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PLATES I TO VI.

THE JURASSIC AND CRETACEOUS AMMONITES AND BELEMNITES OF THE
ATTOCK DISTRICT.

By

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THE JURASSIC AND CRETACEOUS AMMONITES AND BELEMNITES OF THE ATTOCK DISTRICT.

BY

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

(With Plates I-VI.)

INTRODUCTION.

THE ammonites and belemnites described in this paper come from a number of localities in the Attock district, in the extreme north-west of the Punjab, on the borders of the North-West Frontier Province. They were sent to me marked partly 'Basal Giumal beds' (the Jurassic and Spiti shales species), partly 'Upper Giumal beds' (the Albian forms and some indeterminable belemnites). These cephalopods were accompanied by a number of brachiopods, also pelecypods and gastropods, which are being described by Miss H. M. Muir-Wood and by Mr. L. R. Cox respectively. The fauna has already been referred to in my Revision of the Jurassic Cephalopoda of Kachh, but the publication, in the meantime, of other works, especially on Upper Jurassic successions, makes it desirable to discuss the stratigraphical results afresh and in more detail in a final chapter.

I have to record my grateful acknowledgments to the past and present Directors of the Geological Survey of India in Calcutta (Sir Edwin Pascoe and Dr. L. L. Fermor) for entrusting me with the description of these interesting forms; also to the Keeper of the Geology Department of the British Museum (Natural History), Dr. W. D. Lang, for giving me all facilities in connexion with the study of the collections. I should like similarly to acknowledge the help I am continually receiving from colleagues all over the world by consignments of new material, literature or information, even if it may not seem to be directly concerned with the area here discussed.

The measurements of ammonites are given in the usual order:—(1) diameter in millimetres, (2) whorl-height, (3) whorl-thickness, (4) width of umbilicus in percentages of the diameter. The localities are referred to under numbers 1-12 in the specific descriptions to avoid lengthy repetitions, but they are given in full in Chapter III. Since a number of the species here recorded have been described from Kachh, the synonymies are also generally condensed. A full list of literature on the subject is given in the last part of my Revision of the Jurassic Cephalopoda of Kachh.

SPECIFIC DESCRIPTIONS.

A. Order AMMONOIDEA.

a. Family: *STEPHANOCERATIDAE*, Neumayr emend.

Sub-family: *MAYAITINAE* Spath.

Genus: *EPIMAYAITES*, Spath, 1928.

1. *EPIMAYAITES POLYPHEMUS* (Waagen).

(Plate III, figs. 2a, b.)

1875. *Stephanoceras polyphemus*, Waagen. Jurassic Fauna of Kutch, I, Cephalopoda, *Pal. Ind.*, Ser. IX, No. 4, p. 116; Pl. XXIX, fig. 2 only.
1894. *Macrocephalites polyphemus* (Waagen). Tornquist, Über Macrocephaliten im Terrain-à-chailles, *Abh. Schweiz. Pal. Ges.*, Vol. XXI, pp. 14, 18, 25.
1894. *Macrocephalites polyphemus* (Waagen). Pompeckj, Über Ammonoideen mit 'anomalener Wohnkammer'. *Jahresh. Ver. vaterl. Nat. K. Stuttgart*, Vol. 50, p. 254.
1895. *Stephanoceras polyphemus* (Waagen). Nœtling, Fauna of the Kellaways of Mazar Drik, *Pal. Ind.*, Ser. XVI, Vol. I, Pt. I, p. 14; Pl. XII only.
1910. *Macrocephalites polyphemus* (Waagen). Lemoine, Paléontologie de Madagascar. VIII. Ammonites d'Analalava. *Ann. Pal.*, Vol. V, fasc. 4, p. 30.
1924. *Mayaites polyphemus* (Waagen). Spath. On the Blake Collection of Ammonites from Kachh, India, *Pal. Ind.*, N. S., Vol. IX, Mem. No. I, p. 9.
1924. '*Stephanoceras*' *polyphemus*, Waagen. Buckman. Type Ammonites, Vol. V, p. 46.
1928. *Epimayaites polyphemus* (Waagen). Spath. Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch), *Pal. Ind.*, N. S., Vol. IX, Mem. No. 2, Pt. III, p. 233.

The fragmentary example here figured was at first taken to be merely a variety of the common *Mayaites maya* (J. de C. Sowerby)¹, or one of the passage-forms to more coarsely-ribbed species like *M. jumarensis*, Spath², previously recorded. It differs from *M. maya* in having the primary ribs less closely spaced, there being 33 secondary ribs to eight primaries, *i.e.*, about four outer ribs to each umbilical costa, as against only three in Sowerby's species. In the more finely-ribbed variety which I previously³ figured as *M. cf. maya* but which may be considered a transition to the (typically more compressed) *M. smeei*, Spath⁴, the secondary ribs may increase to four for each primary, but the latter as well as the former are, then, much more closely spaced. On the other hand, in *M. jumarensis* and especially in *M. subkobyi*⁵ with similarly distant primaries, the outer ribs are much coarser.

¹ In Sykes, A Notice respecting some Fossils collected in Kutch, etc., *Trans. Geol. Soc.*, Ser. 2, Vol. V, p. 719, Pl. LXI, fig. 8.

² *Loc. cit.*, p. 228; Pl. XLIII, figs. 1a, b, (1928).

³ Spath, *loc. cit.*, Pl. XXXIX, fig. 5, (1928).

⁴ *Ibid.*, p. 230; Pl. XLV, fig. 7.

⁵ *Ibid.*, p. 229; Pl. XLV, fig. 1.

If the distant spacing of the umbilical ribs in the present form be constant, then the inner whorls would differ considerably from those of *M. maya*. There is a portion of the large next outer whorl preserved, not shown in the figure, but while indicating that the example was septate even then and therefore of considerable size, it is too corroded to help in specific identification.

Epimayaites polyphemus (Waagen emend. Nøtting), as interpreted by the writer, seems to have longer primary ribs than the example here described, but the umbilical margin is damaged and the obtuseness of the ribs conspicuous in the illustration (Plate III, fig. 2a) is also probably due to wear. The rib-curve is the same in the two forms, slightly more sigmoidal than in *M. maya* and projected near the venter, but the suture-line is too incompletely exposed to show the characteristic curve of the present species. The dimensions of the Attock example were approximately:—103 —48 —49 —19, as against 238 —50 —45 —15 in the lectotype of *E. polyphemus*, but the sizes are rather different.

E. axonoides, Spath¹, is also very similar to the present form at a comparable size and I have previously mentioned that the inner whorls of this species, as of the allied *E. batavo-indicus* (G. Böhm)², from the Sula Islands, may not be readily distinguishable.

Horizon.—Argovian (Upper Oxfordian), probably about *transversarius* zone.
Locality.—1 (near Burjianwala Laman), No. K. 23-698.

2. EPIMAYAITES aff. LEMOINI, Spath.

(Plate III, figs. 1a, b.)

1928. *Epimayaites lemoini*, Spath. *Loc. cit.* (Kachh Revision), Pt. III, p. 234; Pl. XXVI, fig. 4; Pl. XXXIV, fig. 1. (See there for synonymy.)

This form is represented by a septate fragment which, however, is even less favourably preserved than that last described. It shows fine secondary ribbing, slightly projected, as in the holotype of the present species, and a somewhat compressed whorl-section, with the ventral area tending to become narrow. The number of secondary ribs to each primary is about six to seven, which character alone excludes comparison with any species of *Mayaites*, even such finely-ribbed forms as *M. smeei*, already mentioned, having only three or at most four.

The suture-line is not distinctly visible and there is no trace of the inner whorls. The dimensions, apparently, were as follows:—150 —50 —46 —17. In the holotype the thickness is only 38 per cent. but it is crushed and partly corroded and in a paratype, in any case, it amounted to 46 per cent. *E. axonoides*, mentioned above, is more inflated, but has coarser ribbing.

¹ *Loc. cit.*, p. 236; Pl. XLVII, fig. 2; Pl. XLVIII, fig. 4, (1928).

² Beiträge zur Geologie von Niederländisch-Indien, I, Die Südküsten der Sula Inseln Taliabu und Mangoli, Pt. 2, Der Fundpunkt am oberen Lagoi auf Taliabu, *Paläontogr., Suppl.*, IV, I, 2, p. 87; Pl. XVIII, figs. 1-2; Pl. XIX, figs. 1-2, 1907.

E. excentricus, Spath¹, shows general resemblance but has lost the primary ribs at a corresponding size; *E. sublemoini*, Spath², based on one of G. Böhm's examples of his *E. palmarus* similarly tends to weaken its inner ribs.

Horizon.—Argovian (Upper Oxfordian), probably about *transversarius* zone.

Locality.—I (near Burjianwala Laman), No. K. 23-694.

b. Family: *PERISPHINCTIDAE*, Hyatt.

Sub-family: *PERISPHINCTINAE*, Spath.

Genus: *PERISPHINCTES*, Waagen (1869) s. s.

1. *PERISPHINCTES ORIENTALIS*, Siemiradzki.

(Plate IV, figs. 1a, b.)

1931. *Perisphinctes orientalis*, Siemiradzki. Spath, Revision of the Jurassic Cephalopod Fauna of Kachh, *loc. cit.*, p. 416; Pl. LXIX, fig. 1; Pl. LXXII, fig. 2. (See there for synonymy.)

It might be held that a poorly preserved Perisphinctid like that here figured is not definitely recognisable; and, indeed, apart from the subquadrate whorl-section and the regular bifurcation of the ribs there is little to go on, the suture-lines of the specimen (septate to the end) being only very indistinctly visible. The comparison to *P. orientalis* may thus be considered provisional, yet the large, septate example of this species from the Kantcote ironstone which I figured in 1931, in spite of appearing more sharply-ribbed, is undoubtedly extremely close to the Attock form. The differences in the ribbing seem to be due largely to the different preservation and the smaller specimen of *P. orientalis* previously⁴ illustrated seems to be identical in regard to ribbing with the earlier half of the Attock form. This apparently is more closely-ribbed than the corresponding portion in Plate LXIX, fig. 1, but only because the figure is reduced. The obsolescence of the ventral costæ which sets in on the large Kantcote example (an internal cast in limonitic ironstone) at an earlier stage is probably also not of specific significance.

There are also slight differences in the proportions, those of the present example (190 — 28 — 28 — 50) showing a less depressed whorl-section than the large Kantcote specimen or Waagen's largest example, but this is due to corrosion of the Attock form.

A gigantic example of over 300 mm. diameter is unfortunately so fragmentary and so badly corroded as to be almost unrecognisable. Part of the outer whorl may have belonged to the body-chamber, but on the first half the

¹ *Loc. cit.*, p. 239; Pl. XLIV, fig. 4, (1928).

² *Ibid.*, p. 223.

³ *Loc. cit.*, p. 90 (pars); Pl. XXII, fig. 4 only, (1907).

⁴ *Loc. cit.*, Pl. LXXIV, figs. 3a, b, (1931).

square whorl-section with obsolescent secondary ribs at the ventro-lateral edges and a smooth periphery can be seen, as in the Kantcote specimen (at a smaller diameter). Towards the end, the ribbing becomes more distant, so that the last half whorl has only twelve ribs of which the first seven are fairly approximate and the last five distant. This change in ornamentation is similarly gradual in (the much more evolute) *Perisphinctes cristatus*, E. v. Klebelsberg¹, but more sudden in *P. martelli* (Oppel).

The three Franconian ammonites recently figured by P. Dorn² as *Perisphinctes orientalis* do not belong to the Kachh species.

Horizon.—Argovian (Upper Oxfordian), about *transversarius* zone.

Locality.—1 and 2 (near Burjjanwala Laman), Nos. K. 23-692b and K. 23-700.

2. PERISPINCTES cf. INDOGERMANUS, Waagen.

(Plate V, figs. 1a, b, 5.)

1931. *Perisphinctes indogermanus*, Waagen. Spath, Revision of the Jurassic Cephalopod Fauna of Kachh, *loc. cit.*, p. 418. (See there for synonymy.)

The larger example here figured has been slightly deformed in the rock, and has approximate dimensions:—105 —25 —29 —55. It is entirely septate but the suture-line is not distinctly visible and the general preservation is so poor that only the costation of the last quarter of the outer whorl can be relied on for provisional comparison with Waagen's species. Like the holotype of the latter, at the same diameter, the Attock form has an occasional single rib and the characteristic serpentine coiling, but the peripheral ribbing may have been rather coarser and sharper than in the Kachh form. Even if not identical with Waagen's species, however, the present example must have belonged to a closely allied form, though it represents only its inner whorls; for the ribbing changes considerably at a larger size, becoming first closer on the periphery and then (on the body-chamber or before) developing the distant and blunt *Perisphinctes* ornamentation.

A second, slightly larger example (diameter = 120 mm.) of presumably the same species is badly worn and the third example, of which the peripheral view is given in Plate V, fig. 5, also owes its apparent slenderness merely to the corrosion of the lateral areas, and in side-view closely resembles the original of fig. 1.

Since I discussed this species on a previous occasion, Dorn³ figured some Franconian examples of *Perisphinctes*, of which only the smallest (Plate X, fig. 4 only) has the typical ribbing, and may perhaps be attributed to Waagen's species. But the two larger fragments are much too closely-ribbed at a corresponding

¹ Die Perisphincten des Krakauer Unteroxfordien, *Beitr. Pal. Geol. Osterr.-Ung.*, Vol. XXV, p. 192; Pl. XVIII, fig. 3, (1912).

² Die Ammoniten-Fauna des untersten Malm der Frankenalb., *Palaeontogr.*, Vol. LXXIII, p. 123; Pl. I, figs. 2, 5; Pl. II, fig. 5, (1930).

³ *Loc. cit.* p. 148; Pl. X, figs. 2, 4; Pl. XI, fig. 6, (1930).

size and in any case, it is difficult to see how this author could group together in one species such widely different forms as the originals of his Plate X, fig. 4 and Plate XI, fig. 6, unless he considered the suture-lines or the rounded whorl-section as the decisive factor.

The bluntness of the ribbing in the Indian example is due to corrosion, but there is some resemblance to certain *Torquatisphinctes*, e.g., to *T. (?) romanicus* (Simionescu).¹ But size alone prevents exact comparison and the general assemblage favours reference to a form of *Perisphinctes*.

Horizon.—Argovian (Upper Oxfordian), about *transversarius* zone.

Locality.—1 and 4 (near Burjianwala Laman), Nos. K. 23-695c, d, i, j and K. 24-740, K. 24-759b.

3. PERISPHINCTES JELSKII, Siemiradzki.

(Plate IV, figs. 2-4; Plate V, figs. 6a, b.)

1931. *Lithacoceras jelskii* (Siemiradzki). Spath, Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch), *loc. cit.*, p. 457. (See there for synonymy.)

1930. *Perisphinctes jelskii*, Siemiradzki. Dorn, Ammoniten Fauna des untersten Malm der Frankenalb, *loc. cit.*, p. 142; Pl. X, fig. 1.

As in the case of *Prososphinctes virguloides*, Waagen's original of his *Perisphinctes martelli* is now refigured (Plate V, fig. 6) to enable palæontologists to check the accuracy of the somewhat idealised illustration. Unfortunately, the new material is too poorly preserved to throw any additional light on the question of the true affinities of this species, and while the two young examples represented in Plate IV, figs. 2-3 are, of course, too small to be definitely identified, the fragment illustrated in fig. 4 on account of oblique crushing now has an entirely different whorl-section.

This species is left in the original genus *Perisphinctes*, because I now have before me examples of the true *P. biplex* (J. Sowerby)² which also have already the body-chamber at a comparable size. They scarcely differ from this species, except, perhaps, in having slightly shorter secondaries (in some individuals) and until fully grown individuals are known it is impossible to class this species either with *Discosphinctes* (*lucingensis* group) or *Torquatisphinctes* (*alterneplicatus* group) or to consider it intermediate between the two.³ Dorn's *Perisphinctes jelskii*, not being based on Siemiradzki's⁴ original description is quite different from the form here understood and comparable to *Discosphinctes lucingensis* (Favre).

Horizon.—Argovian (Upper Oxfordian), about *transversarius* zone.

Localities.—1 (near Burjianwala Laman), No. K. 23-695 f. g, k and 7 (near Talidhok), No. K. 24-751c-f, j, k.

¹ Studii geologice si paleontologice din Dobrogea, I, Fauna Cefalopodelor jurasice dela Harsova, *Acad. Romana Publ. etc.*, No. XXI, p. 128; Pl. III, fig. 6.

² Mineral Conchology, Vol. III, p. 168; Pl. CCXCIII, fig. 1 only.

³ J. Siemiradzki, Monographische Beschreibung der Ammonitengattung Perisphinctes, *Paleontogr.*, Vol. XLV, p. 275, (1899).

⁴ Fauna Kopalna, etc., *Pam. Wydz. mat.-przzyr. Akad. Umiej. Krakowie*, T. XVIII, p. 47, (1891).

Genus: BIPLICES (v. Sutner) Siemiradzki, 1898.

1. BIPLICES *aff.* DE-RIAZI (Siemiradzki).

(Plate II, figs. 2a.)

1898. *Perisphinctes subrota* (non Choffat) de Riaz. Description des couches à *Peltoceras transversarium* de Trept (Isère), p. 31; Pl. XIV.

1899. *Perisphinctes* (*Procerites*) *de-riazi*, Siemiradzki. Monographische Beschreibung der Ammoniten-gattung *Perisphinctes*, *loc. cit.*, p. 309.

A number of fragments like that here figured, but some with more inclined ribbing, may be compared to the Trept form separated by Siemiradzki from Choffat's *Perisphinctes subrota*, discussed below, and Bukowski's similar *Per. promiscuus*. The figured example has approximate dimensions 135 — 31 — 31 — 48 which indicate a more involute form than the two species just mentioned, but the ribbing is very similar. Dorn's¹ example of his *P. promiscuus* (non Bukowski) with dimensions:—155 — 32 — 31 — 50 apparently also belongs to the present species and I am accepting Siemiradzki's species as valid, in spite of Dorn's² objections.

One fragment, in its slightly more oblique costation, resembles the example of *Perisphinctes chlorolithicus* (Gümbel) figured by Dorn³, but if this form is a *Dichotomosphinctes* of the *wartae* group, as appears from Dorn's redescription, then the resemblance is only accidental. The restored whorl-section in Plate II (fig. 2b) may be too rounded ventrally, but the Attock specimens are all worn and none shows a suture-line.

Horizon.—Argovian (Upper Oxfordian), *transversarium* zone.

Localities.—1 (near Burjjanwala Laman), Nos. K. 23-692c and K. 23-697i; 7 (near Talidhok) K. 24-750g.

2. BIPLICES *aff.* SUBROTA (Choffat).

(Plate II, figs. 7a, b; Plate III, fig. 7.)

1931. *Biplices subrota* (Choffat). Spath, Revision of the Jurassic Cephalopod Fauna of Kachh, Pt. IV, *loc. cit.*, p. 415.

1931. *Dichotomosphinctes* cf. *subrota* (Choffat). Spath, *ibid.*, p. 438. (See there for synonymy.)

This species which is at least as close to *Biplices promiscuus* (Bukowski)⁴ as to the typically more discoidal and more compressed *Dichotomosphinctes* (*plicatilis* group), is taken to be represented by the larger fragment figured in Plate II, fig. 7 and characterised by its quadrate whorl-section as well as the long lateral ribs. In *B. promiscuus*, the periphery is much more rounded and

¹ *Loc. cit.*, p. 151; Pl. XII, figs. 6a, b, (1930).

² *Ibid.*, p. 150.

³ *Ibid.*, p. 131; Pl. XVII, fig. 1.

⁴ Über die Jura-Bildungen von Czenstachau in Polen, *Beitr. Pal. Osterr.-Ung.*, etc., Vol. V, p. 137; Pl. XXVIII, fig. 1; Pl. XXIX, figs. 1-2, (1887).

the secondary ribs encroach more on the whorl-sides. Unfortunately the suture-line is not visible and the smaller fragment, represented in Plate III, fig. 7. is altogether doubtful, as are the other examples listed below.

Horizon.—Argovian (Upper Oxfordian), *transversarius* zone.

Localities.—7 (near Talidhok), Nos. K. 24-750a, and K. 24-751h, i; 9 (near Bagh Nilab), K. 24-759a.

3. BIPLICES sp. ind.

(Plate I, fig. 5.)

This form is discussed separately only because its more compressed whorl-section clearly differentiates it from the other serpenticonic Perisphinctids here described, but the preservation is very poor and comparison with a species like Choffat's¹ *Per. tiziani* (Oppel) var. *occidentalis* must be very tentative. What can be seen of the ribbing, especially the secondaries on the outer whorl-portion, is very similar, but there is no trace of suture-line, except on a septal surface at the end, and the sides are very corroded.

Horizon.—Argovian (Upper Oxfordian), *transversarius* zone.

Locality.—7 (near Talidhok), No. K. 24-751a.

Genus: PACHYPLANULITES, Spath, 1930.

1. PACHYPLANULITES PRALAIRESI (Favre).

(Plate III, figs. 4a-c.)

1875. *Ammonites pralairesi*, Favre. Description des fossiles du terrain jurassique de la Montagne des Voirons (Savoie), *Mém. Soc. pal. Suisse.*, Vol. II, p. 32; Pl. III, figs. 6-7.
1876. *Ammonites (Perisphinctes) pralairesi*, Favre. Description des fossiles du terrain Oxfordien des Alpes Fribourgeoises, *ibid.*, Vol. III, p. 46; Pl. V, fig. 4.
1890. *Perisphinctes pralairesi* (Favre). Michalski, Ammoniten der unteren Wolga-Stufe, *Mém. Com. géol.*, Vol. VII, p. 229.
1891. *Perisphinctes pralairesi* (Favre). Siemiradzki, Fauna Kopalna, etc., *Pam. Wydz. mat.-prz. Akad. Umiej. Krakowie*, T. XVIII, p. 69.
1892. *Perisphinctes pralairesi* (Favre). Siemiradzki, Die Oberjurassische Ammoniten-Fauna in Polen, *Zeit. Deutsch. Geol. Ges.*, Vol. XLIV, p. 477.
1894. *Perisphinctes pralairesi* (Favre). Futterer, Beiträge zur Kenntnis des Jura in Ost-Afrika, *ibid.*, Vol. XLVI (1893), p. 11; Pl. VI, fig. 4.
1899. *Perisphinctes pralairesi* (Favre). Siemiradzki, Monographische Beschreibung der Ammoniten-Gattung *Perisphinctes*, *loc. cit.*, p. 285.
1910. [?] *Perisphinctes pralairesi* (Favre). Dacqué, Dogger und Malm aus Ostafrika, *loc. cit.*, p. 19; Pl. II, fig. 3.
1928. *Perisphinctes pralairesi* (Favre). Welsch, Contribution à la connaissance des faunes jurassiques du Poitou. Étage Oxfordien-Argovien, *C. R. Acad. Sci. Paris* Vol. 187 (II), p. 165.

¹ *Loc. cit.*, p. 32; Pl. V, fig. 6 (5, 7), (1893).

1930. *Perisphinctes pralairi* (Favre). Dorn, Die Ammoniten-Fauna des untersten Malm der Frankenalb. *Palaeontogr.*, Vol. LXXIII, p. 155; Pl. XIII, figs. 6a, b.
1932. *Perisphinctes pralairi* (Favre). Lanquine, Sur l'extension, les facies, et les faunes de l'Argovien dans les chaines provencales, *C. R. Acad. Sci.*, Paris, Vol. 194, No. 7, p. 635.

The fragment under discussion consists of portions of four whorls and on account of partial limonitisation it is in a better state of preservation than the other *Perisphinctids* from the Attock district. It shows a comparatively simple suture-line, with deep external and short lateral lobes, comparable to that figured by Dorn, but less indented and with the principal lateral lobe especially somewhat simpler. The fragment has the *Stephanoceras*-like whorl-shape to which Siemiradzki has directed attention (1891, figure on page 69), with a broad periphery, and there is one pair of parabolæ (in the dark shadow at the lower end of fig. 4c) as in other *Pachyplanulites*. A conspicuous feature of the Attock example is the change in the direction of the costation from strongly oblique (on the three inner whorls) to radial (on the outer whorl). According to Siemiradzki a similar change is observed in *P. pralairi*, but it is not seen in Dorn's latest illustration.

The Kachh *P. subcolubrinus* (Waagen)¹ has a less coronate whorl-shape, while *P. pagri* and *P. subevolutus* (Waagen)² are still more depressed at a corresponding young stage. Dacqué's *Perisphinctes* cf. *pralairi* (non Favre?) which had already been included by Dietrich³ in the synonymy of *P. africanus*, may be more doubtful but I have previously⁴ recorded the existence of small and fragmentary specimens that appeared to be transitional between *Biplices africanus* and forms of *Pachyplanulites*.

Horizon.—Argovian (Upper Oxfordian), *transversarius* and *bimammatus* zones (fide Dorn).

Locality.—1 (near Burjianwala Laman), No. K. 23-695e.

Genus: DICHOTOMOSPINCTES, Buckman, 1926.

1. DICHOTOMOSPINCTES cf. ORBIGNYI (P. de Loriol).

(Plate II, fig. 5; Plate III, figs. 6a, b.)

1930. *Perisphinctes orbignyi*, P. de Loriol. Dorn, Ammoniten-Fauna des untersten Malm der Frankenalb, *loc. cit.*, p. 125 (pars).
1931. *Dichotomosphinctes orbignyi* (de Loriol). Spath, Revision of the Jurassic Cephalopod Fauna of Kachh, *loc. cit.*, Pt. IV, p. 434.

The small fragment figured in Plate II, fig. 5, shows the ribbing of this form more typically than some larger examples which are too much worn to

¹ See Spath, *loc. cit.* (Kachh Revision, III), p. 432.

² *Ibid.*, pp. 428-431.

³ Über eine dem mittleren Sauriermergel am Tendaguru äquivalente, rein marine Kimmeridge-bildung in Mahokondo, etc., *Palaeontograph.*, Suppl. VII, II Reihe, Pt. 1, p. 12, (1925).

⁴ *Loc. cit.*, p. 42, (1930).

be figured or definitely identified. The absence of a distinct point of bifurcation of the ribs and the apparently greater length of the secondaries are believed to be due to the corrosion of the fragments, but the suture-line is only very imperfectly preserved in some. They are referred to the present form merely because of their general resemblance to the *Perisphinctes plicatilis* (d'Orbigny *non* Sowerby) figured by de Riaz¹, especially the originals of his Plate III, figs. 1-3, which were cited by P. de Loriol² in the synonymy of his species. The smaller example represented in Plate III, fig. 6, is not complete enough for definite specific identification but also compares well with de Riaz's figures above cited, if not with Dorn's Franconian examples, most of which probably do not belong to this species.

Horizon.—Argovian (Upper Oxfordian), *transversarius* and *bimammatus* zones (fide Dorn).

Localities.—1 and 5 (near Burjianwala Laman), Nos. K. 23-695*h* K. 23-697*d*, K. 24-742*b*; and 7 (near Talidhok), K. 24-750*b*.

2. DICHOTOMOSPINCTES sp. ind.

(Plate I, figs. 2*a*, *b*.)

The septate fragment here figured is worn, and the suture-line (with strongly dependent umbilical elements) is incompletely shown; but it is discussed separately from the last species because it combines greater involution and increased whorl-height with an apparently different type of ribbing. This is merely slightly curved forward on the whorl-side, but there is no distinct peripheral sinus in the costation. The proportions are:—98 —34 —23 —42, but while these indicate a smaller umbilicus than that of *D. orbigny* the differences in ribbing might be due entirely to the corrosion, causing obliteration of the point of bifurcation of the ribs and an apparently more compressed whorl-section.

The example, however, is interesting because it shows good agreement (except possibly in its less closely-ribbed inner whorls) to the form figured by Dorn³ as *Perisphinctes* aff. *rhodanico* (Dumortier). This form, in my opinion, has nothing to do with Dumortier's⁴ species which is a *Discosphinctes*, with extremely fine and close costation and rapid increase in whorl-height, but the great resemblance in costation between Dorn's form and the Attock example may be due only to the corrosion of the latter. It is thus believed to represent some worn *Dichotomosphinctes* of the group of *D. orbigny*.

Horizon.—Argovian (Upper Oxfordian), *transversarius* and *bimammatus* zones (fide Dorn).

Locality.—1 (near Burjianwala Laman), No. K. 23-695*a*.

¹ *Loc. cit.*, p. 9, (1898).

² Étude sur les Mollusques et Brachiopodes de l'Oxfordien supérieur et moyen du Jura Ledonien, *Mém. Soc. F. S. Suisse*, Vol. XXIX, p. 81, (1902).

³ *Loc. cit.*, p. 141; Pl. XI, fig. 1, (1930).

⁴ Sur quelques gisements de l'Oxfordien inférieur de l'Ardèche, p. 62; Pl. III, (1871).

3. *DICHOTOMOSPHINCTES* aff. *GROSSOUVREI* (Siemiradzki).

(Plate III, figs. 5a, b; Plate VI, figs. 3a-c.)

1899. *Perisphinctes grossouvrei*, Siemiradzki. Monographische Beschreibung der Ammonitengattung *Perisphinctes*, *loc. cit.*, p. 193; Pl. XXVII, figs. 54-5.
1916. *Perisphinctes occultefurcatus* (non Waagen). Ronchadzé, *Perisphinctes de l'Argovien de Chézery et de la Faucille*, *Mém. Soc. Pal. Suisse*, Vol. XLIII, p. 31 (pars); Pl. III, figs. 24-25 only.
1924. *Perisphinctes* cf. *stenocycloides*, Siemiradzki. Spath, On the Blake Collection of Ammonites from Kachh, *loc. cit.*, p. 14.
1928. *Ataxioceras grossouvrei* (Siemiradzki). Welsch, Contribution à la connaissance des faunes jurassiques du Poitou, Étage Oxfordien-Argovien, *loc. cit.*, p. 465.

The larger example here figured has dimensions 62 — 36 — 28 (?) — 36, but it is entirely septate and the suture-line is not clearly traceable. As the specimen, moreover, is worn and the primary ribbing almost effaced, reference to this species is based largely on the pronounced peripheral projection of the secondary ribs. The whorl-section seems to differ from that of the holotype or the form figured by Ronchadzé (Text-fig. 14), but this is due to the absence of the body-chamber. On the other hand, the Attock example may represent merely the inner whorls of a homœomorphous, larger species.

D. helenae (de Riaz)¹ or at least the Kachh examples figured² differ from the form here described in their more rigid costation and larger umbilicus. *D. elizabethae* (de Riaz)³ and *D. thevenini* (Ronchadzé)⁴ are distinguished by slightly finer ribbing, but belong to the same group.

A second, larger, but worn example resembles the Kachh specimen previously⁵ referred to *Discosphinctes* ('*Lithacoceras*') *dybowskii* (Siemiradzki) and might, perhaps, equally well have been attached to this species. The third small fragment figured in Plate VI, fig. 3, is, of course, also doubtful, being deformed.

Horizon.—Argovian (Upper Oxfordian), *transversarius* and *bimammatus* zones (fide Dorn).

Locality.—1 (near Burjianwala Laman), Nos. K. 23-692a, K. 23-697c; 7 (near Talidhok), K. 24-751g.

4. *DICHOTOMOSPHINCTES* sp. nov. ? aff. *WAEHNERI* (Siemiradzki).

(Plate I, figs. 1a, b.)

1891. *Perisphinctes michalskii*, Bukowski. Siemiradzki, Fauna Kopalna, etc., *loc. cit.*, p. 62; Pl. V, fig. 1.
1898. *Perisphinctes waechneri*, Siemiradzki. Monographische Beschreibung der Ammonitengattung *Perisphinctes*, *loc. cit.*, p. 255.
1928. *Perisphinctes waechneri*, Siemiradzki. Welsch, Contribution à la connaissance des faunes jurassiques du Poitou, Étage Oxfordien-Argovien, *loc. cit.*, p. 465.
1930. *Perisphinctes stenocycloides*, Siemiradzki. Dorn, Ammoniten-Fauna des untersten Malm der Frankenalb, *loc. cit.*, p. 133 (pars).

¹ *Loc. cit.*, p. 15; Pl. VIII, figs. 1 (and 3 ?), (1898).² Spath, *loc. cit.*, p. 436; Pl. LXVIII, fig. 9; Pl. LXX, fig. 5, (1928).³ *Loc. cit.*, p. 22; Pl. XII, figs. 4-5, (1898).⁴ *Loc. cit.*, p. 33; Pl. III, figs. 26-27, (1916).⁵ Spath, *loc. cit.*, p. 452; Pl. LXXI, figs. 3a, b, (1931).

The figured example shows undoubted resemblance to *Prososphinctes virguloides*, but the ribbing is not so distinctly projected and differs from that of Siemiradzki's holotype merely in having longer secondaries. The periphery is also more evenly rounded than in Waagen's species and the whorl-section compares well with that of Dorn's *Perisphinctes stenocycloides* (Text-fig. 19, p. 134). The specimen is entirely septate, but the suture-lines have suffered from corrosion. Apparently they agree with the suture-line of *P. virguloides* previously figured¹, although the lateral saddle is higher than the external.

The comparison to *D. waehneri* is open to objection, if this species be identical with *D. stenocycloides* (Siemiradzki)², for then its short secondary ribs are against closer relationship. The forms figured by Lee³ and Neumann⁴, and especially Ronchadzé's⁵ example are also more closely ribbed, but since they as well as Dorn's form do not seem to me to belong to the original *D. waehneri* I am provisionally retaining that species. It is probable that the Attock form represents a new species, transitional between the *waehneri* group and *Prososphinctes* of the group of *P. virguloides* and *P. idocerooides*, Spath.⁶ In this connexion it seems significant to me that Siemiradzki considered his *P. waehneri* to show resemblance to *Ammonites championneti*, Fontannes⁷, for this also has comparatively long secondaries, although it probably belongs to another group.

Biplices africanus (Dacqué)⁸, which at first sight shows great similarity to the present species, has almost straight peripheral ribbing and probably belongs to a slightly later horizon.

Horizon.—Argovian (Upper Oxfordian), *transversarius* and *bimammatus* zones (fide Dorn).

Localities.—1 (near Burjianwala Laman), No. K. 23-690; 7 (near Talidhok), No. K. 24-750h ? (very doubtful fragment).

Genus: PROSOPHINCTES, Schindewolf 1925, emend.

1. PROSOPHINCTES VIRGULOIDES (Waagen).

(Plate I, figs. 3, 4a, b, 6; Plate II, figs. 3, 4a, b; Plate IV, figs. 5a, b; Plate V, fig. 7.)

1928. *Prososphinctes virguloides* (Waagen). Spath, Revision of the Jurassic Cephalopod

Fauna of Kachh (Cutch), *loc. cit.*, Pt. IV, p. 441 (see there for synonymy).

non 1932. *Perisphinctes virguloides*, Waagen. Lanquine, *op. cit.* (C. R. Acad. Sci. Paris, Vol. 194, No. 7), p. 635.

¹ Spath, *loc. cit.*, Pl. LXX, fig. 3, (1931).

² *Loc. cit.*, p. 254; Pl. XX, fig. 11, (1898).

³ Contribution à l'étude stratigraphique et paléontologique de la Chaîne de la Faucille, *Mém. Soc. Pal. Suisse*, Vol. XXXII, p. 77, (1905).

⁴ Die Oxfordfauna von Cetechowitz, *Beitr. Pal. Geol. Öst.-Ung.*, Vol. XX, p. 27; Pl. III, fig. 21, (1907).

⁵ *Loc. cit.*, p. 23; Pl. III, fig. 21, (1917).

⁶ The Ammonite Faunas of the Neighbourhood of Mombasa, *Monogr. Hunterian Museum*, Univ. Glasgow, IV, Pt. 3, p. 46; Pl. III, figs. 5a, b, (1930, 20th March). Dorn (*loc. cit.*, p. 168; Pl. XIV, fig. 3 [lectotype]), later in 1930, again used this name, but his form (*Prososphinctes evolutooides*, nom. nov.) is not an *Idoceras* any more than *Grossouviria calloviensis* (Loosy). (See Spath, *loc. cit.*, p. 363, [1931].)

⁷ In Dumortier and Fontannes, Description des Ammonites de la zone à *Ammonites tenuilobatus* de Crussol, etc., p. 79; Pl. IX, (1876).

⁸ See Spath, *loc. cit.*, p. 42, text-fig. 1; Pl. IV, fig. 12, Mombasa, (1930).

Since this species has so frequently been misinterpreted and since Waagen's original illustration may be thought to be too diagrammatic I am now refiguring the holotype (Plate I, fig. 6; Plate II, fig. 3). The small example depicted in 1928 (Plate XC, fig. 4) was marked as doubtful and shows neither the characteristic peripheral projection of the ribs nor the narrowness of the ventral area, although this is partly the fault of the photograph. Waagen's figure, on the other hand, will be seen to be quite successful, considering it is largely restored.

There is little to add to my previous discussion of this species, but the dimensions quoted (after Waagen and Siemiradzki) were not checked. Since the material from Attock includes a number of typical specimens as well as some varieties, I am now figuring several and hope that they will help to make this species more widely known. The best example is that represented in Plate II, fig. 4, which has dimensions:—92 —33 —26 —42 as against 108 —30 —27 —48 in the holotype. It thus differs in having a smaller umbilicus, probably not a specific difference, but the ribbing is identical as is the suture-line, with its short lateral lobe, so far as can be seen. The present termination of the shell being damaged, it is probable that the whorl-section (fig. 4b) is too rounded, *i.e.*, not compressed enough at the periphery, as it is on the earlier portion and in the holotype. Conversely the typical fragment figured in Plate IV, fig. 5, is too compressed, but only by accidental deformation in the rock like the more doubtful example represented in Plate I, fig. 4. This shows traces of the last suture-line and although the whorl-section may not be relied on, owing to the fracturing, the agreement in ribbing is unmistakable. The proportion of whorl-height to thickness in this fragment is as 32:26.

Some more examples attached to the present species, like those figured in Plate I, fig. 3 (peripheral view), and Plate V, fig. 7 (side-view), are rather poorly preserved, but the peripheral sinus in the ribbing is considered characteristic. In the case of a still greater number, unfortunately, the identification must remain altogether problematical.

Horizon.—Argovian (Upper Oxfordian), *transversarius* (or *bimammatus* ?) zone.

Localities.—1 and 5 (near Burjianwala Laman), Nos. K. 23-693; K. 23-697a, b, e-h; K. 24-742a; 7 (near Talidhok), Nos. K. 24-750c-f; K. 24-751b.

c. Family : *BERRIASELLIDAE*, Spath.

1. Sub-family : *BERRIASELLINAE*, Spath.

Genus : *BERRIASELLA*, Uhlig 1905, emend.

1. *BERRIASELLA* ? sp. ind.

(Plate VI, figs. 9a, b.)

[Compare :—*Berriasella vetusta* (Steuer), Argentinische, Jura-Ablagerungen, *Pal. Abh.* N. F., Vol. III (1897), p. 57 (183); Pl. XVI (XXX), figs. 4-5 (lectotype).]

The characteristic features of the fragmentary example here figured, in the absence of the suture-line, are the evolute whorl-shape, with a conspicuous, rounded and smooth umbilical edge and somewhat flattened sides, also the

irregular ribbing and the hoplitid periphery, agreeing with that of Oppel's¹ *Amm. theodorii*. This species refigured by Uhlig², however, has umbilical tubercles and even in a less nodate form like *Hoplites* (*Neocomites*) *indicus* Uhlig³ the strongly sigmoidal ribbing denotes a different group of forms so that the Attock example is not now referred to *Neocomites* but (doubtfully) to *Berriasella*. The resemblance to the small example figured by Blanford⁴ as *Amm. wallichi*, which made me record this fragment first as *Neocomites*, is however very close.

The presence of one pair of ribs separating near the umbilical border and of single costæ between others that bifurcate at the middle of the side definitely differentiates the Attock form from the more regularly and finely-ribbed species of *Parodontoceras* like *P. calisto* (d'Orbigny)⁵ or *P. carpathica* as figured by Killan⁶, although the original illustration of Oppel's type (in Zittel)⁷ with irregular costation seems to differ merely in its narrower umbilicus. There is better agreement, however, with the restricted *Berriasella* of the *privasensis* group, to which the South American *B. vetusta* belongs. Pictet's holotype⁸ has somewhat coarser ribbing than the Attock form and is more involute whereas the variety figured in his fig. 2, although it has a larger umbilicus, is less closely comparable in ribbing. In *B. vetusta*, which is somewhat transitional to *Blanfordiceras*, the more inflated whorl-section causes a rather different aspect. *B. subprivasensis*, Krantz⁹, which is a similar passage-form to *Blanfordiceras*, if Weaver's¹⁰ identification is correct, is also closely comparable to the Attock form, but more bluntly ribbed.

Since species like the present occur in the uppermost Jurassic as well as in the lowermost Cretaceous, a single fragment of doubtful preservation would not seem to be of much stratigraphical value. *B. vetusta*, in any case, has been found in South America¹¹ to be definitely below the border-line, while *B. privasensis* also has been taken to be the zonal ammonite of the uppermost Tithonian to be replaced, in the lowest Infra-Valanginian, by *Parodontoceras calisto* (d'Orbigny), *P. callistoides* (Behrendson)¹² passing from the upper Tithonian unchanged into the Cretaceous.¹³ Blanford's Niti pass specimen, above referred to, partly pyritic, is undoubtedly from the upper (Cretaceous) beds.

¹ Paläontologische Mitteilungen, IV, Über ost-indische Fossilreste, I, p. 280; Pl. LXXVIII, figs. 3a-c, (1863).

² Fauna of the Spiti Shales, Fasc. 2, *Pal. Ind.*, Ser. XV, Vol. IV, p. 260; Pl. LXXXIX, fig. 1, (1910).

³ *Ibid.*, p. 262; Pl. LXXXIX, fig. 4.

⁴ In Salter and Blanford, Palaeontology of Niti, p. 84; Pl. XIX, figs. 1a, b (reversed and restored), (1865).

⁵ Paléontologie Française, Terrains jurassiques, Vol. I, Céphalopodes, p. 551; Pl. CCXIII, figs. 1-2, (1850).

⁶ Mission d'Andalousie, I, Le Gisement tithonique de Fuente de los Frailes, II, Etudes paléontologiques, *Mém. Acad. Sci. Paris*, Vol. XXX, p. 660; Pl. XXX, fig. 1, (1889).

⁷ Cephalopoden der Stramberger Schichten, *Pal. Mitteil.*, Vol. II, I, p. 107; Pl. XVIII, figs. 4a-d (lectotype), (1868).

⁸ Etudes paléontologiques sur la faune à *Terebratula diphyoides* de Berrias (Ardèche), *Mélanges pal.*, II, p. 84; Pl. XVIII, fig. 1 only, (1867).

⁹ Die Ammoniten des Mittel- und Obertithons, *Geol. Rundschau*, Vol. XVIIa, p. 438 (unfigured), (1926).

¹⁰ Palaeontology of the Jurassic and Cretaceous of West Central Argentina, *Mem. Univ. Washington*, Vol. I, p. 443; Pl. LVI, figs. 356-7, (1931).

¹¹ See Gerth, Contribuciones a la estratigrafía y paleontología de los Andes Argentinos, *Act. Acad. Nac. Cienc. Córdoba*, Vol. IX, p. 41.

¹² See Spath, Ammonites of the Speeton Clay and the Subdivisions of the Neocomian, *Geol. Mag.*, Vol. LXI, p. 80 (Table III), (1924).

¹³ Gerth, La Fauna neocomiana de la Cordillera Argentina en la parte meridional de la Provincia de Mendoza, *Act. Acad. Nac. Cienc. Córdoba*, Vol. IX, p. 88.

Horizon.—Uppermost Tithonian, *privasensis* zone? or Lower Cretaceous?

Locality.—9 (near Bagh Nilab), No. K. 24-760.

Genus: BLANFORDICERAS, Cossmann, 1907.¹

1. BLANFORDICERAS WALLICHI (Gray).

(Plate VI, figs. 6a, b.)

- 1830-32. *Ammonites wallichi*, Gray. Illustrations of Indian Zoology, Vol. I, Pl. C, fig. 3.
1863. *Ammonites wallichi*, Gray. Blanford, On Dr. Gerard's Collection of Fossils from the Spiti Valley, *Journ. As. Soc. Beng.*, Vol. XXVII, p. 127; Pl. III, figs. 2-3.
1865. *Ammonites wallichi* (Gray). Blanford in Blanford and Salter, Palæontology of Niti, p. 84; Pl. XV, fig. 1; Pl. XIX, fig. 1.
1865. *Ammonites parkinsoni* (Sowerby), Stoliczka, Geological Sections across the Himalayan Mountains, etc., *Mem. Geol. Surv. Ind.*, V, p. 98.
1903. *Ammonites wallichi* (Gray). Crick, Note on Dr. Gray's Type-specimens of Jurassic Ammonites from India, *Proc. Malac. Soc.*, Vol. V, p. 287.
1903. *Hoplites wallichi* (Gray). Uhlig in Burekhardt, Beiträge zur Kenntnis der Jura- und Kreide-Formation der Cordillere, *Palæontogr.*, Vol. I, p. 65.
1904. *Ammonites wallichi* (Gray). Crick, Notes on the Cephalopoda belonging to the Strachey Collection from the Himalaya, *Geol. Mag.*, Dec. V, Vol. I, p. 13.
1904. *Hoplites wallichi* (Gray). G. Böhm Beiträge zur Geologie von Niederländisch Indien I, 1, Grenzsichten zwischen Jura und Kreide, *Palæontogr. Suppl.*, IV, I, 1, p. 31; Pl. III, fig. 4; Pl. IV; Pl. V, fig. 1.
1905. *Blanfordia wallichi* (Gray). Uhlig, Einige Bemerkungen über die Ammoniten-Gattung *Hoplites*, Neumayr, *Sitzb. Math.-Nat. Kl. Akad. Wiss. Wien*, Vol. CXIV, p. 605.
1910. *Hoplites (Blanfordia) wallichi* (Gray). Uhlig, Fauna of the Spiti Shales, Fasc. 2, *loc. cit.*, p. 186; Pl. XXIX, figs. 1-3; Pl. XXX, fig. 1; Pl. XXXI, figs. 1, 2.
1923. *Blanfordiceras wallichi* (Gray). Spath in Trechmann, Jurassic of New Zealand, Appendix, *Quart. Journ. Geol. Soc.*, Vol. LXXIX, p. 302.
1925. *Blanfordiceras wallichi* (Gray). Spath, Ammonites and Aptychi from Somaliland, *Monogr. Hunterian Mus.*, Univ. Glasgow, Vol. I, p. 145.
1925. *Blanfordiceras wallichi* (Gray). Gerth, La Fauna neocomiana de la Cordillera Argentina, etc., *Act. Acad. Nac. Cienc. Rep. Argentina*, Vol. IX, p. 93.
1926. *Hoplites (Blanfordia) wallichi* (Gray). Kruizinga, Ammonieten en eenige andere fossielen uit de jurassische afzettingen der Soela eilanden, *Jaarb. Mijnwezen Ned. Ind.*, Vol. 54, p. 79, (1925).
1928. *Blanfordia wallichi* (Gray). Grabau, Stratigraphy of China, Vol. II, p. 486, fig. 610.
1933. *Blanfordiceras* sp. Spath, Revision of the Cephalopod Fauna of Kachh, *loc. cit.*, Pt. VI, p. 694.

Gray's holotype (B. M. No. C 5041) is before me and the Attock example is indistinguishable from it at a corresponding diameter; but as it was originally pyritic and is now limonitised, it has suffered the usual distortion by swelling. Uhlig himself had stated that not one of his many examples was identical with

¹ *Revue Critique de Paléozoologie*, Vol. XI, No. 1, p. 64, (Jan. 1907).

Gray's holotype: conversely I have before me varieties that have more finely-ribbed inner whorls than are shown in any of Uhlig's figures and seem somewhat transitional to *Andiceras*. Yet although the species has been interpreted too widely in the past when it was taken to include, e.g., forms of the Cretaceous genus *Pseudoblanfordia*¹ and although it has even been confused by Grabau with the Lower Liassic *Schlotheimia*², it is an easily recognised form. Its horizon, however, in the Spiti Shales, has never been determined, and while Uhlig³ was inclined to consider it mainly of Upper Tithonian age, but possibly passing up into the Cretaceous, Burckhardt⁴, more recently recorded his Mexican '*Blanfordia*' cfr. *wallichi* from beds (with *Kossmatia*) about 400 feet below the *Steuero-ceras* beds which (with a similar thickness) are themselves overlain by the Infra-Valanginian *Spiticeras* beds.

Horizon.—Uppermost Tithonian, *privasensis* zone?

Locality.—1 (near Burjianwala Laman), No. K. 23-691.

2. BLANFORDICERAS AFF. BOEHMI (Uhlig).

(Plate VI, figs. 7a-c.)

1910. *Hoplites (Blanfordia) boehmi*, Uhlig. Fauna of the Spiti Shales, Fasc. 2, *loc. cit.*, p. 195; Pl. XXXIV, figs. 1a-d.

1928. *Blanfordia boehmi*, Uhlig. Grabau, Stratigraphy of China, Vol. II, p. 487, fig. 611.

The identification of the limonitic fragment here figured must remain provisional since it is so small and does not show the suture-line distinctly. The *Reineckeia*-like spines at the points of branching of the ribs are sharp and prominent, whereas in the typical *Blanfordiceras* of the *wallichi*-group, the finely ribbed inner whorls are quite perisphinctoid. This species, thus, is transitional to *Himalayites*.

Comparison may also be made to forms like '*Berriasella*' *spinulosa*, Gerth⁵, on the one hand and to *Himalayites egregius* (Steuer) Gerth⁶ on the other; for the former was referred to the lowest Infra-Valanginian (zone of *Kilianella burckhardti*) and the latter to the highest (zone of '*Thurmannia*' *fraudans*) so that forms like the present are likely to be found (together with *Spiticeras*) in the lowest Cretaceous.

Horizon.—Lowest Infra-Valanginian (*Spiticeras* beds)?

Locality.—6 (near Talidhok), No. K. 24-749.

¹ Spath, *loc. cit.* p. 145, (1925)=group of *Hoplites australis*, Burckhardt, *loc. cit.* p. 64; Pl. XI, figs. 9-12, (1903).

² A Lower Cretaceous Ammonite from Hongkong, *Bull. Geol. Surv. China*, No. 5, Pt. 2, p. 199; Pl. 1, (1923). Also Geology of China, II, pp. 494 and 774; Pl. IX, (1928).

³ Die Fauna der Spiti-Schiefer des Himalaya, ihr geologisches Alter und ihre Weltstellung, *Denkschr. Math.-Nat. Kl. K. Akad. Wiss. Wien.*, Vol. LXXXV, p. 552, (1910).

⁴ Étude synthétique sur le Mésozoïque mexicain, *Mém. Soc. Pal. Suisse*, Vol. XLIX, Table 6, p. 76.

⁵ *Loc. cit.* (1925, Fauna Neocomiana), p. 91; Pl. VI, figs. 1-2.

⁶ *Ibid.*, p. 73; Pl. II, fig. 7.

2. Sub-family: *HIMALAYITINAE*, Spath.Genus: *AULACOSPINCTES*, Uhlig 1905, emend. Spath.1. *AULACOSPINCTES* sp. juv. cf. *PROXIMUS* (Steuer).

(Plate VI, figs. 10a, b.)

1897. *Reineckeia proxima*, Steuer. Argentinische Jura-Ablagerungen, *Pal. Abh.*, N. F., Vol. III, p. 160; Pl. XXII (VIII), figs. 7-11.
1907. *Perisphinctes proximus* (Steuer). Haupt, Beiträge zur Fauna des oberen Malm und der unteren Kreide in der argentinischen Cordillere, *N. Jb. f. Min.*, etc., Beil.-Bd. XXIII, p. 192.
1910. *Perisphinctes (Aulacosphinctes) proximus* (Steuer). Uhlig, Fauna of the Spiti Shales Fasc. 3, *loc. cit.*, p. 347.
1926. *Aulacosphinctes proximus* (Steuer), Krantz. Die Ammoniten des Mittel-und Obertithon, *Geol. Rundschau*, Vol. XVII a, p. 458.
1931. *Aulacosphinctes proximus* (Steuer). Weaver, Paleontology of the Jurassic and Cretaceous of West Central Argentina, *loc. cit.*, p. 411; Pl. XLIV, figs. 298-9 (?).

There is only a small fragmentary specimen, in a poor state of preservation, and the comparison to a South American species must not be taken to imply that the Attock example could not represent the inner whorls of a similar Himalayan species of the group of *A. mörikeanus* (Oppel)¹, although these do not seem to have so many single ribs. The suture-line is not distinctly visible but the peripheral groove is as pronounced as in Steuer's fig. 11 which also shows the greatest similarity in ribbing and whorl-shape.

A. proximus has been recorded by Stehn² from his zone of *Berriasella* [*Corongoceras*] *mendozaana* and the absence of the typical *Aulacosphinctes* in the *Virgatosphinctes* beds of Kachh and Madagascar makes it probable that the Himalayan *mörikeanus*-group is of Upper Tithonian age, as Uhlig³ held.

Horizon.—Uppermost Tithonian, *-privasensis* zone?

Locality.—1 (near Burjianwala Laman), K. 23-692d.

d. Family: *OLCOSTEPHANIDAE*.Sub-family: *SPITICERATINAE*, Spath 1925.Genus: *SPITICERAS*, Uhlig, 1903.1. *SPITICERAS* sp. ind.

(Plate VI, figs. 8a, b.)

There is no doubt about the generic position of this form, but its fragmentary condition prevents specific identification with any of the Himalayan types described by Uhlig. There is no recognisable suture-line and while the whorl-section (fig. 8b) is common to various species of *Spiticeras*, the evolution and

¹ See Uhlig, *loc. cit.* (Fasc. 2, 1910), p. 351; Pl. XXXIII, fig. 2.

² Fauna und Gliederung des Neocoms in der argentinischen Cordillere, *Centralbl. f. Min.*, etc., p. 148, (1921).

³ *Loc. cit.*, p. 551, (1910).

narrowness of the penultimate whorl indicate a serpenticone form of the group of *S. subbilobatum* (Uhlig).¹ The fragment figured by Uhlig² as *S. sp. nov. indet.* is also very similar, but in the typical *S. spitiense* (Blanford)³, the tubercles are stronger, especially on the inner whorls.

Among the numerous European and especially French forms more recently described by Djanelidzé⁴, there is also none that agrees with the Attock form, but it is important to note that the comparable Spiti forms are all listed as Cretaceous and as true *Spiticeras*, in the restricted sense, and that the Tithonian fore-runners like *S. celsum* (Oppel) and *S. pseudogroteanum*, 'Djanelidzé' are less closely comparable.

Horizon.—Lowest Infra-Valanginian, *Spiticeras* beds.

Locality.—1 (near Burjianwala Laman), No. K. 23-696.

e. Family : *DIPLOCERATIDAE*, Spath.

Genus : *OXYTROPIDOCERAS*, Stieler, 1921.

1. *OXYTROPIDOCERAS* aff. *ROISSYANUM* (d'Orbigny).

(Plate VI, figs. 1a-c.)

1840. *Ammonites roissyanus*, d'Orbigny. *Paléontologie Française, Terrains Crétacés*, p. 302; Pl. LXXXIX, figs. 1-3.
1895. *Schloenbachia roissyana* (d'Orbigny). Parona and Bonarelli, *Fossili albiani d'Escrag-nolles, etc., Pal. Italica*, Vol. II, p. 88; Pl. XI, figs. 7-8.
1906. *Schloenbachia* cf. *roissyana* (d'Orbigny). R. Douvillé, *Sur des Ammonites du Crétacé Sud-Américain. Ann. Soc. Roy. Zool. Malac. Belgique*, Vol. XLI, p. 147; Pl. IV, figs. 3, 3a.
1907. *Mortoniceras ? roissyana* (d'Orbigny). Jacob, *Études paléontologiques et stratigraphiques sur la partie moyenne des terrains crétacés, etc., Trav. Lab. Géol. Grenoble*, p. 383.
1910. *Schloenbachia roissyana* (d'Orbigny). Böse, *Monografia geologica y paleontologica del Cerro de Mulero, Bol. Inst. Geol. Mexico*, No. 25, p. 66.
1911. *Schloenbachia (Mortoniceras) roissyana* (d'Orbigny). Schlagintweit, *Die Fauna des Vracon und Cenoman in Peru, N. Jahrb. f. Min., etc., Beil.-Bd. XXXIII*, p. 64, (pars).
1920. *Oxytropidoceras roissyana* (d'Orbigny). Stieler, *Über sogenannte Mortoniceraten des Gault, Centralbl. f. Min., etc.*, p. 398.
1921. *Pseudophacoceras roissyana* (d'Orbigny). Spath, *Cretaceous Cephalopoda from Zululand, Ann. S. Afr. Mus.*, Vol. XII, Pt. VII, No. 16, p. 281.
1922. *Pseudophacoceras (Oxytropidoceras) roissyana* (d'Orbigny). Spath, *Cretaceous Ammonoidea from Angola, etc., Trans. Roy. Soc. Edinburgh*, Vol. LIII, Pt. 1, No. 6, p. 98.

¹ *Loc. cit.* (Fauna of the Spiti Shales, Fasc. 1), p. 98; Pl. X, fig. 2, (1908).

² *Ibid.*, p. 129; Pl. XI, fig. 4.

³ See Uhlig, *ibid.*, p. 89; Pl. VIII, fig. 1.

⁴ Les *Spiticeras* du S.-E. de la France, in Kilian, *Contributions à l'étude des céphalopodes paléo-crétacés du S. E. de la France, Mém. Explic. Carte géol. dét. France*, p. 207; Pls. I-XXII, (1922).

1924. *Mortoniceras* (*Schloenbachia*) *peruanum* (v. Buch). Lisson, Edad de los Fosiles Peruanos, etc., *Contr. Geol. Peru* (3rd ed.), p. 146.
1926. *Inflatoceras roissyanum* (d'Orbigny). Jayet, Étude stratigraphique de la Perte-du-Rhône, etc., *Eclogae geol. Helvet.*, Vol. XX, No. 2, pp. 176, 179.
1930. *Oxytropidoceras roissyanum* (d'Orbigny). Spath, Lower Cretaceous Ammonoidea, in Fossil Fauna of the Samana Range, etc., Pt. V, *Pal. Indica*, N. S., Vol. XV, p. 61; Pl. IX, fig. 12.
1931. *Oxytropidoceras roissyanum* (d'Orbigny). Spath, Monograph of the Ammonoidea of the Gault, *Pal. Soc.*, Pt. 8, p. 348.

This form is represented by two fragments of which the one here figured is less corroded than the other. It formed part of the body-chamber, with the septal surface at the smaller end representing the termination of the camerate stage, but the unfigured fragment of about similar dimensions (in the unweathered condition) is entirely septate. The suture-line, however, is simplified by wear and incomplete at the ventral end (left in fig. 1c), owing to the weathering off of the periphery. In the figured example, the ventral keel is also worn away and the restoration (fig. 1b) of the high carina is based on the section of the previous whorl. The inner half of the whorl-side is also corroded, which accounts for the apparently more sigmoidal course of the ribbing, but the general whorl-shape is undoubtedly that represented in d'Orbigny's fig. 2.

In view of the many species of this genus in existence the specific identification, of course, is not meant to be more than approximate, yet the large fragment figured by Parona and Bonarelli is closer to the Attock example than any of the other illustrations to be found in geological literature. Even the difference in the section of the inner whorl is probably without significance, owing to the obliquity of the section, and the differences in the suture-line are equally unimportant.

Schloenbachia sp. (cf. *chihuahuensis*, Böse) figured by Douglas¹ is similar, and the Mexican type², with straighter ribs, has a similar whorl-section, but the peripheral termination of the ribs is typically far less projected in Böse's species. On the other hand *O. buarquianum* (White)³ to which Douglas's Peruvian form just mentioned may belong, has slightly coarser ribbing and is apparently transitional to *O. trinitense* (Gabb).⁴

Amm. peruvianus, v. Buch⁵, which according to Steinmann⁶ has narrow ribs and broader inter-spaces, may be closer to the present species than to *O. acutocarinatum*, discussed below, but the large Colombian fragment which I previously attached to v. Buch's species is too finely ribbed and may only represent the body-chamber of a large *O. supani* (Lasswitz)⁷, itself only a variety of *O. acutocarinatum*, discussed below. As the type of *O. peruvianum*, however,

¹ Geological Sections through the Andes of Peru and Bolivia, III, from the Port of Callao to the River Perene, *Quart. Journ. Geol. Soc.*, Vol. LXXVII, p. 269; Pl. XVII, fig. 3, (1921).

² *Loc. cit.*, p. 73; Pl. VII, figs. 3-4; Pl. VIII, figs. 1-2, (1910).

³ Contributions to the Geology of Brazil, p. 222; Pl. XXIV, figs. 3-4, (1887).

⁴ See Adkins, Handbook of Texas Cretaceous Fossils, *Univ. Texas Bull.*, No. 2838, p. 227; Pl. V, fig. 3, (1928).

⁵ Pétrifications recueillies en Amérique par M. A. de Humboldt et M. Ch. Degenhardt, p. 5; Pl. I, figs. 5-7.

⁶ Über Tithon und Kreide in den peruanischen Anden, *Neu. Jahrb. f. Min.*, etc., II, p. 140, (1881).

⁷ Kreide-Ammoniten von Texas, *Geol. und Pal. Abhandl.*, Vol. IV, Heft 4, p. 22; Pl. IV, fig. 3, (1904).

is in Berlin (*vide* Steinmann) it ought to be possible to decide whether it is the same as d'Orbigny's *O. roissyanum* as e.g., Schlagintweit and Lisson maintained, for in that case the older name would have to be used. Judging by the figure (v. Buch's fig. 5) *Amm. peruvianus* is more like *O. acutocarinarum*, i.e., it is what Marcou¹ considered to be *Amm. peruvianus*.

Horizon.—Middle Albian, about upper part of Lower Gault.

Locality.—12 (near Sujhanda), Nos. K. 24-775a, b.

2. OXYTROPIDOCERAS cf. ACUTOCARINATUM (Shumard).

(Plate VI, figs. 2a-c).

1854. *Ammonites acutocarinarus*, Shumard. Palæontology, Description of the species of Carboniferous and Cretaceous fossils collected, in R. B. Marcy, Exploration of the Red River of Louisiana in the year 1852, p. 183; Pl. III, fig. 1.
1920. *Oxytropidoceras acutocarinarum* (Shumard). Stieler, Über sogenannte Mortoniceraten des Gault, *loc. cit.*, p. 398.
1921. *Pseudophacoceras acutocarinarum* (Shumard). Spath, Cretaceous Cephalopoda from Zululand, *loc. cit.*, p. 283.
1928. *Oxytropidoceras acutocarinarum* (Shumard). Adkins, Handbook of Texas Cretaceous Fossils, *loc. cit.*, p. 226.

This is a slightly more finely-ribbed form than the last and the ribbing is characterised by being sometimes bifid and by being (on the side not figured, which was oyster-coated, but retained the test) of that peculiar *multifida*-type which was described by Douglas² from some South American forms. The costae are flattened and the intervening grooves are very narrow compared with the broad ribs, but on the weathered side (figured), the ribs are apparently sharper, as in the many transitions to the last species and to *Adkinsites (belknapi)* group). It is, of course, often found that the ribbing varies greatly in these forms with the mode of preservation, and since I have had the opportunity of examining many specimens from Texas, by the kindness of Prof. W. S. Adkins, I am prepared to accept forms like *O. carbonarium* (Gabb)³, *O. multifidum* (Steinmann)⁴, and *O. supani* (Lasswitz)⁵ all previously⁶ taken as distinct species, to be mere varieties of *O. acutocarinarum*. Since Prof. Adkins has shown that the identity of this species is somewhat doubtful and since I have already mentioned that there is a possibility of its being the same as v. Buch's *Amm. peruvianus*, the continued use of the name *O. acutocarinarum* may seem open to criticism. But the examination of a suite of large specimens of the *supani* type will convince most palæontologists that the closeness of the ribbing in any given fragment is not of specific significance, varying with size in often a quite erratic manner. Similarly the separation of a form like *Schloenbachia* aff.

¹ Geology of North America, p. 34; Pl. V, figs. 1, 1a, b, (1858).

² *Loc. cit.*, Text-fig. 4 A, B, p. 268, (1921).

³ Notes on American Cretaceous Fossils, with Descriptions of some new species, *Acad. Nat. Sci. Phila. Proc.* 3, Vol. XXVIII, p. 269; Pl. XXXVIII, figs. 2, 2a, b.

⁴ *Loc. cit.*, p. 139; Pl. VII, fig. 1 (*Schloenbachia acutocarinarum* var. *multifida*), (1881).

⁵ *Loc. cit.*, p. 22; Pl. IV, fig. 3 ('*Sonneratia*'), (1904).

⁶ Spath, *loc. cit.*, p. 283, (1921).

