similar number of constrictions, namely five to seven to about 50 mm. are found in both \textit{H. mediterraneum} and the many specimens here referred to Benecke's well-known species. The numerous examples of \textit{H. polyolcum}, recorded by Neumayr from the \textit{acanthicus} zone, show that there are eleven to twelve constrictions only at diameters of over 100 mm. but seven to eight on specimens up to 50 mm. in size; so that there is some doubt as to whether even such examples of the present species as that figured in pl. VI, fig. 1, are identical with the true \textit{H. polyolcum}, which may represent a more extreme type. This was figured by \textit{e.g.} Favre (1877, pl. I, fig. 11) and is before me in a typical specimen from San Giorgio (Verona), kindly sent by Prof. Dacqué. On the other hand examples of the present form from the Diphya Limestone of the Trentino were labelled "\textit{Phylloceras silesiacum}, but are different from a typical Stramberg specimen of this species in the same collection.
The suture-line figured by Waagen (pl. vii, fig. 3c) still shows a broad-stemmed external saddle. On the outer whorl (not figured) of the example represented in pl. VI, fig. 2b, this external saddle is seen to be completely undercut by the outer branch of the lateral lobe (pl. VI, fig. 2e, natural size). The internal lobes are also highly complex and the second, third and fourth internal saddles are diphylllic, whereas in the Rumanian example of \textit{H. mediterraneum} represented by Simionescu (1905, p. 12, text-fig. 2) the dorsal lobes are of the simpler type found in \textit{Calliphylloceratids disputabile}. In \textit{H. silesiacum}, according to Salfeld (1919, p. 4), only the second and third dorsal saddles are diphylllic and Neumayr's (1871a, pl. xvii, fig. 7) figure of the dorsal lobes of \textit{H. polyolcum} shows a similar arrangement.

The rursiradiate constrictions of the present species are characteristic. They are more strongly bent than those of \textit{H. silesiacum} and have a different course (with respect to the normal line) and form a more acute angle than those of \textit{H. tauricum}. In \textit{H. mediterraneum} they are not only far more projected, laterally, but do not form the backward sinus on the periphery, which is shown in pl. VI, figs. 2a, b and visible to the practised eye. in Dacque's pl. i, fig. 1b. The example of \textit{Phylloceras zignodianum} d'Orbigny, figured by Zittel (1870, pl. xxv, fig. 15 only) probably also belongs to the present species and not to \textit{H. tauricum}, as Retowski thought. Similarly Gemmellaro's \"\textit{Phylloceras zignodianum}\" (1868, I, p. 47, pl. ix, figs. 1-2) is referable to our form, and undoubtedly also the Kimmeridgian form of 1877, quoted in the synonymy, according to a topotype in the B. M. (No. C. 6593), but not his Callovian \textit{Ph. mediterraneum} of 1872 (p. 11), with which the other examples quoted were erroneously identified. The Madagascar example figured by Lemoine also seems intermediate to the species last described. Its comparatively fine ribbing at a diameter of 190 mm. does not suggest a transition to \textit{H. passati}, as Lemoine thinks. When the writer recorded a similar Madagascar fragment, quite smooth on the cast, but showing well parts of the suture-line, including the internal lobe, he had not before him the rich Katrol material collected by Mr. J. H. Smith.

\textit{Horizon}.—Argovian to Tithonian (?)

\textit{Localities}.—Waagen's figured example was labelled "from Upper Callovian beds of the valley west of Soorka Hill." The example represented in pl. VI, fig. 2d is also from "West of Soorka," but the only other cephalopods in the Blake Collection from that locality are \textit{Peltoceratoides} (arduennensis group) and \textit{Belemnopsis orientalis} Waagen sp. (Dhosa Oolite) and various \textit{Virgatosphinctes} of the \textit{denseplicatus} type (Umia group). A very poorly preserved specimen from the latter group (bed No. 5) of North Moondan (B. M., No. C. 22357) was labelled by Prof. Blake "\textit{Phylloceras benacense}," but may also be included here, and another immature example (No. C. 22356) came from "above zone 1," Walakhavas. Mr. J. H. Smith's collection includes thirty examples from the Katrol Group of Fakirwadi and Ler, one specimen labelled "Samatra ?" and two examples, in a slightly tougher limestone matrix, are from the "Dhosa
Oolite" and "Top slabs of Dhosa Oolite Ridge" of Fakirwadi respectively. It is possible that these and some of the immature Katrol forms belong to *H. mediterraneum*.

Genus *Sowerbyceras*, Parona and Bonarelli.

*Sowerbyceras loryi* (Munier-Chalmas).

(Pl. VI, fig. 4).

1907 *Phylloceras* (*Sowerbyceras*) *loryi* (Munier-Chalmas); Pervinquière, p. 15, pl. i, figs. 1, 2, (with synonymy).

1907 *Phylloceras* aff. *tortisulcatum* (d'Orbigny); Toula, p. 17.

1914 *Sowerbyceras* cf. *loryi* (Munier-Chalmas); Spath, p. 566.

The genus *Sowerbyceras*, previously (1924, p. 4) stated to be unknown from the Jurassic of Kachh, is now represented by a single fragment here figured (pl. VI, fig. 4), the dimensions of which are: 55—50—43—18. These are almost identical with those of the Tunisian examples recorded by the writer, and agree very well with those of "*Amm. silenus*" Dumortier and Fontannes (1876, p. 33, pl. v, fig. 2). There are three constrictions on the fragment, which appears to have been the body-chamber, and they show the characteristic forward sinus on the periphery. There is very good agreement with typical examples of this species in the British Museum from French and Italian localities.

*Sowerbyceras inflatum*, Burckhardt (1912, p. 43, pl. viii, figs. 7-16) and the same author's *S. pompeckji* (p. 45, pl. ix, figs. 1-5, 11) are closely allied species, but the curve of the constrictions on the inner half of the side is quite different in the Mexican forms.

*Horizon.*—Katrol Group (Kimmeridgian); *beckeri* zone?

*Locality.*—Fakirwadi.

Family *Lytoceratidae*, Neumayr emend.

The family Lytoceratidae, Neumayr emend. Zittel, as commonly employed, is still far too comprehensive and subdivision has become necessary. There must be excluded from it altogether the families Pleuracanthitidae, Hyatt emend. (to include only *Pleuracanthites*, Canavari), Derolyceratidae, fam. nov. (with *Derolyceras*, Rosenberg emend. Spath, *Ægolytoceras* Spath, and *Tragolytoceras*, Spath), and Ectocentritidae, fam. nov. (to include *Ectocentrites*, Wänher, *Cosmolytoceras*, *Holcolytoceras*, *Peltolytoceras* and *Lytotropites*, Spath). The Cretaceous uncoiled derivatives that were included by Prof. J. Perrin Smith (in Zittel-Eastman, 1913, p. 652) in a comprehensive ‘subfamily’ *Macroscaphitinae*, Hyatt, also must be kept apart and have now themselves been distributed among various independent families. There still remain, however, a considerable number of Jurassic and Cretaceous stocks, some not yet named, that it would be inadvisable to group together in one sub-family. It is now known that many of these lateral offshoots of the persisting conservative main stocks *Phylloceratidae* and *Lytoceratidae* gave rise to the important ammonite families of
the extra-Mediterranean regions; and detailed classification will assist the work yet to be done in connection with the attachment of each offshoot to its radical. From the Lytoceratidae are also excluded Cicatridae fam. nov. (for Cicatrites, Abich) a development compared by Prof. Salfeld (1924, p. 11) to the Domerian Prodactyloceras, Spath (group of Amm. daveoi, Sowerby), the ancestor of the family Dactylioceratidae. Cicatridae may similarly have given rise to Cheloniceratidae, the lytoceratid coiling of the root-form of which (Paraspiticeras, Kilian) already struck Uhlig (1882, p. 237), although he left his Aptian forms in the Jurassic genus Aspidoceras. The transformation of the suture-line, owing to the increase in depth of the external lobe and the reduction of the internal lobe, with general loss of symmetry, is particularly interesting.

The earliest forms of Lytoceratids, Analytoceras, Hyatt, and Audaxlytoceras, Fucini, may be referred to a separate family Analytoceratidae, fam. nov. Hyatt (1900, p. 568) grouped the former genus with Pleuracanthitidae and Prof. Salfeld (1924, p. 7) has shown that Analytoceras is also closely related to Psiloceratidae.

In a restricted family Lytoceratidae the writer would now include only those stocks that may have a costate stage (as in Alocolytoceratinae subfam. nov.) but that retain throughout such obvious Lytoceras characters as the typical suture-line, loose coiling, and flares or constrictions, associated with plain or fimbriate striation in varying combinations. There are still many genera, and subdivision, however arbitrary, may facilitate a general view of their probable interrelations. The divisions are:—

**Family LYTOCERATIDÆ, Neumayr emend.**

Sub-family.—LYTOCERATIDÆ s. s.
Genus Lytoceras, Suess emend. Buckman (genotype.—L. postfimbriatum, Prinz).

Fimbriyltoceras Buckman (genotype.—F. fimbriatum J. Sowerby).

Kallilytoceras, Buckman (genotype.—K. interlineatum Buckman).

Thysanoceras Hyatt emend. Buckman (genotype.—T. orbignyi Buckman).

Trachylytoceras Buckman (genotype.—T. nitidum [Young and Bird sp.] Buckman).

Thysanolytoceras, Buckman (genotype.—T. eudesianum d'Orbigny sp.).

Sub-family.—HEMILYTOCERATIDÆ nov.
Genus Hemilytoceras nov. (genotype.—H. immane Oppel sp.).

Pterolytoceras nov. (genotype.—P. exoticum Oppel sp.).

Eulytoceras nov. (genotype.—E. inæqualicostatum d'Orbigny sp.).

Metalytoceras nov. (genotype.—M. triboleti [Hohenegger MS] Uhlig sp.).

Ammonoceras (Lamarck) Chenu (genotype.—A. glossoidea Lamarck).

Pictetia, Uhlig (genotype.—P. astieriana d'Orbigny sp.)
Sub-family.—MEGALYTOCERATINÆ nov.

Genus Megalytoceras, Buckman (genotype.—M. confusum Buckman sp.).

? Ptycholytoceras nov. (genotype.—P. humile Prinz).

? Metrolytoceras Buckman (genotype.—M. metretum Buckman).

Sub-family.—ALOCYTOCERATINÆ nov.

Genus Alocolytoceras Hyatt (genotype.—A. germani d'Orbigny sp.).

Pleurolytoceras Hyatt (genotype.—P. hircinum Schlotheim sp.).

Pachylytoceras Buckman (genotype.—P. torulosum Zieten sp.).

Lobolytoceras Buckman (genotype.—L. siemensi Denckmann sp.).

? Asapholytoceras nov. (genotype.—A. jorojulise [Meneghini] Prinz sp.).

With regard to the new genera mentioned in the above list it ought to be briefly explained that the two Thysanolytoceras developments Hemilytoceras and Pterolytoceras, differ considerably in their ornamentation and especially in the type of flares, also in suture-line. Uhlig (1903, p. 13) has pointed out that in Hemilytoceras immame Oppel sp. (in Neumayr, 1883, p. 101, pl. xx), the genotype, “the apertural widenings are directly continuous with the siphonal wall and were secreted by the same organ as it (mantle and mantle-margin); they in fact represent merely the outermost, marginal, portions of that wall.” In Pterolytoceras (genotype.—P. exoticum, Oppel sp. in Uhlig, 1903, p. 14, pl. i, figs. 4a-c, Blanford’s types in the Strachey Collection, referred to by Crick, 1904, p. 5 [=Amm. alatus, Blanford] being too fragmentary), as Uhlig points out, “the ridges were the outcome of external deposition on the shell.”

Eulytoceras, with specialised costation, resembling somewhat that of certain Holcodiscids and Crioceratids, includes also the group of Amm. pheustus, Matheron (1879, pl. C-20, fig. 5), but some forms show first coarse alternating costae and then fine lineation, resembling in their outer whorls developments of some of the other stocks. Lytoceras densefimbriatum, Uhlig (1882, p. 191, pl. vi, figs. 1-2), according to its author has a suture-line different from that of the sutile group of Hemilytoceras, which continues into the Cretaceous, but it agrees in ornamentation with Ammonoceras (Lamarck) Chenu (1859, p. 90, figs. 391-2). The latter is here adopted for the group of Ammonites mahadeva, Stoliczka (1866, p. 165, pl. lxxx) which is probably identical with the fragments originally described by Lamarck as Ammonoceratites glossoida, certainly not a Jurassic form as has been held by Beyrich (1877, p. 99). This is the last true ‘Lytoceras,’ and some Albian examples of the same group have been described by Jeannet (1908, pp. 105-18, pls. iii-vi). Metalytoceras triboleti (Hohenegger MS) Uhlig sp. (1901, p. 22, pl. i, fig. 1) of the Valanganian, with bifurcating costae, was considered by its author to be distinct from all Cretaceous Lytoceratids and to be comparable to Pompeckj’s Liassic ‘group of Lytoceras villas Meneghini.’

Ptycholytoceras, gen. nov. (for Lytoceras humile, Prinz, 1904, p. 60, pl. xxxi, fig. 1) is probably close to Megalytoceras, but characterised by its oblique folds and three lateral lobes. Asapholytoceras gen. nov. (genotype.—Lytoceras
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*forojuliense*, Meneghini sp. in Prinz, 1904, p. 58, pl. xxxvii, fig. 4 and text. fig. 6, p. 59) with four lateral and two internal lobes, is also quite distinct and must be separated generically; but its inclusion with somewhat similar Upper Liassic Allocolytoceratids is at present provisional.

The genera listed below were also at one time included in Lytoceratidae, but like Macrosaphitidae and other uncoiled stocks that will be dealt with elsewhere (Monograph of the Ammonoidea of the Gault), they are distinct enough to be definitely separated from the unmodified parent stock.

**Family NANNOLYTOCERATIDÆ nov.**

Genus *Nannolytoceras*, Buckman (genotype.—*N. pygmaeum*, d'Orbigny sp.).

*Polystomiceras* Spath (genotype.—*P. tripartitum*, Raspail sp.).

**Family PROTETRAGONITIDÆ nov.**

Genus *Protetragonites*, Hyatt (genotype.—*P. quadrirugatum*, d'Orbigny sp.).

*Leptotetragonites* nov. (genotype.—*L. honoratianum*, d'Orbigny sp.).

*Hemitetragonites*, nov. (genotype.—*H. crebrisulcatus*, Uhlig sp.).

**Family TETRAGONITIDÆ emend.**

Genus *Gabbioeceras*, Hyatt (genotype.—*G. batesi*, Gabb sp. [pars]).

*Tetragonites* Kossmat (genotype.—*T. timotheanus*, Mayor MS Pictet sp.).

*Jaubertella* Jacob (genotype.—*J. jaubertiana*, d'Orbigny sp.).

*Kossmatella* Jacob (genotype.—*K. agassiziana*, Pictet sp.).

*Epigoniceras* Spath (genotype.—*E. epigonus*, Kossmat sp.).

*Pseudophyllites* Kossmat (genotype.—*P. indra*, Forbes sp.).

**Family GAUDRYCERATIDÆ nov.**

Genus *Gaudryceras* Grossouvre em. Kossmat (genotype.—*G. mite*, Hauer sp.).

*Eogaudryceras* nov. (genotype.—*E. numidum*, Coquand sp.).

*Mesogaudryceras* nov. (genotype.—*M. leptonema*, Sharpe sp.).

Nannolytoceratids and Protetragonitids are interesting on account of their resemblance to certain Perisphinctids (*Polysphinctes*, S. Buckman, 1922, pl. 322) and Simoceratids (*Lytogyroceras*, Spath, 1925a, p. 131). Unfortunately as Prof. Salfeld (1924, p. 3) has pointed out, Mediterranean deposits have not yet been explored in sufficient zonal detail to enable us to connect the various modified developments with the Lytoceratoid parent stocks. *Leptotetragonites* may also include *L. municipale* (Oppel) Zittel sp. (1868, p. 72, pl. viii, fig. 5, lectotype) wrongly united by Toucas (1890, p. 591) and [doubtfully] by Gignoux (1921, pp. 108, 110) with d'Orbigny's *L. honoratianum* (1841, p. 124, pl. xxxvii). Toula's (1907, p. 19) large examples of forms allied to *L. municipale*, from the acanthicus zone, show that, then, *Leptotetragonites* is still close to *Protetragonites* as well as to *Hemilytoceras* (though this has a high external lobe), but the resemblance between *L. municipale* and *L. honoratianum* may
not be so close as is assumed by most authors. *Hemitetragonites* (for *Lytoceras crebrisulcatum*, Uhlig, 1882, p. 191, pl. v, figs. 8-10) has long since been recognised as a form intermediate between the earlier *Protetragonites* and the later *Gabbioeras* and *Tetragonites* (see Gignoux, 1921, p. 111).

With regard to the separation of *Epigoniceras* from *Tetragonites*, attention may be drawn to the important differences in the internal suture-lines, noticed by Prof. Salfeld (1924, p. 8).

The early *Eogaudryceras* gen. nov. (genotype.—*Lytoceras numidum*, Coquand, in Sayn [1890, p. 15, pl. i, figs. 3-4] as represented by Fallot, 1921, p. 233, pl. ii, fig. 1) is close to *Gabbioeras*, Hyatt, on the one hand, and on the other shows a remarkable likeness to the Desmoceratid genus *Melchiorites*, with, however, a trifid lateral lobe. *Mesogaudryceras leptoneuma* (Sharpe, 1855, p. 32, pl. xiv, fig. 3) was previously (Spath, 1923b, p. 21) characterised as "unlike any described Albian species of Gaudryceras, except possibly a Japanese 'Lytoceras' sp., figured by Yokoyama, and compared to Gaudryceras sacya (Forbes)." The type of this species and its relations to true *Gaudryceras* (s. s.) of the Senonian were discussed on another occasion (Spath, 1921b, p. 41). In *Mesogaudryceras* the inner whorls are compressed and flattened and the external lobe is shallower than the lateral lobe, not deeper, as it is in the true *Gaudryceras*, with circular whorl-section of the inner volutions.

The Kachh examples of this vast mass of Lytoceratids unfortunately include only four species, referred to three genera, but elsewhere also, in Upper Jurassic times, ammonites of this stock are never so abundant as the contemporaneous Phylloceratids.

Genus *Thysanolytoceras*, S. Buckman.

**Thysanolytoceras adeloides** (Kudernatsch).

(Pl. VI, fig. 5; pl. VII, fig. 1).

1875. *Lytoceras adeloides* (Kudernatsch); Waagen, p. 37, pl. viii, fig. 2.
1881. *Lytoceras adeloides* (Kudernatsch); Uhlig, p. 389, pl. viii, figs. 1-2.
1891. *Lytoceras adeloides* (Kudernatsch); Parona and Bonarelli, p. 89.
1894. *Lytoceras adeloides* (Kudernatsch); Parona, p. 375.
1895. *Lytoceras adeloides* (Kudernatsch); Parona, p. 10.
1905. *Thysanolytoceras adeloides* (Kudernatsch); S. Buckman, p. 149.
1905. *Lytoceras adeloides* (Kudernatsch); Simionescu, p. 22, pl. i, fig. 13.
1905. *Lytoceras adeloides* (Kudernatsch); Popović-Hatzeg, p. 15, pl. iii, figs. 8-9.
1910. *Lytoceras cf. adeloides* (Kudernatsch); Dacqué, p. 36.
1910. *Lytoceras rex* (non Waagen); Lemoine, p. 142, text-fig. 2.
1912. *Lytoceras adeloides* Kudernatsch; Tsytovitch, p. 196.
1915. *Lytoceras adeloides* Kudernatsch; Loczy, p. 54, text-fig. 32.
1923. *Lytoceras adeloides* (Kudernatsch); Roman, p. 13, pl. i, figs. 5, 5a.
1924. *Lytoceras* ('Thysanolytoceras') *adeloides* (Kudernatsch) Waagen; Spath, p. 4.

Waagen examined only fragments of this species and gave no measurements, but he stated that "the section of the whorls was a little broader than high,
though there was, it seemed, a little variation in this, and this character was not quite constant." The only one of Waagen's examples forwarded to the writer, i.e., the original of his pl. viii, fig. 2 (suture-line only) has a whorl-height of 90 mm. and a thickness of 88 mm. In a very typical fragment of this species in the Blake Collection (No. 106, previously recorded from beds 7-10 of Khera) whorl-height and thickness are equal (88 mm.), and this is also the case with the examples recorded by e.g., Simionescu and Popovici-Hatzeg.

In the worn specimen here figured (pl. VII, fig. 1) the dimensions cannot be accurately determined, and the characteristic flares are barely visible. The three denticulations of the primary ribs, described by Zittel (1868, p. 603) are, however, well shown on Waagen's fragment and two Khera examples in the Blake collection. The small specimen figured in pl. VI, fig. 5 again, is somewhat corroded and does not show differentiation of the costae, like the excellent figures of Popovici-Hatzeg, which, however, may represent a slightly earlier mutation.

Lemoine's Madagascan specimen, figured as Lytoceras rex, Waagen, shows only four denticulations at a whorl-height of 135 mm., and probably belongs to the present species and not to the more compressed Hemilytoceras rex. Whether Neumann's (1907, p. 14) Lytoceras cf. adeloides from the cordatus zone really belongs to the same group as the present species is also doubtful; but the scarcity of Lytoceratids in the Argovian at present prevents a detailed study of the forms transitional between Thysanolytoceras and Hemilytoceras.

Horizon.—Lower and Middle Chari groups. Callovian (macrocephalus to anceps zones).

Localities.—Khera and Fakirwadi. Prof. Blake's three examples are from Bed No. 3 (No. 108, 'Lytoceras sp.' of 1924, p. 21, anceps zone; B. M., No. C 22353, pl. vi, fig. 5), beds 7-10 (No. 106); and from 'below Oxfordian' (No. 110). Mr. J. H. Smith marked two examples 'bed 6' of Khera (pl. vii, fig. 1) and recorded (1913, p. 211) 'not a few fragments of a Lytoceras' from the same horizon. But his 'bed 6' is now 'bed 3,' and three other Khera examples are marked 'sub-anceps zone.' A doubtful fragment, perhaps even a Megalytoceras, is from the 'athleta beds' of Habye.

Genus Megalytoceras S. Buckman.

Megalytoceras ? sp. nov. ind.

(Pl. VII, fig. 7).

A gigantic fragment of a form, still septate at probably over 300 mm. diameter, unfortunately is too poorly preserved to be figured. The whorl-height is 135 mm. at the larger end (here figured pl. VI, fig. 7) and 98 mm. at the smaller end; the thickness is 145 mm. and 110 mm. respectively. The whorl-section resembles that of M. amplum (Oppel) as figured by Prinz (1904, p. 57, pl. x) and the suture-line is of the same type as far as it can be seen; but whereas one side of the present example is weathered, the other was ori-
ginally oyster-coated and shows only traces of slightly rursiradiate, subfimbriate stria. Quenstedt's *Ammonites lineatus ferratus* (1866, p. 476, pl. ix, fig. 1) which has been united by Pompeckj (1893, p. 309) with *M. amplum*, shows a far too distinct umbilical edge; and *M. depressum* (Till, 1910, p. 262, pl. xvi, figs. 15-17) has a much more depressed whorl-section.

Parona's (1895, p. 11, pl. i, fig. 3) Bajocian *M. meletense*, which has been stated to resemble *M. amplum*, but which is more involute, phylloceratoid, has no connexion with the form here described.

The present fragment is clearly different from the Lytoceratids recorded by Neumann (1907, p. 14) and Neumayr (1871b, p. 364) from the *cordatus* and *transversarius* zones, and by Pompeckj (1893, p. 355) from the *lamberti* zone. Until better specimens are available, however, the species cannot be definitely determined, even generically.

**Horizon.**—Argovian (Dhosa Oolite).

**Locality.**—Wanda (zone 1), B. M., Blake Colln., No. 107, associated with *Aspidoceras sparsispinum*, Waagen, a typical Dhosa Oolite form.

**Genus HEMILYTOCERAS nov.**

**HEMILYTOCERAS REX** (Waagen).

1875. *Lytoceras rex*, Waagen; p. 36, pl. viii, figs. 1a, b.
1903. *Lytoceras rex*, Waagen; Uhlig, p. 17.
1913. *Lytoceras rex*, Waagen; Smith, p. 212.

The gigantic holotype of this species unfortunately is missing, and if Waagen's figure and description are correct, none of the other Lytoceratids before the writer can have even remote resemblance to *H. rex*. Its striate inner whorls and the seven denticulations of the primary flares of the outer whorl are characteristic features, also the slightly compressed whorl-section, with its height and thickness in the proportion of 11 : 10. *Thysanolytoceras adeloides* (d'Orbigny) has only two to four denticulations on each flare and for this reason the Madagascar form, figured by Lemoine and referred to above (p. 68), cannot be identified with the present species. Kilian and Guébhard's (1905, p. 788, pl. xlix, fig. 1) *Lytoceras orsinii* (non Gemmellaro) from the *acanthicus* zone of the Alpes Maritimes, considered by Lemoine to be a closely allied species, also does not belong to *H. rex*, which, at the same size, has ornamentation resembling that of ' *Lytoceras' sutile* (Oppel).

The New Zealand example recorded by the writer (1923b, p. 297) as *Lytoceras* cf. *rex* is doubtful and may be a *Hemilytoceras* of the *sutile* group. Similarly Beyrich's (1877, p. 99) *Ammonites* cf. *rex*, and Dacqué's (1910, p. 9) *Lytoceras* cf. *rex* are merely doubtful fragments. The latter author considered it not improbable that his examples represented merely the adult ' *Lytoceras' frasii', a species that is numerously represented among the Mombasa material in the British Museum and includes the ' *Lytoceras quadriruacatum* ' (non d'Orbigny) of which Crick described the muscle-impression (1898, pp. 92-3.) Since
H. *fraasi* is undoubtedly close to *H. orsinii* (Gemmellaro) and *H. montanum* (Oppel) and since Waagen (on p. 216) definitely listed *H. rex* as of Katrol Sandstone age, the resemblance of its inner whorls to *H. sutile* (Oppel) is not surprising. All the species of this group, which probably includes *Lytoceras album* (Quenstedt) Pompeckj (1893, p. 313), show a return to something like *Thysanolytoceras* ornamentation on the outer whorls that may have misled Lemoine.

Beyrich’s suggestion that the present species may be identical with Lamarck’s ‘*Ammonoceratites* glossoidea,’ obtained from the Cretaceous region of Pondicherry, cannot be accepted (see supra, p. 65).

**Horizon.**—Kimmeridgian (Katrol Sandstone, *fide* Waagen).

**Locality.**—South of Khera Hill (See Smith, 1913, p. 212).

**Hemilytoceras cf. montanum** (Oppel).

(Pl. VI, fig. 3).

1870. *Lytoceras montanum* (Oppel) Zittel; p. 163, pl. xxvi, figs. 3, 4.
1894. *Lytoceras* cf. *montanum* (Oppel); Futterer, p. 12, pl. iii, fig. 3.
1924. *Lytoceras* sp. (montanum group); Spath, p. 4.

The small example here figured is entirely septate and has the following dimensions: 48—36—34 ?—42. Although on account of crushing the whorl-thickness cannot be accurately determined, the section was possibly slightly higher than wide. The measurements are close to those given by the writer (1913, p. 567) for a Tunisian *Lytoceras*, compared to *L. gastaldii* Gemmellaro, in which species is also included the ammonite referred by the same author (Gemmellaro, 1870, p. 33, pl. vi, fig. 1) to Oppel’s *Amm. montanus*. The East African *Lytoceras fraasi* (Dacqué, 1910, p. 8, pl. i, fig. 4) also has similar dimensions but a more circular whorl-section, and it agrees in ornamentation, except the presence of constrictions. It is associated, however, according to the collections in the British Museum, with forms that are indistinguishable from the species here described; and Futterer’s original, re-examined by Dacqué, may be one of these.

The inner whorls of the Kachh example are corroded, but on the outer whorl the rursiraditate and fimbriate costae, at irregular intervals, are clearly visible. In the closely related *H. orsinii* (Gemmellaro, 1872, p. 33, pl. viii, figs. 2-3) the fimbriate costae are closer at the same diameter and the outer whorl is also more quickly increasing. The suture-line, so far as it can be observed on the present example, is closely similar and highly complex, not reduced, as in somewhat similar but constricted *Protetragonites*.

An example which is taken to represent the inner whorls of *H. rex* has now (December, 1925) been sent by Mr. J. H. Smith (from the Katrol Beds of Lep) and will be figured in pl. IX, fig. 1.
It may be mentioned that the inner whorls of *Pterolytoceras exoticum*, Oppel sp. (=alatum, Blanford) are also very similar to those of the group here discussed and that the generic differences appear only on the larger whorls. The *Lytoceras* sp. figured by G. Boehm (1904, p. 25, pl. ii, figs. 2, 3a-c, 4) from the lowest Infracalpangian or uppermost Tithonian of the Sula Islands thus probably represents a new species of *Pterolytoceras*.

Choffat's *Lytoceras* cf. *adeloides* (non Kudernatsch) from the Portuguese Montejunto Beds (1893, p. 17, pl. xv, figs. 9a-c) may belong to the same group as the species here described, but, like the form figured by Toula (1907, p. 18, pl. iii, fig. 1) and compared to Oppel's *Amm. montanus*, it is unrecognisable specifically.

_Horizon._—Umia Group, Tithonian (*transitorius* zone?).

_Locality._—North Moondan, bed No. 5 (B. M., No. C 19980) associated with *Ptychophylloceras tithonicum* and *Virgatosphinctes* spp.
PLATE I.

**Fig. 1.** *Belemnopsis kuntkostenis* (Waagen) a. Ventral view of a complete example (B. M., No. C. 19921; J. F. Blake Colln.) from the River, East of Kantcote, with outline lateral view and cross-section. b. Ventral view of Waagen's holotype (pl. i, figs. 3a-e; G. S. I. Colln. No. 1/874) with section at alveolar end. Argovian (Kantcote Sandstone). D= dorsal, V= ventral side. P.8.

**Fig. 2.** *Hibolites flemingi* sp. nov. Ventral and outline lateral views of holotype (B. M., No. C. 4926; Rev. R. Baron Colln.) with outline sections at upper ends of two fragments (possibly placed a trifle too far apart). From the Kimmeridgian of Andranosamonta, Madagascar (=*Belemnites hastatus*, Blainville, in Newton, 1889, p. 334). P. 13.

**Fig. 3.** *Belemnopsis tanganensis* (Futterer). a. Ventral view and cross-sections of Waagen's example of "*Belemnites gerardi*" (pl. ii, fig. 3; G. S. I. Colln. No. 1/883). b. Same of a Somali-land example (B. M., No. C. 25870; Col. R. A. Farquharson Colln.) from the Kimmeridgian 'White Shales' of Merajellah. P. 9.

**Fig. 4.** *Belemnopsis aff. tanganensis* (Futterer). Ventral and outline lateral views with cross-section, of an immature example (B. M., No. C. 19935; J. F. Blake Colln.) from bed No. 2, Katrol Hill (with the Kimmernidian ammonites previously recorded). P. 10.

**Fig. 5.** *Hibolites* sp. ind. (*Belemnites savanaus*, Waagen, non d'Orbigny). Ventral lateral views, with cross-sections, of Waagen's original example (G. S. I. Colln. No. 1/886) from the Argovian (Dhosa Oolite) south of 'Samtra.' The cross-section of the alveolar end is drawn slightly enlarged. P. 16.

**Fig. 6.** *Belemnopsis grantana* (d'Orbigny). Ventral view and cross-sections at alveolar end and thickest part of an example (B. M., No. C.19954; J. F. Blake Colln.) from Bed 2 (Callovian, *athleta* zone) of Wandra. P. 7.

**Fig. 7.** *Belemnopsis calloviensis* (Oppel). Ventral view of Waagen's holotype (pl. ii, figs. 4a-d; G. S. I. Colln. No. 1/884) with cross-sections at base of phragmocone (= position of protoconch) and at thickest part of guard. Callovian (anceps zone) of Khera Hill(?). P. 6.

**Fig. 8.** *Belemnopsis orientalis* (Waagen). Ventral view and section at alveolar end of an example (B. M. No. C.19910; J. F. Blake Colln.) from bed No. 1 (Dhosa Oolite) of Walakhavas. P. 10.
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Plate 1.
PLATE II.

**Fig. 1.** *Poracenoceras* cf. *calloviense* (Oppel). Lateral (a) and peripheral (b) views of Sowerby's original of ' *Nautilus hexagonus* ' (1840, pl. xxiii, fig. 4) from the Callovian (horizon doubtful, anceps? zone) of Chari (B. M., No. 9975, Geol. Soc. Colln.). P. 31.

**Fig. 2.** *Megateuthis* sp. ind.? Natural longitudinal section of a complete specimen (B. M., No. C. 19961: J. F. Blake Colln.) from the "Putchum Dolomite" (Bathonian ?) of Andhm. P. 19.

**Fig. 3.** *Procymatoceras* ? *intumescens* (Waagen). Peripheral view of a specimen (B. M., No. C. 19827: J. F. Blake Colln.) from bed No. 10 (=upper *macrocephalus* beds) of Khera. P. 33.

**Fig. 4.** *Belemnopsis* aff. *kunstkotensis* (Waagen). Ventral and outline lateral views and cross-sections of an immature example (B. M., No. C. 19943: J. F. Blake Colln.) from the "Crimson Bed" (Argovian ?) North of Wamka. P. 8.


**Fig. 6.** *Paracenoceras* cf. *lorioli* (Loesch). Lateral (a) and peripheral (b) views of an example (B. M., No. C. 19828: J. F. Blake Colln.) from bed No. 1 (Dhosa Oolite) of Charwar. P. 29.

**Fig. 7.** *Hibolites blakei* sp. nov. Ventral and outline lateral views, with cross-sections, of holotype (B. M., No. C. 19932; J. F. Blake Colln.) from the 'Oxfordian Clay' of Wantra (Upper Callovian, *athleta* beds?). P. 15.
PLATE III.

Fig. 1. *Hibolites* sp. nov. ? cf. *hastatus* (Blainville). Ventral view and cross-section of a specimen (B. M., No. C. 19938 ; J. F. Blake Colln.) from Jumara, bed No. 3 (Callovian, Middle Chari Group).  P. 12.

Fig. 2. *Hibolites* cf. *semisulcatus* (Münster). Ventral view and cross-sections of an example (B. M., No. C. 19916 ; J. F. Blake Colln.) from bed I, Walakhavas (Kimmeridgian, Katrol Group). P. 13.

Fig. 3. *Belemnopsis grantana* (d'Orbigny). Ventral view with cross-sections of a specimen (B. M., No. C. 19920 ; J. F. Blake Colln.) from bed No. 9 (Callovian, base of Middle Chari Group) of Khera. P. 7.

Fig. 4. *Paracenoceras wandaense* (Waagen). Peripheral view of Waagen's holotype (pl. iv, fig. 3) from the Dhosa Oolite (Argovian) of Wanda. (G. S. I. Colln., No. 1/897). P. 30.

Fig. 5. *Paracenoceras* cf. *calloviense* (Oppel). Lateral view of Waagen's original (pl. iii, figs. 2a, b) from the 'macrocephalus beds' (Lower Callovian) of Jumara. (G. S. I. Colln. No. 1/892). P. 31.

Fig. 6. *Paracenoceras? jumarense* (Waagen). Lateral (a, b) and peripheral (c) views of Waagen's holotype (pl. iv, figs. 1a, b) from the "Grey Limestones of the Putchum Group," Jumara. (G. S. I. Colln. No. 1/895). P. 32.
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Plate 111.
PLATE IV.

Fig. 1. *Hijolites cf. semisulcatus* (Münster). Ventral view and cross sections of an example (B. M., No. C. 19914; J. F. Blake Colln.) from "above zone I." Walakhavas (Kimmeridgian, Katrol Group). P. 13.

Fig. 2. *Paracenoceras kumagunense* (Waagen). Peripheral view of Waagen’s holotype (pl. iii, figs. 1a, b), from the upper *macrocephalus* beds (Callovian), North of Kumaguna. (G. S. I. Colln. No. 1/891). P. 26.

Fig. 3. *Paracenoceras cf. kumagunense* (Waagen). Side (a) and peripheral (b) views of an example (B. M., No. C. 19829; J. F. Blake Colln.) from the Higher Beds (Dhosa Oolite, Argovian) of Gangta Bet. (Fig. 3b, owing to crushing of the anterior part of the shell, does not represent the true whorl-shape). P. 26.

Fig. 4. *Paracenoceras hexagonoides*, sp. nov. Side (a) and peripheral (b) views of holotype (B. M., No. C. 19826; J. F. Blake Colln.) from the Tithonian (Umia Group) of North Mocnden (bed No. 5). P. 28.

Fig. 5. *Belemnopsis* sp. ind. Ventral view (diagrammatic) and section at alveolar end of an example (B. M., No. C. 19936; J. F. Blake Colln.) from bed No. 2, Katrol Hill (Kimmeridgian). Compare with pl. i, fig. 4 (*B. aff. tanganensis*, Futterer sp.). P. 11.
PLATE V.

Fig. 1. Holcophylloceras mediterraneum (Neumayr). Side view of largest example, transitional to H. polyolcum, Benecke sp. (J. F. Blake Colln., No. 89) from bed No. 7, Khera Hill. Middle Chari Group, Callovian, anceps zone. P. 58.

Fig. 2. Ptychophylloceras insulare (Waagen). Part of external suture-line from median saddle in E (left) to first auxiliary lobe (right). Diagrammatic and enlarged (x about 3), from Waagen's holotype G. S. I. Colln. No. 1/916. Kimmeridgian (Kantcote Sandstone (?)) of Gangta Bet. P. 45.

Fig. 3. Phylloceras sp. nov. ? cf. plicatum, auct. non Neumayr. Internal lobe and first two saddles, diagrammatic (x about 3). From a fragment in the Blake Collection (B. M., No. C.22358) from south of Maujal. Callovian, probably anceps zone (loose). P. 40.

Fig. 4. Ptychophylloceras tithonicum, sp. nov. Side and front views of holotype (B. M., No. C. 19973 ; J. F. Blake Colln.) from bed No. 5, North Moondan. Tithonian, Umia Group, transitorius zone. P. 48.

Fig. 5. Phylloceras aff. kazegi, Loczy. Tracing of lateral saddle (with L=lateral lobe on right). Callovian, macrocephalus zone, of Jumara (bed No. 13 A). J. F. Blake Colln. No. 85. See pl. vii, fig. 6. P. 39.
PLATE VI.

Fig. 1. *Holcophylloceras* aff. *polyolcum* (Benecke). Side view of a large example, with half a whorl of body-chamber. Katrol Beds, Kimmeridgian, of Fakirwadi. (J. H. Smith Colln., G. S. I. No. 24). P. 60.

Fig. 2. *Holcophylloceras* aff. *polyolcum* (Benecke). (a) Peripheral view of example figured by Waagen (pl. vii, figs. 3, a, b), said to be from Upper Callovian beds of valley west of Soorka Hill. (b) Peripheral view of inner whorls of a large, fragmentary, example from which parts of external (e) and internal suture-lines (f) were taken (both natural size). Katrol Beds, Kimmeridgian, probably of Fakirwadi. J. H. Smith Colln. No. 16, G. S. I.). (c) Example from Katrol Beds of Ler, same colln. No. 26. (d) Example from ‘Moondan Group’ of West Soorka, B. M. No. C. 19974. P. 60.


Fig. 4. *Sowerbyceras loryi* (Munier-Chalmas). Side view of fragmentary example from Katrol Group, Kimmeridgian, of Fakirwadi. J. H. Smith Colln., G. S. I. P. 63.

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FIG. 6. *Phylloceras aff. hatzegi*, Loczy. Outline whorl-section of the example from the Lower Callovian of Jumara, of which the first lateral saddle is figured on pl. v, fig. 5. P. 39.


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Plate VII.