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PART III.

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By

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

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

BY

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

PART III.

Super-family: *STEPHANOCERATIDAE.*

Since the Jurassic deposits of Kachh have yielded only very few pre-Callovian Cephalopods, it is unnecessary to deal in detail with the early members of the present super-family. The Stephanoceratidae* in the restricted sense, although typically Bajocian, with genera like *Polyplectites* (= group of *Amm. linguiferus* d'Orbigny and *'Stephanoceras' daubenyi*, Gemmellaro) undoubtedly persisted to the Middle and even Upper Bathonian (Siemiradzkian and Oxyceritan). No forms of this family, or of Sphaeroceratidae and of Tulitidae, descendants of Stephanoceratidae s.s., have yet been found in Kachh.

There are, however, certain members of the two Bajocian-Bathonian families Parkinsonidae and Morphoceratidae, also descendants of Stephanoceratids s.s., that may be discussed since they show similarity to the Kachh form described by Waagen as *'Perisphinctes' decorus*. This species, for which the new generic name *Epimorphoceras* is proposed below, will require detailed discussion. It had been included already by Lemoine in *Reineckeia*, but it is of the same early age as *Procerites hians* and *'Perisphinctes' congener* (Waagen), described in the next part of this work. The earliest cephalopods so far known from Kachh are probably *Megateuthis* sp. ind. (p. 19), preserved in an orange-coloured dolomite, and the doubtful impressions of *Paroecotraustes* (*Oecotraustes*?) sp. (p. 80) in a non-calcareous, greenish-grey shale. The uppermost beds of the Patcham (= Putchum) Group, consisting of a light-grey, compact, flinty, limestone, included by Waagen in the Bathonian, have yielded very few ammonites, notably some large *Macrocephalites*, in addition to *Procerites*-like Perisphinctids. One of the *Macrocephalites*, however, belongs to a species that apparently still occurs in the overlying *'Macrocephalus* Shales', whilst it may be just 'collection-failure' that there are no *'bullati'* or other types characteristic of the upper Bathonian, such as distinguish the faunas (with typical *Macrocephalites*) recorded by Popovici-Hatzeg (1905) and Simionescu (1905)

* With regard to the name *Stephanoceras* Waagen, it is not now held to be invalid through prior use (of *Stephanoceros* Ehrenberg). Mr. Buckman who replaced *Stephanoceras* by *Stepheoceras* on account of this preoccupation (the genotype remaining the same:—namely *St. humphriesianum* Sowerby sp.) maintained the alteration in his Type Ammonites (Vol. II, 1918, p. XI), yet in the next volume (III, 1921, p. 55) held that *Sagittoceras* Hind, does not invalidate *Sagitticeras* Buckman, since nomenclatorial rules stated that the distinction of a letter was sufficient. The family name *Stephanoceratidae* Neumayr is thus re-instated, but not used in Mascke's (1907, p. 32) interpretation and in the restricted sense corresponds neither with *Stephenceratidae* Buckman (1898, p. 461) nor with *Stepheoceratidae* Loczy 1915 (p. 347).

from Rumania, by Boeckh (1881) from Hungary, and by Sharpe (1840) and Choffat (1880) from Cape Mondego. In 1920 (p. 312) I expressed the opinion that the *macrocephalus* zone should be included in the Bathonian since it formed part of the Cornbrash; and that although such a classification was contrary to Continental usage, the English type succession should be adhered to. Unfortunately this would mean drawing the line between the Bathonian and Callovian in the middle of the *macrocephalus*-beds. It seems preferable therefore to adopt the classification of *e.g.* Haug (1907, p. 998) as I have also done in more recent papers (1924, p. 21, 1925, p. 24, 1926, p. 324, supra, p. 81). This necessitates the inclusion of the *Macrocephalus* Shales of the Lower Chari Group as well as of the Coral (and Brachiopod) Beds of the uppermost Patcham Group in the Callovian although they may be contemporaneous with the *Oxycerites* beds of the European Upper Bathonian. It is therefore less convenient to refer Waagen's '*Perisphinctes*' *decorus*, representing apparently a transitional type, to Parkinsonidae or Morphoceratidae of earlier beds, and *Epimorphoceras* is now included in Reineckeidae. Petitclerc (1917, p. 27, Pl. III, fig. 4, Pl. VIII, fig. 13) has shown that comparable forms still occur in the Middle Callovian.

Hyatt (1900, p. 583) was induced by the presence of coronate young in both Morphoceratids and Reineckeids to group them together in a too heterophyletic super-family. This 'recapitulatorial' evidence is now known to be of but little significance and in the case of his derivation of Macrocephalitids from *Otoites contractus* (1876, pp. 366, 372, 390), which is quite inadmissible, Hyatt was probably influenced by his developmental theories. As in the young of *e.g. Asteroceras stellare* of the Lower Lias, previously (Spath, 1926b, p. 140) referred to, the tubercle may be merely a strengthening device, and its 'phylogenetic' value is nil, *i.e.* the coenogenetic appearance of spines in the young of unrelated stocks cannot be used to demonstrate common descent from a 'coronate' ancestor. Reineckeidae, as shown below, may however, well be derived from the same (Stephanoceratid-Perisphinctoid) stock that produced Parkinsonids and Morphoceratids. They are dealt with after the other Stephanoceratid families here discussed only to avoid separating in the descriptions below the Proplanulitidae from the other Perisphinctids.

The Callovian family Macrocephalitidae is represented by hundreds of individuals. These Macrocephalitids with which is conveniently grouped *Morrisites* S. Buckman (=*Morrisiceras* † S. Buckman = *Pionoceras* Lissajous = group of *Amm. morrisi*, Oppel) include direct developments of *Sphaeroceras*, as Rollier (1909, p. 613; 1911, p. 287; 1922, Pl. XXI) holds, including the Bathonian '*bullati*' which are all derivatives of the Stephanoceratids. This family Macrocephalitidae is discussed below. Cadoceratidae which may be partly descendants of Macrocephalitids, partly more or less parallel developments (ex Tulitidae), are as yet unknown from Kachh, and such typical genera as *Cadoceras*, *Pseudocadoceras*,

† See Spath, 1923, p. 6. In the following year, Mr. Buckman (1924 p. 6) unjustifiably assumed it to be of later date, a statement rashly adopted by Crickmay (1927, p. 514).

Chamoussetia, *Arcticoceras*, are apparently confined to more northern latitudes. On the other hand the closely allied Pachyceratidae, with *Erymnoceras* and *Pachyceras*, are represented in the Kachh fauna by a few examples, whilst there is no trace again of Cardioceratidae, representing an enormous range of variety from *Quenstedtoceras* through *Cardioceras* to the Kimmeridgian *Amoeboceras*.

So far as present knowledge goes, these are all restricted to what has been called the 'boreal' province, and it is not surprising that we have also to record the total absence of members of the family Kosmoceratidae. The Eucycloceratids discussed below are a somewhat corresponding development of Macrocephalitidae, unknown where Kosmoceratids occur; but they are almost confined to the Reineckeian age and only one doubtful form may pass up into the '*athleta* beds', yielding Kosmoceratids in abundance elsewhere.

This family shows a surprising richness in forms, which, however, are available as yet mostly in imperfect fragments. It has been considered advisable to illustrate a number of these since in the classical Callovian sections of Europe no trace has been found of this remarkable group of forms which existed in Kachh during the Reineckeian age.

Another interesting family, typically developed in the Kachh Jurassic, are the Mayaitidae, now separated from Pachyceratidae and discussed below.

Mayaitids to a certain extent replace Cardioceratids in the Kachh Jurassic. They have been persistently confused with the earlier Macrocephalitidae and Lemoine's latest attempt to deal with this group has been about the least successful of all. This may justify the illustration of a comparatively large number of these forms.

It is interesting to note in this connection that in a recent publication, Dr. O. Schindewolf (1926, p. 508) refers to the 'proterogenetic' appearance of new characters in certain Stephanoceratids and quotes as illustrations the series *Macrocephalites—Kepplerites—Kosmoceras* on the one hand and *Macrocephalites—Cadoceras—Quenstedtoceras* on the other. He calls *Kepplerites* and *Cadoceras* mixed types that in the young 'encroach on their descendants' but in the adult retain the characters of their ancestors. This is the conclusion I had come to and expressed, *e.g.* four years ago in the case of Schlotheimids (Spath, 1924b, p. 198, 1923, p. 65).

The Stephanoceratid families to be dealt with in the present part include the following:—

Macrocephalitidae Buckman emend.
Eucycloceratidae, nov.
Pachyceratidae Buckman emend.
Mayaitidae, nov.
Reineckeidae Hyatt emend.

They are represented altogether by about five hundred specimens, whilst there are over fifteen hundred Perisphinctids. These figures do not include the abundant new material brought by Mr. Raj Nath to London in the spring of 1928.

Family : *MACROCEPHALITIDAE* S. S. Buckman.

This family was previously (1924, p. 7) stated to be sufficiently distinct to be separated from the earlier Sphaeroceratidae Buckman, 1920 (= Otoitidae Mascke, 1906), Morphoceratidae Hyatt 1900 emend., and Tulitidae Buckman 1921, which successively produced somewhat similar types. Since this was written, diagnoses of the genera included by Mr. Buckman in his family Macrocephalitidae have appeared (1923, p. 54) but his method of working is open to criticism (see *Nature*, 1924, p. 232). He does not know their stratigraphical succession, as is clear from his later table of hemerae (1925, pp. 72-3); he assumes the existence of a 'common primitive form', with simpler suture-line than the later developments, and arbitrarily puts 'high or low numerical values' to characters such as the compression of whorl shape, etc.; he also has only such inadequate material as that single, dubious '*Tmetokephalites*', referred to on p. 55; consequently Mr. Buckman arrives at a classification that is much more of a hindrance than a help to those who have to deal with faunae from other localities and hundreds of specimens. The differences between the seven genera, are not even 'fairly obvious' in the case of the seven type-specimens figured by Mr. Buckman and examined by the writer; and as the late M. Cossmann (1921, p. 152) remarked in the case of the same author's thirty 'species' of *Proplanulites*, it only proved that Mr. Buckman had had at least that number of specimens.

The writer has repeatedly stated his belief that ammonites are far too homogeneous a group to be readily divided into families. The genera of the family Macrocephalitidae again are so closely interconnected that their discrimination may seem a hopeless task. We may well ask with Lemoine (1910, p. 16) whether the specific unity of all Macrocephalitids cannot, perhaps, be admitted; and if we here adopt independent genera (each of which is open to criticism) within the family rather than sub-genera of *Macrocephalites*, it is done merely to conform with the equally questionable and equally artificial subdivision of other groups.

Of the characters used in the classification of Macrocephalitids the suture-line is a good criterion, but it cannot be used by itself. It may be remembered that the two suture-lines of *Macrocephalites formosus* here figured (Pl. XXIV, figs. 2a, b) show different features at different diameters, and the immature example represented in Pl. XXI, figs. 2a, b, has the lateral lobe decidedly shorter than the external lobe. In M. *chariensis*, again, the lateral lobe may be as deep as the external lobe (Pl. XXV, fig. 2), or even more reduced than that of the large *M. formosus* (Pl. XXIV, fig. 2b), and with L not much more than half the depth of E. Such statements as 'suture-line feeble' or 'suture-line subsimple' or 'E longer than L' are therefore valueless in a generic diagnosis. The ribbing, to the casual observer, may seem a useful character for grouping, yet there is probably no feature more open to different individual interpretations than the peripheral convexity of the costation, even when the actual specimens and not only figures are available

for study. Thus Uhlig (1910, p. 264) left a Spiti form that he compared to Waagen's '*Stephanoceras*' *maya*, and two additional species ('*Macrocephalites*' *waageni* and '*M.*' *kitchini*), in the genus *Macrocephalites*, considering them to be '*recticostati*'; and it must be admitted that certain Franconian *Macrocephalites* of the *bathytmetus* type show extremely close resemblance in their outer whorls. While uniting with the later forms, generically, certain curvicostate Callovian species (here referred to *Kamptokephalites* and *Dolikephalites*) Uhlig assigned the 'geologically younger' *curvicostati*, including not only *Grayiceras nepalense* (Gray) and *Prograyiceras grayi* (Spath) but also *Subkossmatia opis* (Sowerby) and *Idiocycloceras singularis*, nov. (= Waagen's *Stephanoceras fissum*, non Sowerby sp.), to the Hauterivian genus *Simbirskites*. Obviously there is no connexion between date of existence and amount of peripheral projection. Lemoine (1910, p. 20) again thought that his group II of *macrocephali*, namely this same *maya* group (to which he again compared Waagen's *Stephanoceras semilaeve*, already listed in group I), on account of its slightly forwardly projected costation, was rather closer to *Simbirskites* than to *Macrocephalites*.

The classification of *macrocephali* into *recticostati* and *curvicostati* certainly does not work in practice; Waagen's '*Stephanoceras*' *lamellosum* and *St. subtrapezinum*, assigned one to each of these divisions, are here united specifically. Again the recognition by later authors of a group of '*flexicostati*' was unsuccessful, nor can the coarseness or fineness of the ribbing be used except in conjunction with other characters. *Kamptokephalites lamellosus* illustrates the impossibility of relying on the variable course of the ribs as the sole criterion of classification. When comparing (1924, p. 8) Sowerby's unique holotype (Pl. XIX, figs. 8*a*, *b*) with Waagen's (slightly inaccurate) figure, I laid stress on the difference in the course of the radial line; but the examination of abundant additional material has shown that the more or less apparent biconvexity of the ribbing as well as the peripheral projection and approximation of the ribs near the aperture are subject to considerable variability and not of specific importance. The characterisation of Mr. Buckman's genus '*Macrocephaliceras*' (1923, p. 54), based on an execrable whorl-fragment, as 'flexicostate, ribs medium size' is not only useless but misleading.

Finally whorl-shape is so variable individually as well as at different growth-stages, that the generic separation of the sphaeroconic forms from their compressed allies is not natural or scientific. *Kamptokephalites* was defined as 'compressed', but its genotype was included by Blake (1905, Pl. IV, fig. 2) in the more sphaeroconic *K. herveyi* (Sowerby) and a comparison of the originals shows that it is perhaps scarcely sufficiently different to be classed even as a variety.

Lemoine (1910, p. 17) thought it preferable to substitute for Waagen's 'rather too theoretical' classification of the *macrocephali* an essentially practical scheme, based mainly on external shape. It will be necessary to criticise this classification in detail, but for the present it may suffice to state that Waagen's careful grouping at least had the advantage of taking into consi-

deration the most important of all factors, namely succession in time, and that Lemoine's hasty classification—apart from its numerous inaccuracies—is sufficiently condemned by his including in the well-defined Tithonian genus *Kossmatia* such a typical Macrocephalitid as '*Stephanoceras*' *chariense* Waagen.

Before, however, dealing with the genera which have been recognised in the present family, it is necessary to define the genus *Macrocephalites* itself and to discuss *M. macrocephalus*, often quoted but differently interpretated. To take some more recent cases, Petitclerc (1915, p. 39) who created numerous species in other genera, showed commendable caution in not separating, specifically, the inflated and compressed forms of one contemporaneous population; but we are unable to discover whether his forms included what is here taken to be the true *M. macrocephalus*, whilst the diagrammatic figure in Felix (1924, p. 139, text fig. 406) is altogether useless. At present there is still a tendency to refer an inflated Macrocephalitid, whether early or late, to Reinecke's *Amm. tumidus*; and the more discoidal forms are identified with Quenstedt's '*M. compressus*', whatever zone they may belong to. Going to the other extreme Mr. Buckman (1925, pp. 72-73) recently produced an incredible jumble of hemerae, already criticised elsewhere (1926, p. 325), which shows a remarkable lack of knowledge of Callovian faunas as a whole and separates a *Pleurocephalites* horizon by eighteen imaginary hemerae from its true zone (*rehmanni*).

Ammonites macrocephalus Schlotheim (1813, p. 70) is based on the Franconian form depicted by Baier (1757, Pl. XII, fig. 8); but his illustration, reproduced by Blake (1905, text-fig. 3, p. 43), is obviously diagrammatic and unrecognisable, and it would be unsafe to assume that because it came from Franconia it must be identical with Reinecke's *Nautilus tumidus* (1818, p. 74, Pl. V, figs. 47-8). In 1820, Schlotheim (p. 70) included in the synonymy of his *Amm. macrocephalus* the very doubtful ammonite figured by Bourguet (1742, Pl. XL, fig. 267), possibly drawn from a *Phylloceras*, and Reinecke's form, which was taken by its author to include Walch's (1768, Pt. II, Pl. I, fig. 4, Pl. I*a*, fig. 1) two apparently different forms. Schlotheim thus interpreted his *Amm. macrocephalus* very widely and he distinctly referred to several varieties. Quenstedt, in 1886 (p. 645) still adopted this comprehensive interpretation, but confined himself to a simple, local, fauna.

The customary restriction of *Ammonites macrocephalus* to those 'varieties' that show only slight inflation dates back to Zieten (1830). To know what this author figured (Pl. V, fig. 4) as *Amm. macrocephalus*, we must examine those oolitic Wurtemberg examples which, as Quenstedt (1886, p. 645) has pointed out, were so common that 'mountains' of them got distributed among the collections. To judge by a considerable number in the British Museum, no two individuals of these *macrocephali* are alike, but their intricate suture-lines and smooth umbilical aspect, at least at diameters of 100 mm. and more, are characteristic. The larger example figured by Zieten (1830, Pl. V, fig. 1), according to Quenstedt's (1886, p. 517) authoritative opinion, may be a Bajocian *Emileia*, and must be left out of consideration. Its umbilical aspect certainly is not that of a '*macrocephalus*'. Parona and Bonarelli (1897, p. 157)

referred this to their *Macrocephalites pilleti*, but Zieten's diagrammatic drawing had similarly misled Oppel and d'Orbigny and other authors before them.

Waagen (1875, p. 109) again definitely restricted *Amm. macrocephalus* to Zieten's fig. 4 (non 1), the first recognisable representation of Schlotheim's species, correct even in proportions, if diagrammatic. Lemoine (1910, p. 29) in his list also took this illustration to exemplify Schlotheim's 'unfigured' species. On a later page (p. 31), however, when speaking of the 'type-figure' in Zieten, Lemoine gave as reference "Pl. V, fig. 1 (*an* fig. 4 ?)", although he had previously excluded fig. 1 and stated it to belong probably to *M. pilleti*. In any case the restriction of *Amm. macrocephalus* to the somewhat compressed shells has been accepted by most authors from d'Orbigny (1847, p. 471) and Oppel (1857, par. 68, no. 7) to Zittel (1884, text-fig. 655, p. 470) and it does not seem advisable now to go back with Blake (1905, p. 43) to Baier's unrecognisable illustration, the original of which is lost. Even workers on the Franconian forms, like Model (1914, p. 19) find it necessary to record "*Macrocephalites macrocephalus*" (Schlotheim, sec. emend. autorum excl. Blake). Zittel's figure has been copied in numerous text-books including Abel's (1920, p. 216, text-fig. 338) who labelled it *Macrocephalites compressus*, whilst Parona and Bonarelli (1897, p. 118) included it in the synonymy of *M. cannizzaroi* (Gemmellaro). According to Buckman (1922, Pl. CCCXXXIVA, B) who re-figured it under a new name, the whorl-section of Zittel's early (1884) type is that of the true *M. macrocephalus*. The substitution, in recent editions of Zittel's Grundzüge, and in the two English editions (Eastman, 1900 and 1913), of a copy of d'Orbigny's diagrammatic figure for this true *M. macrocephalus* may account for some of the misinterpretations of this species.

It is connected by numerous transitions with *M. compressus* Quenstedt sp. (1849, Pl. XV, figs. 1*a-c*) and the form described below as *M. triangularis* on the one hand, and with *M. rotundus*, Quenstedt sp. (1849, Pl. XV, fig. 2*a-c*) and the more finely ribbed, globose, *M.* **leei**, nom. nov. (= *Amm. macrocephalus rotundus* Quenstedt, *pars*, 1886, Pl. LXXVI, fig. 11 only, B. M. No. 22361) on the other. These two have been persistently confused with Reinecke's *Amm. tumidus* (and *Amm. platystomus*) and by Parona and Bonarelli (1897, p. 155, synonymy) and Simionescu (1905, p. 33) even with the Argovian *Epimayaites subtumidus* (Waagen).

It is proposed in the present paper to use the genus *Macrocephalites* only for this restricted group, extremely rare in England, which may be taken to include also *M. formosus*, the Indian equivalent of *M. macrocephalus*, and its special, galeate offshoot *M. chariensis*, although this is an extreme form; further *M. madagascariensis* Lemoine and *M. mantararanus* G. Boehm, the last possibly intermediate between *M. formosus* and *M. compressus*. In this restricted *Macrocephalites*, generally involute, the primary costæ are never very prominent, always disappear sooner or later, and the whorl-sides become smooth, whilst the umbilical edge is rounded, but distinct. The very involute Andine form of *M. macrocephalus*, according to a Chilean example in the British Museum

(No. C. 15417), is sufficiently distinct to be separated with a new name:— M. **steinmanni** (see Steinmann, 1881, p. 271, Pl. XI, fig. 4).

The Mediterranean forms of the type of *Stephanoceras macrocephalum* Boeckh (1881, p. 55, Pl. VI, fig. 5, Pl. VII, fig. 2, Pl. VIII, fig. 1) and probably *M. macrocephalus* Popovici-Hatzeg (1905, p. 23), on account of their rursiradiate costation and general resemblance to *e.g.* '*Stephanoceras*' *eszterense* Boeckh (Pl. VI, fig. 3) and '*Sphaeroceras*' *suevicum* Roemer (1911, Pl. VII, figs. 18, 21) and similar '*tumidus*' in the British Museum from Barréme, Randen, and Mondego, may be assumed to represent the ancestral type with very slender saddles. Steinmann's (1908, p. 191) derivation of *Macrocephalites* from the Triassic *Juvavites* has been shown to be untenable already by Pompeckj (1910, p. 65).

Mr. Buckman restricted Schlotheim's name to a depressed whorl-fragment (referred to a new genus '*Macrocephaliceras*'), but apparently in ignorance of the earlier stages of that form which are quite different from those of the *Macrocephalites* so far discussed, but are not unlike what he had previously figured as '*Catacephalites*'. Similarly the same author's '*Tmetokephalites*' *bathytmetus* (1923, Pl. CCCLXXIII) is believed to represent merely the inner whorls of a *Macrocephalites* of the type of *M. madagascariensis* here figured (Pl. XXII, figs. 3*a*, *b*), and '*Tm.*' *septifer* Buckman (1923, Pl. CDXXXIII), the unique type of which was kindly lent to me by Mr. J. W. Tutcher, is a more evolute, advanced development of the same group, recorded from Uetzing (Model, 1914, p. 26, Madsen, 1904, p. 192) as *M. compressus* (Quenstedt) and *M. subcompressus* (Waagen).

Lemoine's group I is not identical with this restricted *Macrocephalites*. It includes forms here referred to *Pleurocephalites* ('*M*'. *tumidus* Reinecke sp.), *Morrisites* ('*M*'. *morrisi*, Oppel sp.), *Nothocephalites* ('*M*'. *semilaevis* Waagen sp.) and *Indocephalites* ('*M*'. *colcanapi* Lemoine), in addition to the Argovian *Epimayaites polyphemus* (Waagen).

Reinecke's *Amm. tumidus* does not represent the inner whorls of a form of the more or less megalomorph *Macrocephalites* as here understood, nor is it a 'less globose' form of *M. macroeephalus*, due to difference of sex, as Loczy (1915, p. 353) held. To know it we again have to study that 'Goldschnecken' fauna of Franconia that has lately been the subject of research by several workers (Reuter, 1908, 1909, Model, 1914, Dorn, 1921). It is useless to count the ribs of Baier's illustration or to measure the dimensions of similar sketchy figures; and Reinecke's fig. 47 may seem to have a decidedly more depressed whorl-section than his fig. 48 to those who do not know the variable *Amm. tumidus* from actual examples, or who, like Model (1914, p. 26) have all these varieties, including Reinecke's *Nautilus platystomus* (1818, p. 81, Pl. VII, fig. 60), but give misleading specific names. If we relied on measurements of proportions only, entirely erroneous identifications might result, and the frequent misinterpretation of *Pleurocephalites* of the *platystomus*-type for the entirely unrelated *Epimayaites subtumidus* (Waagen) is a striking instance. Reinecke's two species are very close to *Pleurocephalites folliformis* S. Buckman (1922),

Pl. CCCXLVIII) and I have stated previously that in the 'Kellaways-Clay' of Chippenham (of *rehmanni*) date there occur forms like the true *Amm. tumidus* as figured by Reuter (1908, p. 88, fig. 3*a*). Typical examples of this *Pleurocephalites*, with fine costation in the young, are here figured in Pl. XXXVI, figs. 6*a*, *b* (*P. folliformis* S. Buckman, from Chippenham) and Pl. XXXVI, fig. 4 and Pl. XXXVII, fig. 10 (*P.* aff. *platystomus* Reinecke sp. from Uetzing), together with the external suture-line of a true Bavarian *P. tumidus* Reinecke sp. (Pl. XXXIII, fig. 5). There is no comparable form known from Kachh (except perhaps the immature forms out of the matrix of *Bonarellia fornix* referred to on p. 193); but the small Sinde example here figured (Pl. XXXVI, fig. 5) is apparently a *Pleurocephalites* of this group.

These sharply costate forms with prominent primary ribs are closely connected with *Macrocephalites rotundus* and *M. leei*, but the genotype of *Pleurocephalites*, namely, *P. lophopleurus* Buckman (1922, Pl. CCLXXXIV A, B) according to the holotype and paratype specimens kindly lent to me by Mr. J. W. Tutcher and Dr. F. L. Kitchin, like the two Indian forms here referred to *Pleurocephalites*, is intermediate between this genus and the earlier group of *Kamptokephalites herveyi*, and belongs to a separate division.

Now whether we accept *Pleurocephalites* in the wider sense or as restricted to the *lophopleurus-habyensis* group, it does not comprise Waagen's '*Stephanoceras tumidum*', connected by a new transitional species with *Macrocephalites madagascariensis* on the one hand and with Waagen's '*Stephanoceras*' *chrysoolithicum* on the other. This group (*Indocephalites*, gen. nov.) is characterised by coarsely-ribbed, *Cadoceras*-like, inner whorls, and shows a return to a Macrocephalitid aspect of the outer whorls. Some of the forms of this *chrysoolithicus* group, typically developed in the East Indies, have indeed been referred to *Cadoceras*, as H. Douvillé (1904, p. 213) and, after him, Lemoine (1911, p. 9) quoted even *Amm. herveyi* as a *Cadoceras*; but the adult suture-line of *Indocephalites* resembles that of the later *Pleurocephalites*, although when simplified, or in the young (compare, fig. 2, Pl. XXII, and fig. 4, Pl. XXXV, and Spath, 1925*b*, Pl. I, fig. 3), there is similarity also with the lobes of *Cadoceras*. As type of this new group must be taken *I. kheraensis*, already figured (Pl. XIX, figs. 1*a-c*, and Pl. XXI, fig. 5) although *I. chrysoolithicus* (Waagen) is perhaps more characteristic. To *Indocephalites* are now also referred some new forms of the *chrysoolithicus* group, and Waagen's '*Stephanoceras diadematum*' although its inner whorls show great resemblance at a certain stage to those of the *elephantinus* group.

There is a small group of forms that are taken to represent evolute offshoots of the stock that also gave rise to the more involute and cadi one *Indocephalites chrysoolithicus*. As *Indocephalites transitorius* and the form figured in Pl. XXII, fig. 1, are transitional from *Macrocephalites madagascariensis* to *Indocephalites* of the *kheraensis* type, so the more coarsely ribbed example represented in Pl. XXIV, fig. 7, is a passage form from the *chrysoolithicus* stock to the special group here discussed. In addition to its open umbilicus this group has a characteristic rounded, umbilical border, and a comparatively simple

suture-line and it can be distinguished at once from similarly evolute *Kamptokephalites* by its blunt ribs. Since this group comprises only two forms and since it is undoubtedly connected with *Indocephalites chrysoolithicus*, it is included in the genus *Indocephalites*, the inner whorls in the early forms being coarsely ribbed in this genus as well as in *Kamptokephalites*.

Indocephalites kheraensis is based on one of J. de C. Sowerby's examples of *Amm. herveyi*, but the other specimen referred by the same author to this species is here described as *Mayaites obesus* (see Pl. XLII, figs. 1*a*, *b*) and belongs to a much later group. The true *Amm. herveyi*, J. Sowerby (1818 Pl. CXCV, upper figure only, somewhat unsuccessfully drawn), from the English Upper Cornbrash, is referable to a group of forms characterised by sharp and coarse (rectiradiate or flexiradiate) costation, which also includes the true *Amm. grantanus*, Oppel (= d'Orbigny's *Amm. herveyi*, 1846, p. 428, Pl. CL) but is less closely related to the Kachh form identified by Waagen with this species. Its inner whorls, like those of the allied *Amm. elephantinus*, J. de C. Sowerby (see Pl. XXXI, figs. 2*a*, *b*) are finely costate, as in young *Pleurocephalites*, but like the similar *lamellosus*-group, they are also intimately connected with Waagen's *Stephanoceras dimerum*. The suture-lines of the *grantanus-elephantinus* group are simpler than those of *Pleurocephalites* of the *tumidus*-group (typically with long and slender elements), but it may be remembered that the genotype of *Pleurocephalites* (*P. lophopleurus*) had at first been identified with '*Macrocephalites*' *grantanus* (Oppel) and it has already been mentioned that the typical *Pleurocephalites* are as closely allied to *Kamptokephalites* as to the *tumidus-folliformis* group. '*Macrocephalites*' *tuguriensis*, Hébert and Deslongchamps sp. (see R. Douvillé, 1914, Pl. VII, figs. 1-2 and Petitclerc, 1915, p. 45) again belongs to a specialised offshoot.

The genus *Kamptokephalites*, Buckman, similarly is now emended to include not only the evolute *herveyi*-group and the Kachh *K. magnumbilicatus* and *K. dimerus*, but their compressed as well as their inflated derivatives. The fine costation of the inner whorls of the later forms is comparable to that found in most late Macrocephalitids (and Eucycloceratids) and appears to have similarly developed in the young of those forms that like *Macrocephalites madagascariensis* and *M. bathytmetus* lead from the true *M. macrocephalus* to the *Pleurocephalites* of the *tumidus-folliformis* group.

Whereas *Indocephalites* develops large macrocephalitic shells, as is well illustrated by the Madagascan *I. colcanapi* Lemoine sp. (1910, pl. II, figs. 1-2), with *formosus*-like outer whorl, *Kamptokephalites* shows persistent coarse ribbing, with a tendency to approximation near the aperture only; and most of the shells remain comparatively small. The writer would include in this genus also *K. hudlestoni*, Blake sp. (1905, p. 47, pl. IV, fig. 3), *K. terebratus*, Phillips sp., as restricted previously (1924, p. 8 =Blake's [1905] pl. III, fig. 6 only, B. M. No. 39566, bearing Bean's MS label '*Amm. terebratus*'), the more evolute, less globose, and more finely ribbed K. **bedfordensis**, nom. nov. (=Blake, 1905, pl. IV, fig. 1), and doubtfully K. **maconnensis**, nom. nov. (=*Macrocephalites herveyi*, non Sowerby, Lissajous, 1912, p. 49, pl. VI, fig. 7 =? Bronn's

Amm. herveyi, 1837, p. 455 =*Amm. macrocephalus*, 1851, p. 356, pl. XXIII, fig. 11) although the Niort specimen (B. M. No. 74227) which I regard as type of this species has stronger primary ribs than Lissajous's figure; further K. **subpila**, nom. nov. (=Sowerby's smaller figure pl. CXCV [1818], with smaller umbilicus, *chrysoolithicus*-like ribbing, and *pila*-like whorl-shape). The largest specimen seen of the last species, from Aldwinkle (B. M. No. 19539*d*, recorded by Blake, 1905, p. 44 as '*M. macrocephalus*') at a diameter of 84 mm. has nearly a whole whorl of body-chamber and retains comparatively coarse, trifurcate, *chrysoolithicus*-like ribbing to the end.

Catacephalites, Buckman, is difficult to recognise from the indifferent figure (1922, pl. CCLXXXIII) and I previously wrongly referred to *Catacephalites* some Madagascan forms (1925*b*, p. 14, pl. I, figs. 3-4) of which the smallest (No. 9) is now refigured (pl. XXXVI, fig. 12). This is probably an immature *Indocephalites* of the *diadematus* type, but the other two examples are less well preserved and are not definitely referable to this genus. By the kindness of Mr. Frank Petch B.Sc., I have now been able to examine the holotype of *Catacephalites durus*. In spite of apparent differences in the suture-line (which is not so well exposed in the holotype as might be assumed from the figure) it is believed to be merely one of the forms of the *herveyi*-group and very close to *Kamptokephalites subpila*, nom. nov., *i.e.*, the smaller of Sowerby's two syntypes of *Amm. herveyi*. That is to say, '*Catacephalites*' merely denotes the subsphaeroconic developments of the typically slightly more compressed *Kamptokephalites*.

Lemoine (1910, pp. 20, 24) distributed the forms here referred to *Kamptokephalites* into his group IV ('*M*'. *dimerus*), group V (*M. subtrapezinus*) and group VI ('*M*'. *magnumbilicatus*), but his remark that it seemed probable that the forms of the group of '*M*'. *polyphemus* represented the adults of the *magnumbilicatus* group indicates that he must have been misled by Waagen's (and other authors') figures.

The isolated *Stephanoceras subcompressum*, Waagen, is referred to the genus *Dolikephalites*, Buckman, based on *D. dolius*, S. Buckman (1923, pl. CCCLXXII) which according to the holotype before me is scarcely specifically distinct from Blake's *D. typicus* (1905, p. 42, pl. III, fig. 1) and possibly the (idealised) *Ammonites macrocephalus* (variété comprimée) figured by d'Orbigny (1846, pl.CLI). The small example figured by Blake (1905, pl. III, fig. 3) in the Geological Survey Collection (No. 8652) was, indeed, labelled by Mr. Buckman '*Macrocephalites* cf. *subcompressus*'. This is connected with the true *Macrocephalites* of the *compressus* type by numerous transitional forms, including D. **gracilis**, nom. nov. (=*Macrocephalites canizzaroi*, Couffon, non Gemmellaro, 1919, p. 97, pl. XV, figs. 4, 4*a*, *b*) but somewhat similar passage forms (see Lapparent and Fritel, 1888, pl. VIII, fig. 12) also connect *Macrocephalites* with the degenerate Cape Mondego form figured in pl. XXXVI, figs. 16*a*, *b*.

On account of its reduced costation, often also suture-line, the genus *Nothocephalites*, including probably offshoots of various compressed *Dolikephalites*, or

Macrocephalites, is here referred to Eucycloceratidae. It is taken to include also '*Stephanoceras*' *semilaeve*, Waagen, but the inner whorls of this are still similar to those of *Macrocephalites formosus*.

The compressed Eucycloceratids, dealt with below, are probably partly developments of the *subcompressus* group; and in side-view an immature *Subkossmatia* is scarcely distinguishable from the young *Dolikephalites typicus* figured by Blake (1905, pl. III, fig. 2, pl. IV, fig. 5). An example of this species in the Geological Survey Collection (No. 25634) was labelled by Mr. Buckman '*Macrocephalites subtrapezinus* (Waagen)', so that but for its closer resemblance to *Kamptokephalites dimerus* and such forms as K. **subkamptus,** nom. nov. (='*Macrocephalites*' *keeuwensis gamma*, pars, G. Boehm, 1912*a*, pl. XLI, figs. 1*a*, *b* only) Sowerby's *Amm. lamellosus* might also have been included in *Dolikephalites*. Waagen himself already stated that *D. subcompressus* was very nearly allied to his *Stephanoceras* '*subtrapezinum*' (*i.e. lamellosum*).

Arcticoceras, Spath, created for the very sharply-ribbed '*Macrocephalites*' *ishmae*, Keyserling sp., may be referred to Cadoceratidae, like its close ally *Pseudocadoceras*, Buckman, which comprises *Quenstedtoceras primigenium*, Parona and Bonarelli (1897, p. 125, pl. II, fig. 4). These form Group II of Lemoine's '*Macrocephalites*'. On the other hand, *Amm. ishmae* var. *arcticus*, Newton (1897, p. 500, pl. XL, figs. 1, 1*a* =*Amm. arcticus*, Whitfield, 1906, pl. XVIII, fig. 2 only) with smooth, outer whorl at a comparatively small diameter and blunt ribs is closer to Macrocephalitids, *e.g.* '*Macrocephaliceras*', Buckman (1922, pl. CCCXIII). The compressed Arctic group, for which we may propose the new name **Arctocephalites** gen. nov. (and as type of which I would consider Newton's species as represented by example No. C 7249 in the British Museum) has typically deeply divided and interlocking suture-lines, like *Arcticoceras*, but they may be simplified as in *Arctocephalites pompeckji* (Madsen) Sokolov sp., (1913, p. 62, text-fig. 1); those of *Macrocephaliceras* are simpler, distantly spaced in the young and have broad saddles. The last is now taken to include those sphaeroconic forms with smooth outer whorl that d'Orbigny figured as *Amm. tumidus* (1846, pl. CLXXI, fig. 1, *non* Reinecke). This is unlike anything found in Franconia or Wurtemberg and understood as *Amm. macrocephalus* by Schlotheim and Zieten, so that we may safely rename it:—*Macrocephaliceras* **polyptychum,** nom. nov., type to be a Weymouth example in the British Museum (No. 23873) of perhaps the same species as Buckman's fragment which differs from d'Orbigny's idealised example in becoming smooth at 150 mm. diameter and in having close, trifurcate, *chrysoolithicus*-like ribbing already at 15 mm. diameter. As in the probably ancestral group of *Kamptokephalites subpila* and *K. terebratus* ('*Catacephalites*', S. Buckman), however, the development of the ribbing in *Macrocephaliceras* is from fine to coarse, not from coarse to fine as in *Indocephalites chrysoolithicus*, to which species Waagen, not inaptly, had compared d'Orbigny's *Amm. tumidus*. The resemblance, at a certain size, of the two developments is an illustration of what Buckman (1913, p. 166) called 'transversal homœomorphy', and *Macrocephaliceras* is probably later than the Kachh *macrocephali* and somewhat equivalent to *Nothocephalites*.

The South American forms figured by Stehn (1924, p. 80, pl. II, figs. 1-3, pl. VII, fig. 3, pl. VIII, fig. 4, text-fig. 10, p. 81) and again quoted in Gerth (1925, p. 33) as *Macrocephalites diadematus* appear to be *Indocephalites* like the group above referred to; the species (type:—fig. 4, pl. VIII) may be renamed I. **gerthi.** nom. nov. The change of ornamentation on the body-chamber is interesting, but no mouth-border has been observed in any Kachh example. These peculiar Argentine specimens are associated with a new stock **Eurycephalites,** gen. nov. (for *Macrocephalites vergarensis*, Burckhardt, 1903, p. 21, pl. II, figs. 18-20, pl. III, fig. 4) which has been considered by Burckardt to be a descendant of the Bathonian *Morrisites morrisi* although Lemoine (1911, p. 52) thought it to be perhaps a *Sphaeroceras*. It may be remembered that Waagen already had taken *Macrocephalites chariensis* to be a mutation of this *Morrisites morrisi*, and although on account of its late age it is here connected with *Macrocephalites formosus* (which itself includes passage forms to *M. madagascariensis*), *M. chariensis*, being an extreme development, might well have been separated generically.

It is also interesting to note that *Eurycephalites eurystoma*, Stehn sp. (1924, p. 72, pl. I, fig. 1) shows bifurcation of the peripheral ribs of the outer whorl, as found in *Macrocephalites formosus* and allies, and it is connected by transitions with the involute *M. steinmanni*, nom. nov. which may be a local, Andine, race of *M. macrocephalus*, in Lemoine's sense, as *M. formosus* replaces it in India. But the same author's view that Burckhardt's '*Macrocephalites*' *epigonus* (1906, p. 20, pl. III, figs. 6-11) represent merely a local (Mexican) race of *Macrocephalites macrocephalus* can on no account be accepted. This Kimmeridgian form, for which a new generic name (**Epicephalites,** gen. nov.) is necessary, merely simulated a macrocephalic type of shell and ornamentation as did already the immature *Hammatoceras* and misled Hyatt (1867, p. 88); by its suture-line *Epicephalites* is closer to *Subneumayria* (=group of *Neumayria ordonezi*, Burckhardt) and probably the Portlandian Craspeditids.

Another Mexican—South American group is **Xenocephalites,** gen. nov. (for *Macrocephalites neuquensis* Stehn, 1924, p. 86, pl. I, fig. 3) probably an extreme, coarsely-ribbed, offshoot of *Eurycephalites rotundus* (Tornquist) but with suture-line as yet unknown. The reference, by Stehn, of *X. neuquensis* to a different group of '*macrocephali*' from that of his *X. extremus* (non Tornquist), by the way, again shows the impossibility of classifying these forms according to the curvature of the ribs.

To assume difference in age of the deposits to account for the differences of their Macrocephalitid faunas and for the absence of certain well-known European forms, is clearly futile, and the forms of every province bear their own peculiar stamp, easily recognised by those who have handled actual specimens. On the other hand, whilst there are abundant Macrocephalitids from the *diadematus* and *dimerus* zones of Kachh, the few Patcham specimens yet available are clearly unrepresentative of the ammonite fauna of the early horizon, which was probably itself preceded in the Mediterranean Province by the Upper Batho-

nian assemblage that included forms of the type of '*Stephanoceras*' *eszterense* (Boeckh) and the '*bullati*'.

We cannot, thus, agree with Loczy (1915, p. 443) who stated that Macrocephalitids, in India, appeared already in the Lower Bradfordian (=zone of *Parkinsonia ferruginea*) and therefore had their origin in that area.

Kheraiceras is more or less homoeomorphous with its forerunner, *Bullatimorphites*, but apart from the differences in the suture-line and evolution, the earlier whorls of the former are almost cadoceratid, those of the latter sphaeroceratid. Reinecke's *Nautilus platystomus* of Reineckeian age with a somewhat cadoceratid whorl-shape has already been stated to be a *Pleurocephalites*, close to *P. tumidus*, but Quenstedt's *Amm. platystoma*, previously referred to (Spath, 1925*b*, p. 16) and Roemer's Bathonian forms (1911, pp. 41-43, pl. VII, figs. 15-22, pl. VIII, fig. 1) include various transitions from *Bullatimorphites* to *Kheraiceras*. Similar forms have recently been quoted again by Lissajous (1923, pl. XIX, figs. 1-3) and Bataller (1927, p. 111) as '*Sphaeroceras*' *platystoma*, Reinecke sp. from the Upper Bathonian of France and Spain.

The genus *Bullatimorphites* is included by Mr. Buckman in Tulitidae, but it is also connected with Sphaeroceratidae, whereas *Amm. morrisi*, Oppel (=*Morrisites* [+ *Morrisiceras*] Buckman = *Prionoceras*, Lissajous, non Hyatt nec Buckman) is more intimately connected with some Macrocephalitid offshoots here discussed. Whether *Morrisites* be assigned to Macrocephalitidae or T litidae may be a matter of personal opinion, but the latter family cannot compare in importance with the former, being in fact based largely on individual variations of one species, *Ammonites subcontractus*, Morris and Lycett, that have been unduly raised to generic rank. Tulitids are a horizontally limited offshoot of the persisting Stephanoceratid stock; in the Mediterranean Province there is apparent continuity from *Sphaeroceras*, or possibly *Emileia* (Pompeckj, 1894, p. 255) to *Macrocephalites*. Although we must reject Hyatt's 'evidence' of a tuberculate ancestor of Macrocephalitids and his 'gradual' increase of lateral compression, it is probable that *Sphaeroceras* itself is not the root form of all Macrocephalitids.

The Macrocephalitids of Kachh belong to the following six genera and nineteen species:—[1]

Genus *Macrocephalites* (v. Sutner MS) Zittel.
- *M. formosus* (J. de C. Sowerby).
- *M. chariensis* (Waagen).
- *M. triangularis* sp. nov.
- *M. madagascariensis*, Lemoine.

Genus *Indocephalites* Spath.
- *I. transitorius*, sp. nov.
- *I. kheraensis*, Spath.
- *I. chrysoolithicus* (Waagen).
- *I. diadematus* (Waagen).
- *I. indicus* sp. nov.

[1] *Oecoptychius refractus* Reinecke has now to be added (June, 1928: see pp. 252, 277).

I. gibbosus, sp. nov.
I. sphaeroidalis, sp. nov.
Genus *Pleurocephalites* S. Buckman.
P. habyensis sp. nov.
P. elephantinus (J. de C. Sowerby).
Genus *Kamptokephalites* S. Buckman.
K. magnumbilicatus (Waagen).
K. dimerus (Waagen).
K. ? sp. ind.
K. lamellosus (J. de C. Sowerby).
K. lamellosus (J. de C. Sowerby), var. *aureus*, nov.
Genus *Dolikephalites* S. Buckman.
D. subcompressus (Waagen).
Genus *Kheraiceras* Spath.
K. cosmopolita (Parona and Bonarelli).

Genus: MACROCEPHALITES (v. Sutner MS) Zittel.

MACROCEPHALITES FORMOSUS (J. de C. Sowerby.)

(Pl. XXI, figs. 2*a*, *b*; Pl. XXIII, figs. 1*a*, *b*; Pl. XXIV, figs. 2*a-c*).

1840. *Ammonites formosus* J. de C. Sowerby, pl. XXIII, fig. 7.
1875. *Stephanoceras macrocephalus* (Schlotheim) Waagen, pars, p. 109, pl. XXV, figs. 1*a*, *b*; pl. XXVII, figs. 1*a*, *b*; pl. XXXIII, fig. 5.
1893. *Macrocephalites macrocephalus* (Schloth.) Waagen sp.; Tornquist, p. 8.
1894. *Macrocephalites macrocephalus* (Waagen); Pompeckj, p. 254.
1902. *Ammonites formosus* J. de C. Sowerby; Blake, p. 35.
1924. *Macrocephalites formosus* (Sowerby); Spath, pp. 7 and 22.
1927. *Macrocephalites formosus* (Sowerby); Burckhardt, p. 33.
non ? 1896. *Macrocephalites macrocephalus* (Schlotheim); Noetling, p. 12, pl. VII, figs. 1, 1*a*; pl. VIII; pl. IX, fig. 1.

This species is intermediate between the true *Macrocephalites macrocephalus*, as defined above, and *M. chariensis*. Its distinctive features are the subtrigonal whorl-section (pl. XXIV, fig. 2*c*) and the smoothness of the inner lateral area at all diameters; also a somewhat irregular type of ribbing, rather distinct from that of *M. macrocephalus* and well shown in pl. XXI, fig. 2*a*. Waagen, after Bronn (1848, p. 49) and Oppel (1857, p. 547) included *Amm. formosus* in the synonymy of Schlotheim's species, and Parona and Bonarelli (1897, p. 151) and Popovici-Hatzeg (1905, p. 23) followed him; but the differences are constant enough for specific separation and noticeable already at the diameter of the small shell here figured (pl. XXI, figs. 2*a*, *b*). Sowerby's holotype, of a diameter of 126 mm., agrees with the inner whorls of the large example figured by Waagen (pl. XXV), but the peripheral view of his smaller specimen (pl. XXVII, figs. 1*a*, *b*) is not drawn accurately, the inner whorls being shown as too much rounded ventrally, whilst the terminal portion is corroded and thus appears rather too compressed in the drawing. This smaller specimen I had previously considered to be close to Sowerby's species from

the figure alone, but it had been included by Lemoine in the synonymy of his 'local race' '*M. madagascariensis*,' discussed below. The third of Waagen's types, the suture-line of which was figured (pl. XXXIII, fig. 5), has very slightly coarser costation than the other specimens so far mentioned, but there are various additional examples that show slight individual differences, also transitions to the more extreme *M. chariensis*. Those who have studied large numbers of *Macrocephalites* will know that as in most other ornamented ammonites there are so many differences in ribbing as well as in whorl-shape and coiling that no two examples are identical.

In some of the specimens there is an attempt at repeated peripheral furcation of the ribs as in the form referred by G. Boehm (1912*a*, p. 162, text-fig. 72) as a variety *gamma* to his far too comprehensive '*Macrocephalites keeuwensis*'. This is also seen in some examples of *M. madagascariensis* and even *Indocephalites ransitorius* (pl. XXIII, fig. 2*a*), but these forms have distinct primary ribs. One specimen with very small umbilicus and finer costation converges somewhat towards the species here described as *M. triangularis*. Apparently the earlier forms (*e.g.* Jumara examples from the lowest flags immediately above the Patcham limestone), although unfortunately crushed, have either a smaller umbilicus or else finer costation than the later typical Golden Oolite examples, or they converge towards *M. trigonalis* or *M. chariensis* in whorl-section.

The fragmentary Northampton specimen (B. M. No. C 82389) previously referred to as the only British specimen showing some resemblance to the forms of the *formosus* group, is less close to Sowerby's species than to *M. madagascariensis*, referred to below, with distinct primary ribs; but Blake's large Garsdon specimen, figured (in part) as *M.* '*compressus*' (1905, p. 45, pl. IV, fig. 4)[1], like other true *M. macrocephalus* from Wurtemberg (*e.g.* B. M. No. C 1141, 50452, etc.) in their smooth outer whorls show resemblance to the adult *M. formosus*.

A Khera fragment shows the massive cast of the siphuncular tube, 2-3 mm. in thickness at a whorl-height of 70 mm., and constricted at the apex of the median saddle in the external lobe.

Macrocephalites dicosmus Gemmellaro sp. (1872, p. 22, pl. II, fig. 5, in side-view, seems indistinguishable from Waagen's figured body-chamber example and the differences in the proportions of whorl-height (47 per cent. instead of 50 per cent.) and umbilicus (16 per cent. instead of 14 per cent.) are not of importance. The body-chamber, however, is probably similar in most true *Macrocephalites*. The apparently closely allied *M. mantararanus*, G. Boehm (1912, p. 159, pl. XXXV, figs. 3*a*, *b*; text-figs. 68*a*, *b*, p. 160) has a more compressed whorl-section and a more elaborate suture-line.

Horizon:—Lower Callovian, [*triangularis* ?] *dimerus* and *diadematus* zones.

Localities:—Waagen's localities include Surka, Jumara, Khera, and Juria, all in the median of the three great Kachh ranges. Whether his examples

[1] Associated with a gigantic *M. rotundus*, Quenstedt (1887, pl. LXXVI, fig. 11), wrongly compared by Blake with *Kamptokephalites terebratus* (Phillips).

from the Patcham Coral Limestone are referable to *M. formosus*, however, is as doubtful as whether the remainder of his sixty specimens not seen by the writer belong to this species. There is no Patcham specimen in the collections examined by me except possibly the crushed fragment in the Blake Collection (No. 219) referred to below, under *M. trigonalis*. Most of the new material comes from Khera, beds 3 and 4 (Golden Oolite) of Mr. J. H. Smith, and beds 11 and 14 of Blake, also from beds 9-11 of Jumara. The Habye (Habo) Hills in the Middle Range have now also yielded examples of the present species, and there is a doubtful fragment from Kaora in the Northern (Patcham) Range.

The example figured in pl. XXIV, figs. 2*a-c*, from an old collection (Toulmin Smith) in the British Museum was labelled 'Normandy'. Its agreement with the typical Kachh examples both as regards specific features and mode of preservation is so perfect that the writer is inclined to suspect confusion of labels. Some doubtful larger fragments may possibly belong to similar body-chambers of forms of *Indocephalites*, such as Lemoine's *I. colcanapi* (1910, pl. II, fig. 1), or the Kachh species described below.

Macrocephalites chariensis (Waagen).

(Pl. XXV, fig. 2; Pl. XXXIII, fig. 11; Pl. XXXIV, fig. 2; Pl. XXXV, fig. 8).

1875. *Stephanoceras chariense* Waagen, p. 126, pl. XXX, figs. 2*a*, *b*; pl. XXXI, figs. 1*a-c*.

1893. *Macrocephalites charicus* (Waagen); Tornquist, p. 13 (footnote).

1896. *Macrocephalites chariensis* (Waagen); Sémenow, p. 95.

1910. *Macrocephalites* (*Kossmatia*) *chariensis* (Waagen); Lemoine, p. 19, fig. 15, p. 29.

1914. *Macrocephalites chariensis* (Waagen); R. Douvillé, p. 363.

1924. *Macrocephalites chariensis* (Waagen); Spath, p. 7.

This well defined species is now represented by about thirty specimens. Its broad and irregular ribs are more characteristic than the subtrigonal whorl-section. The two Habye examples here figured differ in this respect from Waagen's smaller specimen, being more finely ribbed, but there is also a coarser variety with the ribs more distant than in the type. At larger diameters they all show more approximate costation, and the peculiar whorl-shape, as outlined by Lemoine, can also generally be easily recognised. There are a number of transitions to *M. formosus*, with still finer ribbing, and greater compression, but whereas in some examples the high umbilical edge is combined with close costation, others have the typical *chariensis* type of ribbing but are as compressed as *M. formosus*.

The inner whorls are finely costate, like those of other immature Macrocephalitids, *e.g.* the example figured in pl. XXV, fig. 7*b*, but only to a diameter of about 15 mm. Then the umbilical half of the whorl-side becomes smooth and the outer ribs become irregular. In the presumably late variety associated with *Pleurocephalites* and *Bonarellia fornix* J. de C. Sowerby sp. (see p. 96,

supra) the ribs are more lamellar or scaly, with steep posterior and gentle anterior slopes, but unfortunately this form is represented only by a fragment.

The small specimens figured in Pl. XXXIII, fig. 11 and pl. XXXV, fig. 8 well show the suture-line, drawn separately in pl. XXV, fig. 2. The lobes are deeper in this example than in Waagen's original (pl. XXXI, fig. 1*b*), and compared with the suture-line of *e.g. M. triangularis* the saddles are plumper and less subdivided. There is a decided resemblance to *Morrisites morrisi* (Oppel) on the one hand and to *Eurycephalites vergarensis* (Burckhardt) on the other. This, however, is probably due to their derivation from a common ancestor, and *M. chariensis*, if an extreme form in the restricted genus *Macrocephalites*, belongs to a comparatively late horizon.

Lemoine (p. 24) referred this species to Uhlig's genus *Kossmatia* but there is no resemblance whatever to any of the forms of this Tithonian genus and not even to such Callovian forms as had wrongly been included in the same group. Sémenow's (1896, p. 130, pl. II, fig. 3) *Macrocephalites andrussowi*, described as intermediate between the present species and *M.* [*Pleurocephalites*] *pila*, Nikitin, also belongs to quite a different group.

Horizon:—Callovian, *dimerus* to *rehmanni*? zones. The typical coarsely ribbed examples are from the *diadematus* zone; the earlier varieties are more finely ribbed, whilst a fragment (with various small *Bonarellia fornix* and *Pleurocephalites* in its matrix), presumably from the *diadematus* or even *rehmanni* zone, has more lamellar ribs.

Localities:—Waagens two figured examples came from the Golden Oolite of Khera and he had eight further specimens including some from the *macrocephalus* shales of Jumara and Surka. The twenty additional specimens in the collection of Mr. J. H. Smith and the Geological Society and Blake Collections in the B. M. are from the Habye Hills (eleven); Khera, beds 3-5 (old =4-6 new) of Mr. J. H. Smith and beds 11-20 of Blake (six); and Jumara, Blake's beds 9-11 (one). Two examples, probably from Habye, are not localised.

MACROCEPHALITES TRIANGULARIS, sp. nov.

(Pl. XXI, figs. 1*a*, *b*).

1924. *Macrocephalites* aff. *chariensis* (Waagen); Spath, p. 22 (No. 218).

This form is undoubtedly close to *M. compressus* (Quenstedt, 1849, pl. xv, figs. 1-2) with equally intricate suture-line, and to '*M. canizzaroi*', Parona and Bonarelli (1897, p. 150, text-fig. *a*), which is here considered to be identical with Quenstedt's form, as Pompeckj held in 1901 (p. 149), but not with Gemmellaro's original *Stephanoceras cannizzaroi* (1868, p. 45, pl. IX, figs. 9-11) which is a true *M. macrocephalus* and was indeed referred to this species by Gemmellaro himself at a later date (1872, p. 23, pl. IV, fig. 1). There are, unfortunately, only two Kachh examples; but its subtrigonal whorl-shape and narrow ventral area sufficiently distinguish this species from Quenstedt's form, with subparallel sides and a comparatively wide and rounded periphery. As in Quenstedt's Wurtemberg examples (1849, pl. XV, figs. 1*a*, *b*; 1886, pl. LXXVI,

figs. 14-15) and Lochen specimens before me (*e.g.* B. M. No. 22223*a*), the costation of the inner whorls is extremely fine, branching some distance from the abrupt umbilical edge, and perfectly straight across the venter. In young *Subkossmatia* and *Epimayaites* of the *transiens* group, with similar fine ornamentation, there is a distinct peripheral projection of the ribs. The whorl-thickness (39 per cent.) is less than that of *M. compressus*, as given by Parona and Bonarelli (43 per cent.); on the other hand the whorl-height is slightly greater (54 per cent. instead of 52 per cent.) and the umbilicus is smaller (10 per cent. as compared with 14-17 per cent. in *M. compressus*).

By its indistinct primary ribs and smooth whorl-sides the present species can be distinguished from those discoidal forms of *Dolikephalites* that have occasionally been confused with the true *M. compressus*, including probably Bataller's (1927, p. 112) *M. sp. aff. canizzaroi* (non Gemmellaro); and it has already been pointed out that since flattened forms of Macrocephalitids (though generally with simpler suture-line) persist into later zones, records in geological literature of '*M. compressus*' cannot be trusted. For this reason alone it seems advisable to separate the present early form with a new name.

Horizon.—Lower Callovian, *triangularis* zone (Grey Patcham Limestone =Coral Beds).

Locality.—Jumara (bed No. 13 or 14*a*), Blake Colln. A fragment from 'below bed 12' (No. 219) is crushed and not definitely identifiable.

Macrocephalites madagascariensis Lemoine.

(Pl. XXII, figs. 3*a*, *b*).

1875. *Stephanoceras macrocephalum* (Schlotheim); Waagen, pars, p. 109 (*non* figs.).
(?) 1910. *Macrocephalites macrocephalus* (Schlotheim), race *noetlingi*; Lemoine, p. 31, pl. III, fig. 3.
(?) 1911. *Macrocephalites madagascariensis*; Lemoine, p. 51.
1924. *Macrocephalites madagascariensis* Lemoine; Spath, pp. 7 and 22.
1925. *Macrocephalites* aff. *madagascariensis* Lemoine; Spath, p. 13, pl. I, fig. 7.

Lemoine probably included several forms in his species, among them certainly *M. formosus* above described. It seems permissible to restrict *M. madagascariensis* to those developments—perhaps parallel with the typical *M. macrocephalus* and not confined to one province—in which primary costation of the early *eszterensis* type persisted to a diameter of about 100 mm. So far as one can judge from Lemoine's (poorly preserved) figured example the primary ribs are certainly well developed; and although, as this author points out, they are less conspicuous than [and decidedly less sharp than] in *Epimayaites transiens* (Waagen), they are much more prominent than in *M. macrocephalus*. Sowerby's *M. formosus* has not only smooth inner whorl-sides but also a more triangular cross-section. Whilst Waagen's forms are referable to *M. formosus*, Noetling's Mazar Drik examples (1895, pp. 12-13, pl. VII-IX), also included by Lemoine in the synonymy of his species, or rather local race, are altogether doubtful, and may even turn out to belong to other genera. Less helpful still

is Lemoine's erroneous statement that European specimens generally had a more globular shape and a deeper umbilicus than the Indian 'race' or 'mutation'; and the identification of the Kachh forms with Lemoine's species is thus open to criticism.

In the Madagascan holotype of this species, the measurements are:—150—·56—·47—·11. The Patcham example here figured (pl. XXII, figs. 3*a*, *b*) has dimensions 130—·52—·45—·12. There are, however, passage forms to *Indocephalites transitorius* with increasingly coarser inner whorls, such as the example figured in pl. XXIII, figs. 2*a*, *b*. These seem to differ from the earlier form merely in a wider umbilicus with less pronounced rim, perhaps also in the more frequent subdivision of the ribs near the periphery; and it has already been mentioned under *M. formosus* that the ribbing of the outer whorls is similar in many Macrocephalitids with widely different earlier stages. There appears to be a similar series of transitions from the stock that produced the present species to the sharply-ribbed *Pleurocephalites*, *e.g. Macrocephalites septifer*, S. Buckman sp. (1923, pl. CDXXXIII).

In the transitional specimen figured in pl. XXIII, figs. 2*a*, *b*, and pl. XXXII, fig. 1, and referred to below (p. 183) the measurements are:—131—·52—·48—·14, and 77—·50—·54—·16 respectively. This shows resemblance to the *Indocephalites* described by Lemoine as '*Macrocephalites tumidus*' as well as to that author's Madagascan type of the present species; it is less close to the Patcham example here figured, with a more angular and higher umbilical rim than to *Indocephalites transitorius*. The Patcham specimen, however, again shows great resemblance to the Madagascan specimen recorded by myself as *M.* aff. *madagascariensis*. By its cross-section (with a somewhat too tabulate venter in the diagrammatic sectional outline) and by its fine costation, it is closely comparable to the true *M. macrocephalus*, as here understood, and there are various transitions between it and Lemoine's more rounded but larger holotype.

The Chanaz example, with which the writer's Madagascan example was compared, and similar forms from various European localities in the British Museum, are more sharply ribbed, especially round the umbilicus, and therefore belong to that comprehensive group of transitions from *M. macrocephalus* to *M. septifer* and to *Dolikephalites* that has already been discussed, and to which seems to belong Lissajous's Macon example (1912, pl. VI, fig. 9). In a fragmentary Khera specimen of the present form, on the other hand, the blunt bundles of the primary ribs of the inner whorls are only slightly more distantly spaced than in *M. steinmanni*, nom. nov., or in *M. andinum*, Burckhardt (1900, pl. XIX, figs. 9-10) and give rise to three or four secondaries each.

Horizon.—Lower Callovian, *triangularis* to *diadematus*? zones.

Localities.—Jumara, bed No. 13 or 14*a*, and a doubtful fragment from 'below No. 12' (Blake Colln.); Khera (J. H. Smith Colln.). The transitional form to *Indocephalites transitorius* figured in pl. XXIII, figs. 2*a*, *b*, and pl. XXXII, fig. 1 (B. M. No. 392) is unlocalised. Waagen's sixty examples of his *Stephanoceras macrocephalus* may have included the present species, but

his three figured Khera examples belong to *M. formosus*; and the presumably still more involute Jumara specimens also do not appear to be referable to *M. madagascariensis*.

Genus: Indocephalites Spath.

Indocephalites transitorius, sp. nov.

(Pl. XXI, fig. 3; Pl. XXIII, figs. 2*a*, *b*; Pl. XXIV, figs. 6*a-c*; Pl. XXXII, figs. 1, 7*a*, *b*).

This species is created for certain examples intermediate between *Macrocephalites madagascariensis* on the one hand and *Indocephalites* of the *kheraensis—chrysoolithicus* type on the other. They may be defined as differing from the former in their more coarsely-ribbed and evolute inner whorls, and from the latter in reverting at an earlier stage to closer and finer ribbing and a '*Macrocephalites*' aspect. Fragments of outer whorls probably cannot be distinguished from large, true *Macrocephalites* and the adults of the more compressed varieties of *Indocephalites chrysoolithicus*; and, as has been shown in the case of *M. formosus*, the saddles tend to become broader with increase in size in the same individual.

As holotype may be taken the Khera example figured in pl. XXIV, figs. 6*a*, *b* (inner whorls) and fig. 6*c* (outline whorl-section of septate larger whorl). The volutions at first are rounded, comparatively evolute, and coarsely ribbed, as in the similar if more depressed young *Indocephalites kheraensis* figured in pl. XXI, fig. 4. Later the whorl-section becomes more compressed and finally it is as highly arched as in many typical *Macrocephalites*. At the same time the strong and, at first bifurcating, primary ribs become blunter, with generally three, later more, secondaries united into a bundle where they merge into the umbilical rib. At larger diameters apparently only the fine and close secondary costation remains, as in fully grown *I. kheraensis* or in *Macrocephalites madagascariensis*. The umbilical edge is vertical and the aspect of the evolute inner whorls is quite cadoceratid. As in many forms of that genus the ribs form a backwardly directed comma at the distinct edge, are concave forward on the inner half of the side and become straight on the outer half. This curvature is well shown in the holotype and in the example figured in pl. XXIII, figs. 2*a*, *b* and pl. XXXII, fig. 1, which has already been referred to (p. 182) as a connecting link with *Macrocephalites madagascariensis*.

The suture-line, with its comparatively wide first lateral saddle, is essentially that of *I. kheraensis*, as figured by Waagen (1875, pl. XXVII, fig. 1*c*), and as seen in the example here represented on pl. XXII, fig. 1*a*, which on account of its increased whorl-thickness, must be considered a passage form between *I. kheraensis* and the present species. There are a number of small specimens of *Indocephalites*, like those here figured in pl. XXI, fig. 3 and pl. XXXII, figs. 7*a*, *b*, that may be attached to the present species, although they differ in small details. The second example is more inflated than the

first and less finely and closely ribbed, but it consists already of more than half a whorl of (temporary ?) body-chamber, which also may account for the change in the curve of the ribs. In *I. indicum* the earlier whorls are more evolute and have a less pronounced umbilical edge. *I. kheraensis* and *I. chrysoolithicus* are more inflated already at a very early stage.

Horizon.—Lower Callovian, *dimerus* and *diadematus* zones (Golden Oolite).

Localities.—Khera (bed No. 5, J. H. Smith Colln.) and Jumara (bed No. 11 Blake, Colln.). Four of the eleven examples referred to this species are unlocalised (B. M. No. C 92, C 23662, 3, 5).

INDOCEPHALITES KHERAENSIS Spath.

(Pl. XIX, figs. 1*a*—*c*; Pl. XXI, figs. 4, 5; Pl. XXII, fig. 2, Pl. XXXI, fig. 4).

1840. *Ammonites herveyi* J. de C. Sowerby (non J. Sowerby), pl. XXIII, fig. 5.
1875. *Stephanoceras tumidum* (Reinecke); Waagen, p. 115, pl. XXVI, figs. 1*a*, *b*; pl. XXVII, figs. 1*c*, 2*a*, *b*.
1902. *Ammonites herveyi* Sowerby, var.; Blake, p. 35.
1911. *Macrocephalites tumidus* (Reinecke); Lemoine, p. 32, pl. III, fig. 2.
1924. *Macrocephalites tumidus* (Waagen *non* Reinecke); Spath, p. 7.

As type of this species is taken J. de C. Sowerby's original here refigured, with which I had previously included Waagen's larger example, but not the specimen figured in his pl. XXVII, figs. 2*a*, *b*. From the figure this seemed to have 'a much wider whorl-side and a smaller umbilicus', than Sowerby's type, and, like a comparable [or identical] example in the Blake Collection (No. 252), was taken to be intermediate between the present species and *Macrocephalites madagascariensis*. The subsequent examination, however, of Waagen's originals and of a number of specimens in Mr. J. H. Smith's collection has demonstrated the futility of distinguishing species or even varieties on the basis of differences in proportions or ribbing. In other words this species is very variable and the evolute holotype (pl. XIX, fig. 1) is connected with the more involute and more compressed passage-form to *I. transitorius* (pl. XXII, figs. 1*a*, *b*) by a number of transitions including the example of which Waagen figured the suture-line (pl. XXVII, fig. 1*c*). The young of one of these transitional forms is figured in pl. XXXI, fig. 4 and like a comparable example in the Blake Collection (No. 256), it differs from the similar *Indocephalites* represented in pl. XXXII, fig. 7, chiefly in continuing to increase its thickness, which, of course, may be merely due to the presence of the body-chamber in the latter. The young of the transitional example figured in pl. XXII, figs. 1*a*, *b* is coarsely ribbed to a much larger diameter and, if isolated, would probably have been grouped with *I. chrysoolithicus*. There are thus transitions to different species in different characters and the (unfigured) outer whorl of the smaller specimen (pl. XXXI, fig. 4) formerly doubtfully attached to '*Macrocephalites lamellosus*' also resembles the more evolute *I. indicus*.

It may be doubted whether the differences between the external and first lateral saddles in the suture-lines of Waagen's *Stephanoceras macrocephalum*

[=*M. formosus*] and the present species are of importance. The saddles are unequally developed on opposite sides of the small example here figured (pl. XXI, fig. 4, pl. XXII, fig. 2) as they are in R. Douvillé's *M. macrocephalus* (1912, p. 14, text-fig. 2); and comparing those of various examples of *I. kheraensis* with the suture-lines of *M. formosus* one cannot find satisfactory distinctions except perhaps in the lateral saddle being comparatively large and wide in young *Indocephalites*. The whorl-thickness was given by Waagen as declining from 64 per cent. at 28 mm. diameter to 57 per cent. at 120 mm. At this latter diameter Waagen's example of pl. XXVII, fig. 2, with a more funnel-shaped umbilicus, and the similar specimen in the Blake Collection (No. 252) show a whorl-thickness of 63 per cent., whilst at half that diameter it reached 70 per cent. Sowerby's evolute type also has 63 per cent. at 112 mm., and Waagen's large example at 100 mm. diameter has a whorl-thickness of about 70 per cent., reduced to 55 per cent. at 180 mm.

The true *Amm. tumidus*, Reinecke, may seem difficult to compare, on account of difference in size, to those unacquainted with the actual specimens; it certainly is not only not identical with the Kachh species, but belongs to a different group. Its inner whorls are very finely flexicostate and show a perfectly rounded umbilical slope with fine primary costae that attain the umbilical suture to a diameter of 30 mm. Later the inner half of the umbilical slope becomes smooth and the ribbing comparatively more distant, and at 90 mm. diameter the dimensions are as follows:—·52 — ·60 —·16. This is the *Macrocephalites tumidus* figured by Reuter (1908, p. 88, figs. 3-5) and its whorl-section is that of the "*M. macrocephalus*" figured by Steinmann and Döderlein (1890, p. 439, text-fig. 532), but not of d'Orbigny's *Amm. tumidus* (1846, p. 469, pl. CLXXI), copied in Chenu (1859, p. 79, text-fig. 333) and thence in Wright (1880, p. 191, text-fig. 66) and other works. The Chippenham form (*e.g.* B. M. No. 51361, pl. XXXVI, figs. 6*a*, *b*) which I identified with Reuter's smallest example of *M. tumidus* (fig. 3), is indistinguishable at diameters up to 25 mm., and the Cadoceratid umbilical wall of *Pleurocephalites* is even then noticeable. It is the same form as that figured by Mr. Buckman (1922, pl. CCCXLVIII) as *Pleurocephalites folliformis*. On the other hand, in the Kachh species, the inner whorls (pl. XXI, fig. 4) are comparatively more coarsely costate than the outer (pl. XIX, fig. 1*a*), and decidedly more cadoceratid; for the uncoiling body-chamber has a rounded umbilical border like many adult *Macrocephalites* combined with a secondarily coarse and blunt costation. This reversal in development of the Indian form, compared with the true *M. tumidus*, is here considered to be of more than specific value, unless we are content to avoid all subdivision of Macrocephalitids.

'*Macrocephalites*' *boonei*, Petitclerc (1915, p. 41, pl. III, fig. 1, pl. XIII, No. 38) is probably not so close to the species here described as might be inferred from a comparison of the figures. The French form, described as 'trés épaisse, globuleuse', has a whorl-thickness of only 34 per cent. of the diameter and the outline section must also have been incorrectly drawn, whilst neither suture-line nor inner whorls are known. The affinities of Petitclerc's

species are thus altogether too doubtful for accurate identification or comparison.

Waagen, and after him R. Etheridge jr. (1890, p. 176), united Sowerby's type with *Amm. grantanus*, Oppel, but it will be shown below that there has been confusion of two entirely different forms.

Horizon.—Lower Callovian, *diadematus* zone.

Localities.—Khera Hill. Even the unlocalised specimens, by their Golden Oolite matrix, can be taken to come from Khera, and two examples in Mr. J. H. Smith's Collection are labelled bed No. 5. This is above the Golden Oolite (Smith, 1913*a*, p. 210) but is here included in the *diadematus* zone.

INDOCEPHALITES CHRYSOOLITHICUS (Waagen).

(Pl. XXI, figs. 6*a*, *b*, pl. XXIV, fig. 7, pl. XXV, fig. 1, pl. XXVI, fig. 6).

1875. *Stephanoceras chrysoolithicum* Waagen; p. 175, pl. XXX, fig. 1.
1878. *Stephanoceras chrysoolithicum* Waagen; Gottsche, p. 42.
(?) 1881. *Stephanoceras chrysoolithicum* Waagen; Steinmann, p. 270, pl. XI, fig. 3.
1885. *Macrocephalites chrysoolithicus* (Waagen); Nikitin, p. 51.
1894. *Macrocephalites chrysoolithicus* (Waagen); Tornquist, p. 25.
1897. *Macrocephalites chrysoolithicus* (Waagen); Parona and Bonarelli, p. 148.
1910. *Macrocephalites chrysoolithicus* (Waagen); Lemoine, fig. 28, p. 21, p. 29.
1914. *Macrocephalites chrysoolithicus* (Waagen); R. Douvillé, p. 363.
1924. *Macrocephalites chrysoolithicus* (Waagen); Spath, pp. 7 and 22.
(?) 1924. *Macrocephalites chrysoolithicus* (Waagen); Stehn, pp. 77 and 147.
1925. *Pleurocephalites chrysoolithicus* (Waagen); Spath, p. 14.
(?) 1925. *Macrocephalites chrysoolithicus* (Waagen); Gerth, p. 33.
(?) 1926. *Macrocephalites* cf. *chrysoolithicus* (Waagen); Kruizinga, p. 55, pl. IV, figs. 1-2.

This form was well characterised by Waagen's figures and description, but it is very doubtful whether authors have correctly interpreted it. Thus Steinmann's involute and inflated form, wrongly stated by Lemoine to be very close to *Kamptokephalites grantanus* (Oppel), differs very considerably in proportions, but was only recently again referred by Stehn to Waagen's species. Nikitin considered his *Macrocephalites pila*, which is close to *Pleurocephalites folliformis*, Buckman, to be intermediate between the more inflated *P. tumidus* and the more compressed Kachh form. His interpretation of *Indocephalites chrysoolithicus*, however, was probably influenced by Steinmann's figures, of which '*Macrocephalites*' *zirkeli* (not *zieteni*, as Nikitin writes) is still less closely related to the present species. Lemoine united *I. chrysoolithicus* with '*Macrocephalites*' *grantanus* (Oppel), but the former agrees neither with the French *Kamptokephalites* of the *herveyi* group to which the name *grantanus* must be restricted, nor with the more involute Kachh species, to which Waagen had erroneously applied Oppel's specific name.

Parona and Bonarelli objected to Waagen's placing of the present species in his '*recticostati*' since by the very obvious bend of the ribs where they

bifurcate, it seemed to them to belong to the section of the '*flexicostati*'. Waagen's second section, however, had been based on the presence of a peripheral sinus, a distinction discussed by Boehm (1912, p. 157) and rejected as useless for systematic purposes since the curvature, peripheral or lateral, often varied in the same individual.

The species is now adopted in a fairly wide sense for those coarsely ribbed *Indocephalites* that differ from *I. diadematus* in being more involute and less depressed, from *I. kheraensis* in having stronger and more distant costation, from *I. indicus* and *I. gibbosus* in having a smaller and deeper umbilicus and much coarser ribbing. A typical example, showing the inner whorls, is figured in pl. XXI, figs. 6*a*, *b*. There are many transitions however to the other species of *Indocephalites*. The example figured in pl. XXV, fig. 1 and pl. XXVI, fig. 6 is transitional to *I. diadematus* in whorl-thickness but retains the rounded edge and smaller umbilicus of *I. chrysoolithicus*. The specimen figured in pl. XXV, fig. 6 represents the inner whorls of a comparable form with the peripheral sinus and sharp umbilical edge (worn on the last part of the outer whorl) of *I. diadematus* and therefore here attached to that species rather than to the present. The completely septate and partly crushed example figured in pl. XXIV, fig. 7 is slightly less coarsely ribbed than the typical forms and may therefore be considered to represent a passage form to such involute varieties of *I. kheraensis* as the specimen illustrated in pl. XXII, figs. 1*a*, *b*, and especially to *I. gibbosus* (pl. XXVIII, fig. 1).

Some large specimens from beds 4 and 5 of Khera, unfortunately crushed so as to resemble *Pachyceras*, may belong to the present species. They are septate to a diameter of at least 200 mm. and show not only the usual broadening of the saddles but also a return to a smooth, macrocephalitid outer whorl.

The '*Catacephalites*' sp. ind. previously figured from Madagascar (1925*b*, p. 14, pl. I, fig. 4 only) differs from *I. chrysoolithicus* mainly in its wider umbilicus. If the comparison to the incompletely known and less inflated *I. colcanapi* is at all apt, it shows that Lemoine's species is indeed a typical *Indocephalites*.

The smaller Madagascar example, however, of which I gave the suture-line (1925*b*, pl. I, fig. 3) and which is now figured (pl. XXXVI, fig. 12) for comparison with other immature *Indocephalites*, is not definitely identifiable. The other examples of '*Catacephalites*' and '*Pleurocephalites*?' recorded, as well as some additional examples since sent by Dr. S. H. Haughton of the South African Museum, are referred to below under *Kamptokephalites*.

Horizon.—Lower Callovian, *diadematus* zone.

Localities.—Khera, beds Nos. 3-5 of Mr. Smith and No. 14 of Prof. Blake. Waagen considered this species very rare, but there are now altogether over twenty specimens from this locality, also one example from Jumara, beds 9-11 of Blake (No. 225).

INDOCEPHALITES DIADEMATUS (Waagen).

(Pl. XXI, fig. 7, pl. XXV, fig. 6, pl. XXXI, fig. 5).

1875. *Stephanoceras diadematum* Waagen, p. 130, pl. XXX, figs. 3*a-c*, 4*a*, *b*.
1885. *Cadoceras diadematum* (Waagen); Nikitin, p. 56.
non 1895. *Macrocephalites*? cf. *diadematus* (Waagen); Parona and Bonarelli, p. 158.
1910. *Macrocephalites diadematus* (Waagen); Lemoine, pp. 21 and 29.
1914. *Macrocephalites diadematus* (Waagen); R. Douvillé, p. 363.
1924. *Macrocephalites diadematus* (Waagen); Spath, p. 7.
non 1924. *Macrocephalites diadematus* (Waagen); Stehn, p. 80, pl. II, figs. 1-3; pl. VII, fig. 3; pl. VIII, fig. 4.

This species may be briefly characterised as a depressed and evolute *Indocephalites kheraensis*, and it again is rather variable. The two examples figured by Waagen differ in whorl-thickness at a corresponding diameter and in the coarseness of the costation, but there are various intermediate forms, also transitions to *I. kheraensis* and to *I. chrysoolithicus*. The example figured in pl. XXI, fig. 7 seems scarcely depressed enough, at first sight, for reference to the present species, but at 40 mm. diameter the thickness has rapidly increased to 85 per cent. In the large and completely septate specimen of which the suture-line is here figured (pl. XXXI, fig. 5) the whorl-thickness decreased from 76 per cent. at 58 mm. diameter to 70 per cent. at 140 mm. The inner whorls agree with Waagen's smaller example except in having straighter peripheral ribs, like the lectotype (= Waagen's larger example, pl. XXX, figs. 4*a*, *b*). This has three-quarters of the outer whorl forming the body-chamber and at 85 mm. diameter its thickness is still 87 per cent.

The 'virgatoid' ribbing on which R. Douvillé laid undue stress, is not at all distinct. The costae bifurcate at first (as in all other *Indocephalites*) and then break up into three or more secondaries, mostly of irregular arrangement. In the absence of the suture-line this may help to distinguish *Kamptokephalites* of the depressed *elephantinus* type from the species now discussed. Waagen stated that at diameters of over 150 mm. the ribs seemed to disappear and the shell to become smooth. The largest specimens available to the writer like that of which the suture-line is figured, still show fine secondary ribs and blunt primary folds. The presence of the latter also characterises certain fragments that on account of their more rounded umbilical wall and less depressed whorl-section might be considered to be passage forms to *I. kheraensis*.

The transitional form to *I. chrysoolithicus*, figured in pl. XXV, fig. 1 and pl. XXVI, fig. 6, has a smaller umbilicus and a more rounded whorl-section than the typical examples of the present species. On the other hand, the small example figured in pl. XXV, fig. 6 and already referred to under *I. chrysoolithicus* is perhaps more doubtful since its outer whorls are poorly preserved.

Stephanoceras cf. *diadematum*, Waagen (in Gottsche, 1878, p. 42, pl. VIII, figs. 2-3) has nothing to do with the Kachh species, nor probably the involute Chanaz form compared to it by Parona and Bonarelli (1897, p. 158). Tornquist (1898, p. 48) renamed the South American form, but the same author's *Sphaeroceras extremum* (p. 47, pl. VI, figs. 5-6) which was compared to the

present species, is an involute *Eurycephalites*. The evolute Argentine forms described by Stehn will be referred to below under *I. indicus*.

Sphaeroceras godohense, G. Boehm (1912, p. 151, pl. XXXV, fig. 1) shows superficial resemblance to *I. diadematum*, but the primary ribs are visible in the peripheral view and there are important differences in the suture-lines.

Waagen compared this species to *Cadoceras sublaeve* (J. Sowerby) and *C. modiolaris* (Llwyd) and Nikitin even thought it intermediate between *C. sublaeve* and *C. elatmae* (Nikitin), but the resemblance is only superficial.

Horizon.—Lower Callovian, *diadematus* zone.

Localities.—Khera Hill (beds 4-5 of Mr. J. H. Smith). Waagen had this species also from north-west of Jumara and from south of Jooria.

INDOCEPHALITES INDICUS sp. nov.

(Pl. XXVI, figs. 5*a*, *b*, pl. XXVII, fig. 5).

1924. *Macrocephalites* sp. nov.; Spath, p. 8.

1924. *Macrocephalites* spp. (Nos. 230, 231); Spath, p. 22.

This form was previously recorded as belonging to the group of *M. chrysoolithicus* but being more compressed and somewhat resembling '*Macrocephalites*' *rotangi* G. Boehm. The similarity to the Wai Galo form is indeed striking, but it is confined to the irregularly trifid or quadrifid ribbing and a somewhat comparable whorl-shape. By its suture-line Boehm's species is definitely recognisable as belonging to the group of *Epimayaites evolutus*, described below. *Indocephalites indicus* has an elliptical, depressed, whorl-section, slightly wider than high, and with its greatest thickness at the evenly rounded umbilical border. The costation as a whole is projected forward as in the South American forms figured by Stehn (1923, pl. II, figs. 1-3, pl. VII, fig. 3, pl. VIII, fig. 4), and similarly irregular, but the secondaries are slightly longer and closer. The Argentine examples, however, are probably much more closely allied to the present species than to *I. diadematus*.

The suture-line is comparatively simple and the saddles are wide, but the general plan is that of the suture-lines of *I. chrysoolithicus* and *I. diadematus*. The inner half of the broad and bifid second lateral saddle is already on the rounded umbilical slope and there is only one additional saddle. On the other hand those *Pleurocephalites* of the *tumidus* group, figured by Reuter (1908, p. 88, text-figures 3-5, especially *b*) that from a comparison of the illustrations alone might be thought to be similar to the species now described, differ not only in the costation, but have a more elaborate suture-line with slender saddles (see pl. XXXIII, fig. 5) and two auxiliary saddles at a smaller diameter.

I. gibbosus, described below, differs in proportions and especially in ribbing, but is undoubtedly the closest ally of the present species. The inner whorls of such *Indocephalites* as that figured in pl. XXXI, fig. 4, described as transitional between *I. kheraensis* and *I. transitorius*, and similar small examples, are difficult to distinguish from the immature *I. indicus*, but the characteristic

open umbilicus, rounded and low umbilical slope, and irregular costation are noticeable already at a comparatively early stage. Among European forms Blake's '*Macrocephalites*' *hudlestoni* (1905, p. 47, pl. IV, figs. 3*a*, *b*) shows superficial resemblance to the species here described, particularly in its open umbilicus. The holotype of this species (B. M. No. C 12088) and a small paratype from Ailsworth (C 11828) are poorly preserved, but referable to *Kamptokephalites*, representing a compressed equivalent of *K. herveyi*, with prominent and sharp primary ribs. Lissajous's '*Macrocephalites herveyi*' (1912, p. 49, pl. VI, fig. 7 =*K. maconnensis*, nom. nov.) represents the lateral aspect of this type of *Kamptokephalites* and is probably intermediate between the Niort form of *K. hudlestoni* (B. M. No. 74227) previously (Spath, 1924, p. 8) recorded and *K. lamellosus* (J. de C. Sowerby).

Horizon.—Lower Callovian, *dimerus* (and *diadematus* ?) zone.

Locality.—Jumara, bed No. 11 (Blake Colln. Nos. 230, 231). Some doubtful, immature examples from the Golden Oolite of Khera, with wider umbilicus and thinner whorls than *I. chrysoolithicus* may also belong to the present species.

Indocephalites gibbosus sp. nov.

(Pl. XXVIII, figs. 1*a*, *b*).

1924. *Macrocephalites* cf. *chrysoolithicus* (Waagen); Spath, p. 22, pars (No. 229).

This species is based on the single example here figured and may be described as an inflated and distantly costate development of the same stock that produced the more finely ribbed *I. indicus* and the more involute *I. chrysoolithicus*. The smooth and rounded umbilical edge seems particularly characteristic; also the distant, blunt, primary ribs. The secondaries are either intercalated in an irregular manner or arise by branching off the primaries, first on the middle of the side and (in two cases) again on the periphery, as in G. Boehm's '*Macrocephalites keeuwensis-gamma*' (1912*a*, p. 162, text-fig. 72). One of the examples included by that author in his far too comprehensive species (pl. XXXIX, fig. 3) shows indeed great resemblance to the form here described, but it has a distinct umbilical wall and the primaries are short and close to the umbilical edge. On the other hand, there is a somewhat similar weakening of the ribs towards the end, although the holotype of *I. gibbosus* is still septate at a diameter of 105 mm. Since it is necessary to restrict *I. keeuwensis-gamma* to Boehm's figs. 5 (4 and 6) of pl. XXXIX and since *Macrocephalites wichmanni* may be advantageously retained for the New Guinea form (1912*b*, pl. IV, figs. 1*a*, *b* only; text-figs. 6*a*, *b*, p. 15) we may name the Keeuw example represented in Boehm's pl. XXXIX, fig. 3 *Indocephalites* **apertus** nov.

The suture-line is similar to that of *I. chrysoolithicus* (see Waagen's pl. XXX, fig. 1*c*) and less 'degenerate' than that of *I. indicus*. The stems of the lateral saddles especially are slenderer and there is also greater frilling of all the ele-

ments. The external lobe is as deep as the first lateral. Some forms of *Mayaites* of the *jumarensis* type show superficial resemblance to the present species and the occasional reference of Callovian Macrocephalitids to the Argovian *Mayaites* (see *e.g.* Stehn, 1922, p. 85) may be due to this similarity of outer whorl-fragments.

Horizon.—Lower Callovian, *dimerus* or *diadematus* zone.

Locality.—Jumara (beds 9-11, Blake Collection No. 229).

Indocephalites sphaeroidalis, sp. nov.

(Pl. XXV, fig. 3, pl. XXVI, fig. 1, pl. XXVII, fig. 2).

1913. *Stephanoceras* sp. (ball-shaped); Smith, p. 210 (bed 1).

This form is available in only a single specimen but it is now given a new name because it seems to form an important link between the group of *Indocephalites chrysoolithicus* on the one hand and *Kamptokephalites dimerus* on the other, the inner whorls resembling the latter, the outer the former species. The suture-line, however, (pl. XXVII, fig. 2) is that of an *Indocephalites*, and the outer whorl, unfortunately too poorly preserved to be figured, is comparable to that of large and equally sphaeroidal and involute *I. chrysoolithicus*, whilst the resemblance to *Kamptokephalites dimerus* and certain passage forms to *Pleurocephalites habyensis* is confined to a similar sharp costation of the inner whorls, combined with an open umbilicus at that stage. The umbilical wall is then vertical and its edge comparatively well-defined, with the region of greatest whorl-thickness in close proximity, giving the section a semi-lunar shape. The periphery then is also more depressed and more flattened than in *I. chrysoolithicus* and the ribs describe a sinus forward in the middle of the ventral area.

On the outer whorl, however, still septate at 110 mm. diameter, the umbilical wall has become lower and more rounded with the—now far less distinct—primary ribs beginning apparently some distance from the smooth umbilical slope. This outer whorl is worn but since the details of the suture-line are visible, not much of the umbilical slope can be missing. The appearance at that stage is like that of the transitional *Indocephalites* figured in pl. XXIV, fig. 7, but the primary ribs appear closer and less distinct, whilst the secondaries seem more distant and proportionately stronger. There are still three secondaries, however, to each primary and the difference is not of importance. On the other hand the umbilicus is smaller. The proportions of the figured inner whorls are :—60 — ·43 — ·57 — ·27; with the septate outer whorl added they are :—110 — ·58 — ·51 — ·14. This change in whorl-shape as well as the macrocephalitid outer whorl indicate closer relationship of the present form with *Indocephalites* rather than the group of *Kamptokephalites dimerus*.

Horizon.—Lower Callovian, *dimerus* zone.

Locality.—Khera, belt 1 (new 8), "lowest exposed—on top of hill" (J. H. Smith Colln., No. 88).

Genus: PLEUROCEPHALITES S. S. Buckman.

PLEUROCEPHALITES HABYENSIS, sp. nov.

(Pl. XXIV, fig. 4, pl. XXX, fig. 6).

1837. *Ammonites* cf. *harveyi* Sowerby; Greenough, p. 150.
1875. *Stephanoceras grantanum* (Oppel); Waagen, p. 123, pl. XXXVI, fig. 6.
1910. *Macrocephalites grantanus* (Oppel); Lemoine, pars, p. 29.
1914. *Macrocephalites grantanus* (Oppel); R. Douvillé, p. 363.
1915. *Stephanoceras grantanum* (Oppel); J. H. Smith, p. 797.
1924. *Macrocephalites grantanus* (Oppel); Spath, p. 8.
1925. *Pleurocephalites* ? *grantanus* (Oppel); Waagen; Spath, p. 14.
non 1896. *Macrocephalites grantanus* (Oppel); Noetling, p. 17, pl. IV, figs. 3, 3*a*.
non 1898. *Macrocephalites grantanus* (Oppel); Skeat and Madsen, p. 104, pl. I, fig. 10.
non 1915. *Macrocephalites* cf. *grantanus* (Oppel); Petitclerc, p. 46.

Waagen already recognised that the "*Ammonites herveyi*" figured by J. de C. Sowerby (1840) in the woodcut on p. 719 differed from the true *Kamptokephalites herveyi* (J. Sowerby) as well as from the example illustrated in J. de C. Sowerby's (1840) pl. XXIII, fig. 5. The latter, however, here refigured as *Indocephalites kheraensis* (pl. XIX, fig. 1, pl. XXI, fig. 5), was included by Waagen in his "*Stephanoceras grantanum*"; the former he correctly referred to the later group of "*S. subtumidum*". There can be no doubt that Oppel (1857, p. 548) created his *Ammonites grantanus* for the French species, *i.e.* d'Orbigny's *Amm. herveyi* (non Sowerby, 1846, pl. CL), not for the Kachh form as assumed by Lemoine. Since the latter certainly does not "agree even in the smallest details" with d'Orbigny's type, as Waagen stated, a new name becomes necessary.

As type of this species may be taken Waagen's figured example of 71 mm. diameter on which his description is based. The lobes could not be observed on any of his fifteen specimens, but the large additional material sent by Mr. J. H. Smith includes several examples that show the suture-line. It is characterised by its comparative simplicity, low and broad saddles and small lateral lobes (see pl. XXIV, fig. 4 and pl. XXX, fig. 6), and does not differ essentially from that of *Kamptokephalites dimerus* and *K. magnumbilicatus*, although it shows little resemblance to the suture-line of *K. grantanus* as figured by d'Orbigny (1846, pl. CL, fig. 3). The drawing may seem diagrammatic on comparison with the suture-lines of the true *K. herveyi* here figured (pl. XLIII, figs. 2*a*, *b*) and in Wurtemberg and Bavarian examples of so-called '*grantanus*' before me, the narrow lateral lobe does not come down to the level of the external lobe. But the '*Macrocephalites grantanus*' from Uetzing in the Model Collection in the British Museum have *Pleurocephalites*-like inner whorls to

quite a considerable diameter; and while one may be in doubt as to whether to include them in that genus rather than in *Kamptokephalites*, they are certainly distinct from the forms of the earlier *herveyi* group as well as from the Kachh form here discussed.

This last species, partly on account of Sowerby's unsatisfactory figures, partly owing to the far too comprehensive interpretations adopted by *e.g.* Grossouvre (1888, p. 388) and Blake (1905, p. 46) and such erroneous accounts as Parona and Bonarelli's (1897, p. 156), has generally been misunderstood. The outline whorl-section of *K. herveyi* given by Sowerby quite correctly shows a flattened periphery, but this was taken from the end of the body-chamber which occupies more than three-quarters of the outer whorl of the lectotype. In the earlier stages the coiling is that characteristic of Nikitin's '*Stephanoceras*' *pila* (1885, pl. X, fig. 45), with fairly rapid increase in thickness and a similarly arched periphery. In *K. grantanus*, with a whorl-thickness of only 56 per cent. as against 66 per cent. in the true *K. herveyi*, the primary ribs are stronger and shorter, whilst *Pleurocephalites habyensis*, with a thickness of 66 per cent. of the diameter, differs from Sowerby's species in its slow rate of growth and broad venter even in the young. There is no direct evidence available as to the very early stages of *K. herveyi*, but the inner whorls of the two species are not closely comparable, judging by the young of the closely allied, more finely ribbed and *pila*-like *K. terebratus*, which is already transitional to *Pleurocephalites*, as here defined.

There are transitions between *K. dimerus* and the present species, differing from the latter in closer costation and greater compression, also in having a peripheral sinus. Passage forms to *Pleurocephalites elephantinus* on the other hand may show increased depression or broader venters in some cases and a wider umbilicus, and ribbing with or without peripheral sinus, in others. These are easily mistaken for the immature *Indocephalites diadematus*, but suture-lines and adult whorls are different in the two stocks.

Noetling's Baluchistan form almost certainly does not belong to the species here discussed, but cannot be definitely identified from his figure.

Horizon.—Lower Callovian, *dimerus* and *diadematus* zones.

Localities.—Waagen recorded this species from Khera, Jumara, North-west of Surka, and Kaora on Patcham Island. To these can now be added the Habye Hills, where Mr. J. H. Smith collected some twenty specimens. One of Prof. Blake's examples from the same locality is labelled "*Nuoula* Flags, No. 12". The Jumara specimens in the Blake Collection come from beds 10 (No. 235), 11 (No. 234), and 9-11 (No. 226). Like unlocalised examples in the Geological Society Collection, these include transitions to *P. elephantinus*. One of the Khera examples in the Blake Collection is labelled "No. 3 or 4", and Mr. Smith's specimens from the same locality are marked as coming from beds 4 and 5. Eight immature *Pleurocephalites* out of the matrix of *Bonarellia fornix* (see p. 171) from "12-15 miles north of Bhuj" may also belong to the present species.

Pleurocephalites elephantinus (J. de C. Sowerby).

(Pl. XXIII, fig. 3; pl. XXIV, figs. 1*a*, *b*; pl. XXXI, figs. 2*a*, *b*).

1840. *Ammonites elephantinus* J. de C. Sowerby, pl. XXIII, fig. 6.

1889. *Stephanoceras herveyi* (J. Sowerby); Newton, p. 334, pars (non pl. XIV, figs. 1-2).

1898. *Macrocephalites elephantinus* (Sowerby); Skeat and Madsen, p. 105.

1902. *Ammonites elephantinus* (Sowerby); Blake, p. 35.

1910. *Macrocephalites elephantinus* (Sowerby); Lemoine, p. 29 (non 36).

1925. "*Stephanoceras herveyi*" (Sowerby); Newton; Spath (*b*), p. 27.

non 1875. *Stephanoceras elephantinum* Waagen, p. 124, pl. XXXI, figs. 3, 3*a*; pl. XXXII, figs. 4*a-c*.

non 1924. *Dhosaites elephantinus* (Waagen); Spath, p. 10.

non 1928. *Macrocephalites elephantinus* (Sowerby); Nickles p. 34.

This species was confused by Waagen with the Dhosa Oolite form described below as *Dhosaites elephantoides* and it has since generally been misinterpreted in geological literature. Before I examined Waagen's original I thought the two forms differed merely in the peripheral projection of the ribs and in proposing the genus *Dhosaites* for the '*elephantinus*-group', I was relying mainly on the *Mayaites*-like earlier whorls represented in the Blake Collection. These resembled Waagen's small example (pl. XXXII, fig. 4) but could not easily be compared to Sowerby's holotype on account of difference in size. The latter, after tedious preparation, has now yielded at least part of the suture-line; and with the information derived from a dozen examples since sent by Mr. J. H. Smith, its systematic position can at last be fixed. The majority of the specimens are intermediate to *P. habyensis*, with straighter ribs and smaller umbilicus, an cannot be distinguished from the Madagascan form figured by Lemoine (1910, pl. II, figs. 3*a*, *b* only). The type itself is still more extreme and the peripheral sinus is well-marked. It is, however, doubtful whether the (inaccessible) inner whorls of Sowerby's type agree with the small example here reproduced (pl. XXXI, figs. 2*a*, *b*) which is taken to represent the immature *K. elephantinus*. On the body-chamber (not here figured) of the example, at a diameter of about 65 mm., the ribbing is perhaps less coarse and slightly closer than in the type, but there is considerable variability among the material available, especially in the amount of peripheral projection at various diameters, so that with less abundant material one might be led into naming individuals instead of species. All these forms show such a striking resemblance to the later *Epimayaites subtumidus* (Waagen), *e.g.* the examples represented in pl. XXXI, fig. 7 or pl. XXV, fig. 5, that the citation of '*Macrocephalites subtumidus*' from Callovian deposits, for example from Chanaz, Savoy (Parona and Bonarelli, 1897, p. 155) or Villany (Loczy, 1915, p. 353) is easily explained.

There are, however, still other developments that have been mistaken for the Kachh form, *e.g.* South American *Eurycephalites* and immature European *Macrocephalites* of the *rotundus* and *eszterensis* types (Simionescu, 1905, p. 33, pl. III, fig. 6 and Popovici-Hatzeg's '*Sphaeroceras ymir*' [Oppel], 1905, p. 22, pl. VI, figs. 8-9), easily recognisable by their intricate suture-lines (compare pl. XXXIII, fig. 4), or *Pleurocephalites* (Bukowski, 1886, p. 127).

The ribbing of the depressed but evenly rounded inner whorls is fine and more or less regularly bifurcating, the branching occurring below the middle of the side in the region of greatest whorl-thickness. In the small figured example the alternation of the pairs on the two sides is very distinct; in Sowerby's holotype, where observable, the rib-pairs of the two sides are symmetrically developed, as in the majority of examples of *P. habyensis*. Towards the aperture the umbilicus widens and the peripheral sinus forward generally becomes very pronounced. The suture-line of the holotype (pl. XXIII, fig. 3) at a larger diameter is slightly more complex than that of *P. habyensis*, and comparable to that of *Kamptokephalites herveyi* (pl. XLIII, figs. 2*a*, *b*); but *Indocephalites diadematus*, which is somewhat similar in whorl-shape at intermediate stages (if entirely different in the young and adult) has longer lobes and much greater complication or frilling.

The true *P. elephantinus* does not yet seem to have been found outside Kachh. One of Lemoine's Madagascan examples, already quoted, is certainly very close, but his two specimens of pl. IV, figs. 8 and 9 (not 7), themselves dissimilar in the mode of branching of the costae, do not seem to be referable to Sowerby's species. Among the Madagascan Macrocephalitids before me, one of the '*Stephanoceras herveyi*' labelled (and recorded ?), by R. B. Newton, may be comparable to the present species; and at least one of the '*Pleurocephalites*' previously (1925*b*, p. 14) stated to show resemblance to '*P.* ?' *grantanus* (Oppel) Waagen may belong to Lemoine's '*Macrocephalites elephantinus*'; but the examples are too poorly preserved for accurate identification. On the other hand the small example here figured (pl. XXXII, fig. 8) in a better state of preservation, is indistinguishable from a number of Kachh specimens intermediate between *P. habyensis* and *P. elephantinus*. Stehn's Argentine '*Macrocephalites* cf. *elephantinus*' (1922, p. 78), to judge by the description, are also probably closer to the *grantanus*-group (if *Kamptokephalites* at all) than to Sowerby's species.

Horizon.—Lower Callovian, *diadematus* zone.

Localities.—Sowerby's holotype and other specimens in the Geological Society Collection are unlocalised. The peculiar matrix of the first and of another crushed example had long puzzled me; but Mr. J. H. Smith has now sent similar specimens from bed 5 of Khera Hill. The species occurs, however, already in bed 4 (Golden Oolite). An example somewhat transitional to *P. habyensis* (Blake Colln. No. 236*a*) comes from bed No. 10 of Jumara and several examples in Mr. J. H. Smith's Collection are from the Habye Hills.

Genus KAMPTOKEPHALITES S. S. Buckman.

KAMPTOKEPHALITES MAGNUMBILICATUS (Waagen).

(Pl. XXXV, figs. 1*a-c*).

1875. *Stephanoceras magnumbilicatum* Waagen, p. 133, pl. XXXIV, figs. 2*a*, *b*.
1903. *Macrocephalites magnumbilicatus* (Waagen); Burckhardt, p. 30.
1910. *Macrocephalites magnumbilicatus* (Waagen); Uhlig, p. 265.
1910. *Macrocephalites magnumbilicatus* (Waagen); Lemoine, p. 30, *non* pl. III, fig. 1.
1915. *Macrocephalites magnumbilicatus* (Waagen); Petitclerc, p. 44.
non ? 1928. *Macrocephalites magnumbilicatus* (Waagen); Nicklès, p. 34.

1924. *Macrocephalites magnumbilicatus* (Waagen); Spath, pp. 7 and 22.
non? 1928. *Macrocephalites magnumbilicatus* (Waagen); Nicklès, p. 34.

This species is easily recognisable from Waagen's figure and description. The example here depicted has a less high umbilical wall, more reclined and longer primary costae and shorter and more regularly bifurcating secondaries. It is transitional to *K. cossmanni* (Petitclerc), which has been aptly compared by its author to certain Madagascan forms of the *magnumbilicatus* group. The suture-line is visible only incompletely, near the end of the septate portion, and shows general resemblance to that of *K. dimerus* (pl. XXX, fig. 5) and *Pleurocephalites habyensis* (pl. XXX, fig. 6).

Kamptokephalites 'kamptus', S. Buckman (1922, pl. CCCXLVII) differs chiefly in having slightly less distinct projection of the peripheral costation, a smaller umbilicus, a less flattened ventral area and a more inflated whorl-section; but Cornbrash examples of this species (connected by various transitions with the larger lectotype of *K. herveyi* J. Sowerby sp.) show that the forward sinus of the peripheral ribs always appears, if occasionally only near the mouth-border.

Lemoine's Madagascan specimen is probably not so close to the Kachh form as this author assumed. His account is obviously inaccurate; but the dimensions of Lemoine's example and of Waagen's holotype seem to compare as follows:—

Lemoine, pl. III, fig. 1 . . .	118(?)	·42	?	·31
Waagen, pl. XXXIV, fig. 2 . .	129	·48	·42	·26

If the thickness of the Madagascan form be 61 per cent. as appears from Lemoine's figures (wrongly listed as height) his characterisation of that form as intermediate between *K. magnumbilicatus* and '*Macrocephalites elephantinus*' is comprehensible, but even the form of *Kamptokephalites* figured by Lemoine (pl. II, figs. 3*a*, *b*) as '*Macrocephalites elephantinus*' has a whorl-thickness of only 64 per cent. The Madagascan form thus clearly differs from Waagen's type, and in costation especially also from the specimen here figured. The latter has dimensions:—94— ·44— ·49— ·25, but at a diameter of 100 mm. Waagen's holotype also is similarly depressed, showing the same whorl-thickness of 49 per cent.

The New Guinea form of '*Macrocephalites keeuwensis-gamma*' figured by G. Boehm (1912*b*, p. 14, pl. V, fig. 3, text-fig. 6*b* ?, p. 15) has a similar outer whorl and shows gradual increase in peripheral projection, but apparently it has finely ribbed inner whorls since it was united by its author with examples (text-fig. 6*a*, p. 15, pl. IV, figs. 1*a*, *b* only = *Macrocephalites wichmanni*, G. Boehm) that resemble at once the young of forms here referred to *Macrocephalites madagascariensis*, Lemoine and *M. septifer* (S. Buckman) and the true *Dolikephalites keeuwensis* as previously restricted. Other forms included by the same author in his meaningless 'species', namely pl. IV, figs. 2*a*, *b*, 4, 5, pl. V, fig. 2, are perhaps closer to certain Kachh forms here described as *Indocephalites* and even Eucycloceratids.

'*Macrocephalites*' *bambusae*, G. Boehm (1907, p. 95, pl. XXV, figs. 1*a-c*) which was considered by Lemoine to be close to the present species, is possibly a *Prograyiceras*, or perhaps allied to *Idiocycloceras*, described below. Similarly '*Macrocephalites*' *rabai*, Dacqué (1910, p. 11, pl. II, fig. 2) is certainly not synonymous with *K. magnumbilicatus* and also apparently is not a Macrocephalitid, but there are yet other, undescribed, forms (see p. 252).

Horizon.—Lower Callovian, *dimerus* zone.

Localities.—North-west of Soorka (Waagen) and Jumara, bed No. 11 (Blake Colln. No. 232).

KAMPTOKEPHALITES DIMERUS (Waagen).

(Pl. XXIX, fig. 4; Pl. XXX, figs. 4, 5; Pl. XXXIII, fig. 8).

1875. *Stephanoceras dimerum* Waagen, p. 132, pl. XXXIII, figs. 2*a*, *b*. (3*a*, *b* ?).
1910. *Macrocephalites dimerus* (Waagen); Uhlig, p. 265.
1910. *Macrocephalites dimerus* (Waagen); Lemoine, p. 29.
1915. *Stephanoceras dimerum* (Waagen); Smith, p. 797.
1928. *Macrocephalites dimerus* (Waagen); Nicklès, p. 34.

This is a well-defined species, easily recognisable from Waagen's figures and description. The immature example depicted by Waagen (figs, 3*a*, *b*) is now missing, but it does not seem to be readily distinguishable from a number of similar young of other species of *Kamptokephalites* before the writer. The typical specimen figured in pl. XXIX, fig. 4 and pl. XXX, fig. 4 has three-quarters of a whorl of body-chamber and shows excentrumbilication exactly like the slightly less coarsely-ribbed holotype. The example figured in pl. XXXIII, fig. 8, with greater compression and more pronounced peripheral sinus seems to be transitional to *K. lamellosus*, but is somewhat crushed. On the other hand the example from which was taken the suture-line (pl. XXX, fig. 5) has ribs that remain straight across the ventral area and it may thus be considered to be a passage form to *Pleurocephalites habyensis*.

K. magnumbilicatus has similar ribbing but is more evolute; *Pleurocephalites elephantinus* is less close to the present species than it is to *P. habyensis*.

Waagen aptly compared this species to *K. herveyi* (J. Sowerby). The type itself differs in proportions, *i.e.* in its rapid increase in thickness, and *K. hudlestoni* is more finely ribbed. There are, however, still other forms of the *herveyi* group, including the true *K. grantanus* that show resemblance to the present species; and a Northampton (Cornbrash) specimen before me (No. 5952) has an outer whorl almost indistinguishable from that of typical *K. dimerus*.

'*Macrocephalites*' *araucanus*, Burckhardt (1903, p. 30, pl. III, figs. 1-3) which was considered by Lemoine (1911, p. 51) and Stehn (1922, p. 88) to be very close to the species here described does not seem to have its characteristic sharp costation, and Noetling (cited by Burckhardt) already directed attention to the difference in the ribbing between the Andine species and *K. magnumbilicatus* (Waagen).

Lemoine, who wrongly attributed this species to the Dhosa Oolite, figured two fragments from Madagascar that may be comparable to the present form but could equally well have belonged to other species.

Horizon.—Lower Callovian, *triangularis* to *diadematus* zones, but especially *dimerus* zone.

Localities.—Waagen recorded this species from six localities in the Middle (Soorka—Habye) Range and from Patcham Island. In the Blake Collection it is represented from Jumara (bed No. 11). Mr. J. H. Smith sent six examples from the Habye Hills (two transitional to *P. habyensis*) and three from Khera; whilst of two further (unlocalised) specimens in the Geological Society (ex Col. Pottinger-) Collection, one has the Golden Oolite matrix of Khera Hill.

KAMPTOKEPHALITES ? sp. ind.

(Pl. XXVIII, figs. 6*a-c*).

The occurrence in Kachh of yet another species of *Kamptokephalites* ? is indicated by the fragment here figured, but until more complete material becomes available no satisfactory description of this presumably new form can be given. The sharp ribbing with its distinct sinus forward on the periphery is somewhat reminiscent of that of *K. dimerus* or *K. magnumbilicatus*, but the primary costae are far more prominent in the present fragment and cause the peculiar bulge of the whorl-section in the region of its greatest thickness near the umbilical slope. This unfortunately is not preserved and the suture-line therefore could not be traced beyond the second lateral lobe.

K. grantanus (Oppel) has different costation and no peripheral sinus. The separation of the ribs into strong and long primaries and comparatively short and weakened secondaries (generally three) is not, indeed, found in any other Macrocephalitid, known to the writer, and the 'virgatitoid' branching found *e.g.* in '*Macrocephalites*' *tuguriensis*, Hébert and Deslongchamps sp. (see R. Douvillé, 1914, p. 359, pl. VII, figs. 1, 2, 4) and '*M*'. *sauvageti*, Petitclerc (1915, p. 44, pl. II, fig. 5, pl. XI, fig. 1) seems to be of quite a different type. The coarse and inflated varieties of *Dolikephalites typicus* (Blake) are perhaps closest to the fragment here described in the branching of the ribs, and it may therefore be provisionally classed as a passage form between this group and such *Kamptokephalites* as the *dimerus*-like Keeuw example figured by Boehm (1912*a*, pl. XLI, figs. 5*a*, *b*) as '*Macrocephalites keeuwensis beta-gamma*'.

Horizon.—Lower Callovian, *diadematus* zone ?

Locality.—Khera (bed unmarked), J. H. Smith Colln. No. 27.

KAMPTOKEPHALITES LAMELLOSUS (J. de C. Sowerby).

(Pl. XIX, figs. 8*a*, *b*; Pl. XXIV, fig. 3; Pl. XXV, figs. 7*a*, *b*; Pl. XXXIII, figs. 9*a*, *b*; Pl. XXXV, figs. 2*a*, *b*).

1840. *Ammonites lamellosus* J. de C. Sowerby, pl. XXIII, fig. 8.
1875. *Stephanoceras lamellosum* (Sowerby); Waagen, p. 122, pl. XXXIII, figs. 1*a*, *b*.
1875. *Stephanoceras subtrapezinum* Waagen, p. 138, pl. XXXIII, figs. 4*a-c*.
1894. *Macrocephalites subtrapezinus* (Waagen); Tornquist, p. 19.
1897. *Macrocephalites subtrapezinus* (Waagen); Parona and Bonarelli, p. 155.
1898. *Macrocephalites lamellosus* (Sowerby); Skeat and Madsen, p. 105.

1902. *Ammonites lamellosus* Sowerby; Blake, p. 35.
1910. *Macrocephalites lamellosus* (Sowerby); Uhlig, p. 269.
1910. *Macrocephalites lamellosus* (Sowerby); Lemoine, p. 29.
1914. *Macrocephalites lamellosus* (Sowerby); Model, pp. 21 and 26.
1915. *Stephanoceras subtrapezinum* (Waagen); Smith, p. 797.
non 1896. *Macrocephalites lamellosus* (Sowerby); Noetling, p. 16, pl. VII, figs. 3, 3*a*.
non 1925. *Macrocephalites* cf. *subtrapezinus* (Waagen); Stefanini, p. 149, pl. XXVIII, fig. 1.
non 1928. *Macrocephalites lamellosus*, *M. subtrapezinus* (Waagen): Nicklès, p. 34.

Sowerby's holotype, here figured (pl. XIX, figs. 8*a*, *b*) is intermediate between Waagen's *Stephanoceras lamellosum* and *St. subtrapezinum*, but closer to the latter. If therefore, Waagen's two forms were accepted as distinct species, his '*lamellosus*' would have to be renamed. There are, however, numerous examples available that show that specific separation is unnecessary, although Waagen originally referred them not only to different groups but even to different sections. It is also probable that Waagen included some compressed examples of the type of *K. dimerus* from the 'Brachiopod Beds' of the Patcham Group in his *Stephanoceras subtrapezinum*, for transitions to this species occur, as the very variable *K. lamellosus* itself and especially the variety described below as var. *aureus*, nov., lead to forms like *K. cossmanni* (Petitclerc, 1915, p. 43, pl. II, fig. 6, pl. XIII, fig. 6). The dimensions of these forms compare as follows:—

	Diameter	Whorl-height per cent.	Thickness per cent.	Umbilicus per cent.
K. lamellosus (Sowerby) . . .	108	·46	·41	·20
K. lamellosus (Waagen) . . .	82	·45	·46	·23
Steph. 'subtrapezinum' (Waagen) .	87	·47	·43	·18
var. *aureus*, nov.	96	·43	·42	·26
K. cossmanni (Petitclerc) . .	66	·42	·41	·30

Waagen described the appearance in the adult, but, laying too much stress on the presence of a peripheral sinus in the ribbing of his '*Stephanoceras subtrapezinum*', he compared it to the entirely unrelated *Kepplerites galilæi* (Oppel) rather than to the slightly more evolute and more coarsely ribbed form he figured as '*Stephanoceras*' *lamellosum*. It should also be added that Waagen's original of pl. XXXIII, fig. 1 is worn and, as Noetling has already pointed out, considerably restored by the artist, especially in the peripheral view (fig. 1*b*), so that the difference from the sharply ribbed and well-preserved type of '*St.*' *subtrapezinum* (Waagen's pl. XXXIII, figs. 4*a-c*) is unduly accentuated.

Sowerby's holotype, which has a long ventral lappet to the aperture (visible on the side not figured) and nearly a whole whorl of body-chamber, unfortunately does not show the inner whorls. The transverse section agrees with that of the Habye specimen here figured (pl. XXIV, fig. 3), indistinguishable from Waagen's Khera example; and the inner whorls of a different specimen, represented in pl. XXXIII, fig. 9, show the characteristic finer costation at early stages. The resemblance to certain immature *Dolikephalites* may then be

great enough to cause misidentification; and it may be remembered that Oppel (1857, p. 547) already included *Amm. lamellosus* in his *Amm. macrocephalus*. The costation in young or early *Dolikephalites* is typically reclined not projected, but the suture-lines are not dissimilar (see pl. XXXIII, fig. 9*b*) *e.g.* in the immature *D. typicus*, Blake sp., and there seem to be various transitions between these compressed *Kamptokephalites* and *Dolikephalites*.

On the other hand the small example figured in pl. XXV, figs. 7*a*, *b*, with a more globose whorl-shape, is almost indistinguishable from immature *Pleurocephalites*. It has already nearly a whole whorl of body-chamber which may explain the presence of close and fine ribbing to the end. Its chambered earlier portion, like the inner whorls of *P. elephantinus* and *P. habyensis*, shows indeed the greatest resemblance to those Uetzing *Pleurocephalites* with more complex suture-lines recorded by Model (1914, p. 26) and not inaptly referred to Sowerby's species.

The example figured in pl. XXXV, figs. 2*a*, *b* of dimensions:—96— ·43— ·42— ·26, is transitional between the more involute *K. lamellosus* and the more widely umbilicate *K. cossmanni* Petitclerc sp. (1915, p. 43, pl. II, fig. 6). The latter also differs slightly in its more regularly bifid and perhaps coarser costation, but its suture-line is unknown. The example here figured, however, has a similarly abrupt umbilical wall, whorl-section, and finely costate, open umbilicus. The ribs, on the other hand, as in *K. lamellosus*, generally divide less regularly. We may designate this variety with wider umbilicus, var. **aureus**, nov.

Noetling misinterpreted Sowerby's species, although he examined Waagen's type, and Boehm's *Epimayaites rotangi* (1907, p. 89), contrary to its author's opinion, is also entirely unrelated. The heterogeneous Callovian assemblage later grouped by the same author in his '*Macrocephalites keeuwensis*', may, however, include forms that, as G. Boehm stated, resemble the present species. Etheridge's New Guinea example (see Pl. XXXII, fig. 3) is also quite distinct. The body-chamber fragment figured by Bukowski (1886, p. 125, pl. XXVI, fig. 19) cannot be referred to Sowerby's species. Like Siemiradzki's (1894, p. 527, pl. XLII, fig. 2) septate example, it probably belongs to a group of forms, intermediate between the coarsely-ribbed varieties of *Dolikephalites typicus* on the one hand and the compressed *Kamptokephalites* '*herveyi*' and '*hudlestoni*' on the other, that occur in the English Upper Cornbrash as well as in the Ardennes, the Sarthe, Deux Sèvres, Wurtemberg, Poland, etc. to judge by examples in the British Museum.

Whether Nikitin's unfigured *Stephanoceras lamellosum* (1881, p. 34, 1885*a*, p. 32) and *Macrocephalites lamellosus* (1885*b*, p. 50) belong to Sowerby's species must remain uncertain. Burckhardt's Argentine '*Sphaeroceras lamellosum*' (1900, p. 11, pl. XIX, fig. 13) and '*Macrocephalites* aff. *lamellosus*' (1903, p. 32, pl. III. figs. 7-8) differ considerably from Sowerby's species as stated by Noetling, who compared a cast of Burckhardt's form with Waagen's originals.

Lemoine's Madagascan '*Macrocephalites subtrapezinus*' (1910, pl. IV, figs. 5*a*, *b*; 1911, p. 37) is probably a *Dolikephalites*, like the young example represented in Lemoine's figs. 7*a*, *b* (wrongly named '*M. elephantinus*'), and

his '*M. transiens*' of fig. 6, if the comparison to Waagen's species is at all apt, may belong to the same group. The Bihendula (Somaliland) example figured by Prof. Stefanini is probably a Kimmeridgian *Pseudinvoluticeras*, Spath (1925*a*, pp. 134, 141-2).

Horizon.—Lower Callovian, *dimerus* ? and *diadematus* zones.

Localities.—To the localities recorded by Waagen may be added the Habye Hills where Mr. J. H. Smith collected some ten specimens. His Khera examples come from beds 3-5 and a doubtful specimen, possibly of the var. *aureus*, but more inflated, from his bed 6 (*rehmanni* zone). A still more uncertain and badly preserved example, resembling *K. lamellosus* in shape, is from the '*Nucula* Flags', East of Kaora on Patcham Island (Blake Colln. No. 215).

Genus: DOLIKEPHALITES S. S. Buckman.

DOLIKEPHALITES SUBCOMPRESSUS (Waagen).

1875. *Stephanoceras subcompressum* Waagen, p. 139, pl. XXXIV, fig. 1.
1910. *Macrocephalites subcompressus* (Waagen); Uhlig, p. 265.
1910. *Macrocephalites subcompressus* (Waagen); Lemoine, p. 30.
? 1912. *Macrocephalites keeuwensis beta* (pars) J. Boehm, p. 161, pl. XXXVIII, fig. 2 (?).
non 1896. *Macrocephalites subcompressus* (Waagen); Noetling, p. 15, pl. IX, fig. 2.
non 1924. *Macrocephalites* (*Eucycloceras* ?) *subcompressus* (Waagen); Spath, p. 21.
non 1926. *Macrocephalites* cf. *subcompressus* (Waagen); Kruizinga, p. 59, pl. VIII, fig. 4.
non 1928. *Macrocephalites subcompressus* (Waagen); Nicklès, p. 34.

This well defined species does not differ essentially from *D. typicus* Blake sp. (1905, p. 42, pl. III, figs. 1*a*, *b*) which perhaps may be distinguished by its bundled primaries and a more acutely arched whorl-section, obviously quite minor features where numbers of specimens are available. There are various transitions between the two species, from Yorkshire as well as from Wurtemberg, also passage forms to *Macrocephalites compressus* (Quenstedt) which differs in its smaller umbilicus and less sharp and more lineate primary ribbing, resembling that of *M. triangularis*. Since there is only one poorly preserved additional specimen and the body-chamber fragment referred to below, the suture-line remains unknown. It was not clearly visible on any of Waagen's examples. One specimen of the form described below as *Paryphoceras rugosum*, nov. from Col. Pottinger's (Geological Society) Collection, rather poorly preserved, was at first taken to belong to the present species. Although there is considerable external likeness, the suture-line of the later form has ascending auxiliaries and it may be safely presumed that in *Dolikephalites subcompressus* the lobes are arranged more radially.

Those forms transitional from Macrocephalitidae to *Cadoceras* and *Arcticoceras*, figured by Nikitin (1881, pl. X, fig. 44 and 1885, pl. III, figs. 15-17) that Blake wrongly included in his *M. typicus* are not closely comparable to any Kachh species. On the other hand, some of G. Boehm's (1912*a*, and *b*) figured examples of *M. keeuwensis beta* seem to be very close to if not identical with Waagen's holotype, although the specimen which has been chosen

as the lectotype of Boehm's species, namely his pl. XXXVI, figs. 3*a*, *b*, differs in being still more finely costate. The evolute form figured by Boehm (1912*a*) in pl. XXXVIII. fig. 1 is transitional to Eucycloceratids, as his pl. XLI, fig. 3 connects with the ancestral *Macrocephalites* of the *madagascariensis*-type.

The more evolute *Dolikephalites dolius*, Buckman, like others of the numerous Cornbrash examples probably merely an individual variation of *Dolikephalites typicus* (Blake), shows recticostation almost to the end and the typical forward projection of the peripheral ribs, if appearing at all, is confined to the vicinity of the aperture as in the equally transitional group of *Kamptokephalites lamellosus*.

Noetling's Mazar Drik form almost certainly does not belong to Waagen's species; and Burckhardt's (1900, p. 11, pl. XIX, figs. 7-8) '*Sphaeroceras subcompressum*', later (1903, p. 31, pl. III, figs. 5-6) renamed *Macrocephalites noetlingi*, is also closer to the group of *Kamptokephalites lamellosus* than to *Dolikephalites subcompressus*.

On the other hand these two species are undoubtedly closely allied, as Waagen already noticed. There is a body-chamber fragment which shows even closer costation than that author's type of the present species, but has a less compressed whorl-section. It may well represent merely a finely ribbed extreme of the same gens as his '*Stephanoceras subtrapezinum*', with similar ornament on the body-chamber.

The small example figured on pl. XXVII, fig. 4 represents the inner whorls of a doubtful form, the corroded and fragmentary (unfigured) outer whorl of which shows a steeper and higher umbilical wall than the present species or *Kamptokephalites lamellosus* var. *aureus*; it may seem referable to either. The bundling of the primary ribs of the inner whorls however, is peculiar and resembles that of immature *Dolikephalites* from the English Cornbrash, although in these the ribbing is not projected on the periphery. The inner whorls of the holotype of *D. subcompressus* certainly do not show bundled primary ribs so that this specimen may well belong to a new species.

Horizon.—Lower Callovian, *dimerus* zone ?

Localities.—Waagen recorded this species from north-west of Soorka and some specimens (probably transitional to *Kamptokephalites lamellosus*) from Jooria and Khera. The additional examples here recorded (J. H. Smith Colln., Nos. 109 and 133) are from the Habye Hills.

Genus: KHERAICERAS Spath.

KHERAICERAS COSMOPOLITA (Parona and Bonarelli).

(Pl. XLVII, fig. 6).

1875. *Stephanoceras bullatum* (d'Orbigny); Waagen, p. 129, pl. XXXII, fig. 1.

1897. *Sphaeroceras cosmopolita*, Parona and Bonarelli, p. 146.

1923. *Sphaeroceras cosmopolita*, Parona and Bonarelli; Lissajous, p. 92, *non* pl. XIX, fig. 5.

1924. *Kheraiceras cosmopolita* (Parona and Bonarelli); Spath, p. 7.

1925 *Kheraiceras cosmopolita* (Parona and Bonarelli); Spath, p. 15.

No additional examples of this species have been found and we can add little to Waagen's description and Noetling's (1895, p. 11) comments thereon. The gigantic Baluchistan example figured by the latter author and wrongly ascribed (on explanation of plate) to the Argovian '*polyphemus*' fauna of Mazar Drik, differs considerably from Waagen's form, but its suture-line is unknown.

Parona and Bonarelli, who based their species on Waagen's figure, stated that the suture-line was unknown, but Waagen described it as nearly identical with that figured by Quenstedt (1849, pl. XV, fig. 4*b*). It required very little preparation to expose it on Waagen's figured specimen and though slightly worn at the umbilical end, it is now reproduced (pl. XLVII, fig. 6) for comparison with that of the less simplified *K. quenstedti*, Joh Römer. sp. (1911, p. 42). The Neuffen example (B. M. No. 22366) which I had taken to represent *K. quenstedti* (wrongly designated as sp. nov., 1925*b*, p. 16) shows considerably more indented suture-lines, even at the end of the septate portion. The second lateral saddle, however, is wide and shallow in all the forms, even Römer's '*Sphaeroceras quenstedti* var. *hannoverana*' (1911, p. XI, fig. 9) which does not belong to *Kheraiceras*, if Lissajous's (1923, pl. XXI, fig. 1) example is correctly identified, and in his *Bullatimorphites suevicus* (pl. XI, fig. 8).

The '*Sphaeroceras cosmopolita*' figured by Lissajous is not so inflated as the Kachh form and probably belongs to *K. quenstedti*, whilst the same author's '*S. subcosmopolita*' appears to be a *Bullatimorphites*.

Amm. trigeri, Hébert and Deslongchamps (1861, p. 161, pl. VIII, figs. 1*a*, *b*) refigured by Couffon (1919, pl. XII, figs. 17, 17*a*, *b*) occurs at Chanaz (Parona and Bonarelli, 1897, p. 147, pl. V, figs. 1, 1*a*) and according to a photograph, preserved in the British Museum, also at Uetzing (Model, 1914, p. 27). It may represent an immature *Kheraiceras*, although its suture-line has slender saddles. The more compressed *K.*? *stansfieldi* Spath (1925, p. 15, pl. I, figs. 2*a*, *b*) with prorsiradiate costation similar to that of *K.*? *trigeri*, differs considerably from the Kachh species in dimensions, as well as in its finely divided and interlocking suture-lines.

'*Sphaeroceras*' *globuliforme*, Couffon (1919, pl. XV, fig. 1, *non* Gemmellaro *nec* Parona and Bonarelli?) is morphologically intermediate between *Bullatimorphites* and *Kheraiceras*, but Pompeckj (1901, p. 150) directed attention to the parabolar markings of the inner whorls of his Callovian forms and to the two types of '*bullati*' with different inner whorls.

Horizon.—Lower Callovian, *diadematus* zone?

Localities.—Khera (Golden Oolite) and north of Kumaguna.

Family: *EUCYCLOCERATIDAE*, nov.

The genera *Eucycloceras* and *Subkossmatia*, with two others to be discussed immediately, are here included in a separate family because future discoveries will probably show them to be important transitions between the Macrocephalitidae and such other stocks as the Kosmoceratidae (*e.g. Kepplerites*), just

as *Epimorphoceras* is believed to prove a valuable link in the chain of ancestry of the Reineckeids. The 'runcinate' stage probably first appeared on the inner (not the outer) whorls of Macrocephalitids or Eucycloceratids, like *Dolikephalites* and *Subkossmatia*, which, in new environment, acquired tabulate and bi-tuberculate peripheries. On their outer whorls they again return to a macrocephalitid type of ribbing, as the early Schlotheimids reverted to a Psiloceratid whorl-shape in the adult (Spath, 1924*b*, p. 198) and it is only in the later developments that the new characters have become firmly enough established to persist throughout ontogeny. In lateral ornamentation *Kepplerites* (=*Gowericeratidae*, Buckman) is also at least as close to, say, *Dolikephalites* as it is to the earlier *Garantiana* with which R. Douvillé connected not only Kosmoceratids but (after Hyatt) even the Lower Liassic *Phricodoceras*.

Waagen's original *Kosmoceras*, of course, included also the '*parkinsoni*'; and Haug (1907, p. 949) apparently still accepted this comprehensive interpretation. Borrisjak (1908, p. 80), however, separated *Garantiana* and *Strenoceras*, as sub-genera of *Kosmoceras*, from the Parkinsonids; and Mr. Buckman (1921, p. 53) similarly considered that whilst the ornate venter of Kosmoceratids was different from the true Parkinsonian venter, it was comparable with that in *Strenoceras*, *Garantiana*, etc. He stated, moreover, that they were not to be directly connected, as the ornate venter was not a primitive feature in Kosmoceratidae, being presumably a modification of certain phases of the runcinate-ornate and therefore of independent origin from that of *Strenoceras*, etc.

The suture-line of early *Kepplerites* (*i.e.* the 'cryptogenetic' *Cerericeras*, S. Buckman, 1926, p. 23), to the writer, is merely a modified or simplified Macrocephalitid suture; and what resemblance R. Douvillé (1915, pp. 62 and ff.) saw between it and the less complex lobe-line of *Garantiana*, etc. is easily explained by their common Stephanoceratid descent. The absence of connecting links is not, perhaps, decisive; and it may be remembered that Steinmann (1909, p. 227) traced *Parkinsonia* back to the Triassic *Sibirites*, and connected the Albian *Dimorphoplites* (='*Otohoplites*') with the recent *Argonautina* (1925, p. 361). It is just in these Hoplitids (*sensu lato*) that runcinate or tabulate peripheries are produced over and over again from Desmoceratid, arched venters, as they had appeared repeatedly in the round-ventered Stephanoceratids. The contention that the presence of a runcinate phase (feeble and quite transitory at first) in what appear to be true Macrocephalitids stamps them at once as Kosmoceratids, *i.e.* descendants of a different offshoot of the original Stephanoceratid radical, does not impress us now that we have lost faith in the value of Hyatt's "recapitulatory laws".

Eucycloceratidae, however, are not direct ancestors of Kosmoceratids, but merely a more or less analogous stock in a different zoological province. The former seem to be directly connected with *Dolikephalites subcompressus* (Waagen); and whilst showing a general resemblance in ribbing and suture-line to the more inflated *Amm. macrocephalus evolutus* of Quenstedt (1886, pl. LXXVII, figs. 1-5) *Eucycloceras* itself is characterised by the peripheral projection of

its costae, its increasingly prominent primaries and smooth periphery of the body-chamber. It is connected by transitions with *Subkossmatia*, also probably derived from the same (*subcompressus*) group of *Dolikephalites* which comprises *D. keeuwensis*, G. Boehm (1912*a*, p. 160, pl. XXXVI, figs. 3*a*, *b*, lectotype). In the comprehensive interpretation of this species, adopted by its author, it included in fact, various evolute forms that are transitional in different ways to Eucycloceratids, whilst one of G. Boehm's later examples (1912*b*, pl. V, fig. 2) is scarcely distinguishable from Waagen's *Stephanoceras opis* (non Sowerby =*Subkossmatia obscura*, nov.).

The genus *Subkossmatia* is characterised by more radial and more biconvex ribbing with distinct secondary branches, smoothness (and, occasionally, tabulation) of the ventral zone, and a simplified suture-line. Neither of these developments seems to have yet been found outside Kachh, the Duch East Indies and New Guinea; for Noetling's *Macrocephalites opis* (1895, p. 17, pl. VII, figs. 2, 2*a*) is badly preserved and has, in any case, been identified with Waagen's fig. 2 (pl. XXXVI) which is an Argovian *Epimayaites* of the *transiens* group, not a *Subkossmatia*. Tornquist's (1894, p. 26, pl. II, figs. 2*a*, *b*) *Macrocephalites opis*, according to Boehm (1907, p. 95), who re-examined the type, so poorly preserved a fragment that he did not care to discuss it, may be comparable to the Argovian *Paryphoceras* described below, but has almost certainly nothing to do with Sowerby's or Waagen's *Amm. opis*.

I previously (1924, p. 11) thought that Waagen confused *Amm. opis* with *Eucycloceras*, since he recorded it from both the Callovian and the Argovian. The study of Waagen's types, however, and of the abundant new material collected by Mr. J. H. Smith, has shown that the confusion between Callovian and Argovian forms was due to the remarkable similarity of *Subkossmatia* and the group of the compressed *Epimayaites transiens*. There can thus be no connection between *Subkossmatia* and Idoceratids; and the Kalabagh (Salt Range) example, previously considered to be of Argovian age, must also be referred to the Callovian genus *Subkossmatia*. This specimen in the Geological Society (*ex* Dr. Fleming's) Collection (No. 9377, labelled 'below Coal Shale') is now figured (pl. XXXVIII, figs. 1*a-c*) as *S.* **flemingi**, sp. nov. and discussed on p. 212.

Whilst the inner whorls of *Subkossmatia* are finely costate and comparatively involute, there is a parallel stock with evolute and coarsely-ribbed whorls (*Idiocycloceras* gen. nov.) of which the form described below as *I. perisphinctoides* may be considered typical. Waagen's larger example of '*Stephanoceras fissum*', believed to have been wrongly assigned to the 'Dhosa Oolite', belongs to this more evolute stock; but his smaller form, described below as *Paryphoceras stephanoides*, is of Argovian age and entirely different, whilst the holotype of *Amm. fissus* (pl. LVI, fig. 6) is a form of the *paramorphus* group **Sivajiceras**, gen. n.). The suture-line of *Idiocycloceras* is simplified like that of *Subkossmatia* and rises distinctly towards the umbilical suture, a feature that is also noticeable in another entirely new form, here described as *Nothocephalites*

asaphus sp. nov., the genotype of a fourth group included in Eucycloceratidae.

This was previously (1924, p. 21) recorded as *Macrocephalites*? sp. nov. (*compressus*, auct. non Quenstedt, No. 265) from bed 10 of Khera (*rehmanni* zone) and it also shows such striking resemblance to *Epimayaites transiens* of the Argovian, that the constant misinterpretation of the forms of these groups is not surprising. This new *Nothocephalites*, however, also resembles Waagen's *Stephanoceras semilaeve* or at least the form in the Blake Collection of which the suture-line is here figured (pl. XXXVIII, fig. 4). The inner whorls of Waagen's slightly different type, here figured, have already been referred to as being still close to those of *Macrocephalites formosus*, which also shows reduction of the suture-line at larger diameters. There is, however, still greater resemblance to certain derivatives of *Dolikephalites*, especially to forms like *Nothocephalites* **mondegoensis** sp. nov. (pl. XXXVI, figs. 16*a*, *b*) or the Madagascan and Mangoli examples figured here (pl. XXXIX, figs. 8*a*, *b*) and in Boehm (1912*a*, pl. XXXVI, fig. 2), with degenerate striation but apparently as yet typical *Macrocephalites* suture-lines. Since *Idiocycloceras*, by way of *I. bifurcatum*, G. Boehm sp. (1912*a*, p. XXXIX, fig. 1 only=*Macrocephalites brouweri* in Kruizinga, 1926, p. 58) and *Eucycloceras* **intermedium** nom. nov. (=*ibid.*, pl. XXXVIII, figs. 3*a*, *b* only) can also be connected with *Dolikephalites* and *Kamptokephalites*, the inclusion of the four genera in one family Eucycloceratidae may, indeed, be justified.

The following Eucycloceratids are here described from Kachh :—

Genus *Nothocephalites*, gen. nov.
N. semilaevis (Waagen).
N. asaphus sp. nov.

Genus *Eucycloceras* Spath.
E. eucyclum (Waagen).
E. pilgrimi, sp. nov.

Genus *Subkossmatia* Spath.
S. opis (J. de C. Sowerby).
S. obscura, nom. nov.
S. coggin-browni, sp. nov.
S. discoidea, sp. nov.
S. ramosa, sp. nov.
S. sp. ind.

Genus *Idiocycloceras*, gen. nov.
I. perisphinctoides, sp. nov.
I. singulare, nom. nov.
I. dubium, sp. nov.
I. sp. ind.

Genus: NOTHOCEPHALITES, nov.

NOTHOCEPHALITES SEMILAEVIS (Waagen).

(Pl. XXX, fig. 1; Pl. XXXIII, fig. 12; Pl. XXXVI, fig. 9; Pl. XXXVIII, fig. 4).

1875. *Stephanoceras semilaeve*, Waagen, p. 119, pl, XXVIII, figs. 3*a*, *b*.
1894. *Macrocephalites semilaevis* (Waagen); Tornquist, p. 14.
1910. *Macrocephalites semilaevis* (Waagen); Lemoine, p. 18, fig. 10, p. 30.
1924. *Macrocephalites* aff. *semilaevis* (Waagen); Spath, p. 21.
(?) 1924. *Macrocephalites* aff. *semilaevis* (Waagen); Stehn, pp. 86, 146.
(?) 1925. *Macrocephalites* aff. *semilaevis* (Waagen); Gerth, p. 33.

There are no examples of this species among the numerous *macrocephali* collected by Mr. J. H. Smith at Khera and Habye; and the specimen in the Blake Collection, previously recorded, differs from Waagen's type in having a larger umbilicus and closer peripheral costation, especially on the outer whorl, which, at 125 mm. diameter, just shows the beginning of the body-chamber. The inner whorls of the holotype are now refigured (pl. XXX, fig. 1, pl. XXXIII, fig. 12) to show the indistinctness of the costation already at a diameter of 60 mm. The outer whorl is far less well preserved than might be thought from Waagen's figures and the restoration of the ribs, though perhaps not unsuccessful as regards their general character, is misleading in its intensity and apparent definition. For this reason it is doubtful whether records of this species from, *e.g.*, Chacay Melehué (Argentine) can be trusted, and the comparison, by Tornquist (1893, p. 12) of Waagen's form with the East African *Mayaites panganensis* is not at all apt.

The suture-line was described by Waagen as having a broader external saddle than that of *Macrocephalites formosus* and it is to be noted that the last few, crowded, septal edges of the example in the Blake Collection (pl. XXXVIII, fig. 4) show greatly shortened and simplified saddles, almost as in typical *Kepplerites*. The dorsal elements of the holotype here figured (pl. XXXVI, fig. 9) are remarkably complex. Since, in ornamentation also, *N. semilaevis* occupies an isolated position in the genus, I at first questioned the age of Waagen's Soorka specimens; but there seems to be no doubt now that this is a Callovian species, although comparatively late. It is even connected, morphologically, with the typical *Macrocephalites formosus* which also simplifies its suture-line, by certain passage forms, resembling the young example figured in pl. XXI, fig. 2.

Nothocephalites mondegoensis, sp. nov. (pl. XXXVI, fig. 16) is considerably more evolute; *N. paradoxus*, sp. nov. (pl. XXXIX. figs. 8*a*, *b*) is much more distinctly costate.

Horizon.—Callovian, *rehmanni* zone?

Localities.—Waagen recorded eight specimens from near Soorka. The example in the Blake Collection (No. 259) is labelled '7-10, Khera'.

NOTHOCEPHALITES ASAPHUS sp. nov.

(Pl. XXVIII, figs. 2*a*, *b*; Pl. XXXVII, fig. 2).

1924. *Macrocephalites* ? sp. nov., Spath, pp. 8 and 21.

This species is based on the single example here figured and its resemblance to the compressed *Epimayaites* of the *transiens* group, in appearance as well as preservation, at once suggested confusion of beds or localities by Blake who marked it 'Bed No. 10, Khera'. There are, however, two other specimens, one unfortunately incomplete and corroded and the other rather too narrowly umbilicate to be safely included with the present species, that show sufficient similarity in general appearance and mode of preservation to suggest that the resemblance to the later *Epimayaites* is merely an illustration of heterochronous homoeomorphy.

The whorl-shape is compressed, discoidal, with the region of greatest thickness near the steep and high umbilical slope, and with subparallel sides. The venter is arched, and the close prorsiradiate costation is confined to the outer half of the sides, the inner half showing scarcely visible, irregular striae in one spot on the outer whorl, the last quarter of which belongs to the body-chamber. It is possible that this striation was bundled near the rounded umbilical edge, but the preservation of the test is unfavourable and on the body-chamber, at any rate, the inner two-thirds of the whorl-side (of the cast) are smooth. The earlier whorls of the holotype, on account of the crystalline calcite-infilling and poor preservation, are inaccessible for study, but the corroded and doubtful (half)-specimen in Mr. J. H. Smith's Collection shows the inner whorls perfectly, in a natural, median, section. The first three or four whorls are depressed, semilunar to a diameter of 3·5 mm. and circular at 7 mm. At a diameter of 15 mm. they are quadrate with the whorl-height equal to the thickness (=6·5 mm.). The complete specimen has dimensions:—66— ·50— ·37— ·15 as compared with 75— ·50— ·35— ·12 on a similarly septate portion of the holotype.

The suture-line (pl. XXXVII, fig. 2) shows the peculiar curve of the umbilical portion, found in Eucycloceratids as well as in *Epimayaites* and other later stocks. The external saddle is slenderer than in *N. semilaevis*, and with its prominent outer leaflet shows a remarkable similarity to that of *e.g. Epimayaites evolutus* (pl. XXXVIII, fig. 5*c*) or the Sula Islands form described by Kruizinga (1926, p. 59, text fig. on p. 60) as *Macrocephalites* cf. *subcompressus* (non Waagen). In the fragmentary specimen the first auxiliary lobe is similarly close to the umbilical edge, but in *e.g. Epimayaites lemoini* the third auxiliary (or fifth lateral) lobe coincides with the umbilical edge so that the suture-line alone does not enable one to distinguish the two stocks.

The more involute and slightly more finely costate East Jooria example in the Blake Collection, previously recorded as '*Macrocephalites* (*Eucycloceras* ?) cf. *compressus*, auct. sp.,' has indications of primary costation as in *Eucycloceras* and may thus belong to a separate species.

Horizon.—Callovian, *rehmanni* (*diadematus* ?) zone ?

Localities.—Khera, bed No. 10 (Blake Colln. No. 265), associated with *Eucycloceras eucyclum* and *E. pilgrimi*. Also doubtfully from East Jooria, lower zone (Blake Colln. No. 268), and from Samatra (J. H. Smith Colln., No. 40, labelled 'Dhosa Oolite').

Genus: EUCYCLOCERAS Spath.

EUCYCLOCERAS EUCYCLUM (Waagen).

(Pl. XXIII, figs. 4*a*, *b*; Pl. XXV, fig. 4; Pl. XXVII, figs. 7*a*, *b*).

1875 *Stephanoceras eucyclum* Waagen, p. 142, pl. XXXV, fig. 1.
1910. *Kossmatia eucycla* (Waagen); Uhlig, p, 268.
1910. *Kossmatia*? *eucycla* (Waagen); Lemoine, p. 29.
1924. *Eucycloceras eucyclum* (Waagen); Spath, pp. 8 and 21.

Waagen had only a single example of this species but he clearly recognised its resemblance to Kosmoceratids. He described it in the text (pp. 142, 221, 229) as coming from the Dhosa Oolite but in the explanation to his plate, it was stated to be from the Golden Oolite. The peripheral view represents the aperture somewhat too rounded, instead of compressed laterally, but otherwise the description and illustrations of this species and its suture-line are accurate enough to enable palaeontologists to recognise it in the adult stage. The holotype, however, is not nearly so well preserved as Waagen's figure suggests and since the restoration of the ornamentation, although essentially successful, is the work of the artist, it has been considered advisable to figure a similar example (pl. XXV, fig. 4) with two-thirds of the outer whorl belonging to the body-chamber. The smaller example (pl. XXVII, figs. 7*a*, *b*) shows the change from sharp to blunt primary ribbing at an earlier stage, but again at about the beginning of the body-chamber which here occupies just over half a whorl. The earlier whorls are not seen in any of the seven undoubted specimens of this species before me, but there are two small examples in the Blake Collection from the same bed which probably represent the inner whorls of *Eu. eucyclum*. One of these is here figured (pl. XXIII, figs. 4*a*, *b*) and shows close resemblance to immature *Subkossmatia*, and to young *Dorikephalites*, *e.g. D. typicus* (Blake, 1905, pl. III, fig. 2), and *D. gracilis*, nov. The Portuguese and Madagascar forms of *Nothocephalites* here figured have more irregular, degenerate, ribbing.

Horizon.—Callovian, *rehmanni* (or *diadematus*) zone?

Locality.—Khera. The examples in the Blake Collection are from beds '7-10' and 10; one of Mr. J. H. Smith's specimens (No. 118) is marked 'Belt 3' (=6 of his paper, 1913*a*, p. 211).

EUCYCLOCERAS PILGRIMI sp. nov.

(Pl. XXVII, fig. 6; Pl. XXIX, fig. 2).

1924. *Macrocephalites*? (*Eucycloceras*?) *subcompressus* (Waagen); Spath, p. 21 (No. 248).

This species is represented only by the figured holotype, but it is possible that some of the numerous fragments of young *Subkossmatia* referred to below

may belong to the present form. It may be briefly characterised as differing from *Eucycloceras eucyclum* in retaining sharp costation and in being transitional to *Subkossmatia* in the forward sinus of the ribs on the arched venter. The costae are regularly bifurcating and only near the end of the shell there occur two intercalated secondaries. The ribs are strongly reclined on the vertical umbilical wall and the distinct but rounded edge thereof; they are almost straight on the whorl-side and projected near the narrowly rounded periphery. The ribs are finer, at first, than at a corresponding stage in *Eu. eucyclum*, but become increasingly sharper and more prominent. The suture-line is not visible.

The more evolute *Subkossmatia opis* (compare pl. XXXIX, fig. 7) with a somewhat similar aspect, has a distinct type of ribbing and tends to differentiate the costation on the periphery. In the Dhosa Oolite *Paryphoceras badiense*, again, the bifurcation of the ribs takes place below the middle of the side, not above, as in the present species, and the more distant costation is prorsiradiate. *Eucycloceras intermedium*, nom. nov. (=*Macrocephalites keeuwensis*, G. Boehm, pars, 1912, pl. XXXVIII, figs. 3*a*, *b* only) which is a passage form to *Idiocycloceras* described below, differs in the much coarser costation of its inner whorls.

Horizon.—Callovian, *rehmanni* zone.

Locality.—Khera, bed No. 10 (J. F. Blake Colln. No. 248).

Genus: Subkossmatia Spath.

Subkossmatia opis (J. de C. Sowerby).

(Pl. XXXVI, fig. 2; Pl. XXXIX, figs. 2*a*, *b*, 7).

1840. *Ammonites opis* J. de C. Sowerby, pl. XXIII, fig. 9.
1902. *Ammonites opis* J. de C. Sowerby; Blake, p. 35.
1910. *Macrocephalites opis* (J. de C. Sowerby); Lemoine, p. 30.
1913. *Stephanoceras opis* (J. de C. Sowerby); Smith, *b* and *c*, pp. 420, 423.
1924. *Subkossmatia opis* (J. de C. Sowerby); Spath, p. 11.
non 1893. *Amm.* (*Stephanoceras*) *opis* Oldham, p. 228.

This species has been generally misinterpreted owing to Sowerby's short description and reduced figure; the holotype is therefore now refigured (pl. XXXIX, figs. 2*a*, *b*), with its suture-line (pl. XXXVI, fig. 2), also a second example of similar size (pl. XXXIX, fig. 7), the beginning of the body-chamber in each case being marked by a cross. The species does not differ greatly from the large example figured by Waagen (pl. XXXVI, figs. 1*a*, *b*) and here renamed *S. obscura*, but this author confused with it certain later forms of *Epimayaites*, *e.g.* the smaller specimen figured by him in pl. XXXVI, fig. 2. This is a typical example of *E. transiens*, but the resemblance to forms like *Dolikephalites keeuwensis* (G. Boehm, 1912, pl. XXXVI, fig. 3 only) and the New Guinea species here figured (pl. XXXII, fig. 4) as *D. flexuosus* is also so close that misinterpretations will often occur.

S. opis, as here restricted, differs from *S. obscura* in dimensions (108—·42—·29—·30 as against 121—·43—·34—·30), *i.e.* it is more compressed and has a less broad periphery and the ribbing remains comparatively fine and close. The two forms are, however, so closely allied that a number of the incomplete and immature examples here grouped with the present species may well belong to *S. obscura*. The periphery of the inner whorls of the latter, however, is more distinctly tabulate or runcinate.

Grayiceras nepalense (Gray) had been identified with *Amm. opis*, *e.g.* by Col. Strachey (MS. note, dated 1861, in B. M.) but Blanford, who in 1863 (p. 128) described *G. nepalense* as 'an ammonite of the *macrocephali* type', directed attention to the differences, although he considered the two species closely allied. *Dolikephalites* also have been confused with Sowerby's species, *e.g.* there is a Cornbrash example of *D. typicus* (Blake) in the Geological Survey Collection (No. 25635) that was labelled by Mr. Buckman '*Macrocephalites* cf. *opis*'. The long secondary ribs of *Dolikephalites*, however, and the more radial suture-line are the principal distinguishing features.

The specimens wrongly attached to Sowerby's species by Noetling and Tornquist have already been referred to. The Baluchistan form, probably an *Epimayaites*, is very involute and the branching of the ribs occurs close to the umbilicus. Lemoine (1911, p. 9) recorded '*Macrocephalites*' *opis*, together with forms such as his '*M*'. *transiens* (*non* Waagen !) and '*M.*' *grantanus*, that make it probable that he had before him examples like the Madagascan form of *Nothocephalites* here figured (pl. X IX, figs. 8*a*, *b*) and discussed on p. 207.

Macrocephalites alfuricus G. Boehm sp. (1907, p. 94, pl. XXIII, figs. 2*a-c*) may be related to *S. opis*, as its author held, but its ribbing is less delicate and its suture-line is more deeply divided, and shows a curious resemblance to that of *Epimayaites*, so that it may yet turn out to be merely a heterochronous homoeomorph of the species here described.

Horizon.—Callovian, *rehmanni* and *anceps* zones.

Localities.—Sowerby's type, from Capt. Grant's collection, is from 'near Chari,' *i.e.* probably Khera Hill. Mr. J. H. Smith's collection includes four examples from the 'Ler-Hamundra Ellipse', one labelled "*sub-anceps* II," two from Khera, and one from Habye, in addition to several unlocalised fragments in the haematite matrix of the '*anceps*' and '*sub-anceps*' beds. In 1912 (*b*, p. 1349) he recorded "great numbers of fragments of *Stephanoceras opis* from Samatra", but there is neither a *Subkossmatia* nor an *Epimayaites* from that locality in the collection forwarded to the writer.

SUBKOSSMATIA OBSCURA, nom. nov.

(Pl. XXXVIII, fig. 5.)

1875. *Stephanoceras opis* (non Sowerby); Waagen, p. 141, pl. XXXVI, fig. 1.
1910. *Macrocephalites opis* (Waagen); Uhlig, p. 265.
1910. *Macrocephalites opis* (Sowerby); Lemoine, pars, p. 30.

The large example figured by Waagen as *Stephanoceras opis* (Sowerby) differs sufficiently from the holotype here refigured (pl. XXXIX, figs. 2*a*, *b*)

to be given a new name, but the two forms are undoubtedly closely related, as already mentioned. Waagen's example shows less compression of whorl-shape and a broader periphery. The opening-out of the umbilicus from 20 per cent. at 66 mm. diameter to 30 per cent. in the adult is very conspicuous and may account for the inclusion by Waagen, in the present form, of examples of involute, young, *Epimayaites transiens*. The differences in the ribbing between the present species and *S. opis*, are slight, but on the outer whorl of Waagen's original the costae are very prominent and almost effaced on the ventral area, whereas in Sowerby's holotype the ribs are more delicate and continuous across the periphery of the body-chamber which occupies nearly three-quarters of the last whorl. On the internal cast the costation is less prominent than on the test and between the strong and sharp primaries and the short secondaries, there is an almost smooth, spiral, zone, not seen in *S. opis*, with its more delicate primary ribs.

The suture-line of *S. obscura* (pl. XXXVIII, fig. 5) resembles that of *S. opis* and has a similarly small second lateral lobe and degenerate, ascending auxiliaries. It is seen partly on the inner whorl and partly at the beginning of the body chamber which occupies three-quarters of the outer whorl. The suture-line here figured is taken from a tracing of the last one, with the deep external lobe added from previous suture-lines which may account for its being deeper than in the last two or three suture-lines of *S. opis*, figured in pl. XXXVI, fig. 2. Waagen's figures are both considerably, but not inaccurately, restored.

Waagen makes no reference to the runcinate venter of the inner whorl, some of the ribs, but not all, being distinctly thickened at the ventro-lateral edge, as in *Kepplerites* or *Sigaloceras*. This is the most distinctive feature of the species here discussed, *S. opis* showing merely inconspicuous tabulation, whilst in *S. coggin-browni* there is no sign of differentiation of the periphery.

The New Guinea form figured by Boehm (1912*b*, pl. V, fig. 2) as *Macrocephalites keeuwensis beta-gamma*, showing an obliquely constricted aperture, is apparently a *Subkossmatia*, close to the species here described, but its umbilicus is smaller and the vertical edge higher than in Waagen's form. *S. flemingi* nov. (pl. XXXVIII, figs. 1*a-c*) with similar smooth ventral area on the body-chamber and similar suture-line, has less conspicuous ribbing and a more rounded whorl-section.

Horizon.—Callovian, *anceps* zone.

Locality.—Khera Hill. All the other localities mentioned by Waagen have yielded 'Dhosa Oolite' forms of *Epimayaites*, wrongly referred to the present species.

SUBKOSSMATIA COGGIN-BROWNI, sp. nov.

(Pl. XXXI, fig. 6; Pl. XXXV, fig. 7; Pl. XXXVIII, fig. 2; Pl. XLI, figs. 4*a-c*).

This species is based on the example represented in pl. XLI, fig. 4*a*, the inner whorls of which are figured separately in the peripheral view, fig. 4*b*.

One half of the outer whorl belongs to the body-chamber and the two suture-lines here figured (4*c*) are the second and third from the end, but there is only slight approximation between the second and the last lines. The characteristic ornamentation is well shown in the paratype specimen of pl. XXXV, fig. 7 and the more doubtful example represented in pl. XXXVIII, fig. 2. It is more prominent than in the two species above described but the inner whorls of the large *S.* sp. ind. referred to below (p. 215) are similar. As in these there is occasional trifurcation of the ribs but only on the body-chamber, and the costae are continuous across the periphery. The whorl-section is evenly rounded, elliptical, even in the young, and there is no sign of tabulation of the periphery.

The suture-line of a fourth, fragmentary, example (pl. XXXI, fig. 6) shows more neatly trifid lobes, but is of the same type as the suture-lines of *S. opis* and *S. obscura*, the former of which is not only more finely ribbed but more discoidal. There are, however, some apparently transitional fragments to *S. opis* as well as to *S. obscura*, with its more compressed and runcinate inner whorls. The dimensions of the holotype of the present species (115— ·40— ·36 — ·30) do not, however, differ much from those of the adult *S. obscura*.

Horizon.—Callovian, lower *anceps* zone.

Localities.—Ler-Hamundra-Ellipse and Habye. One of the seven examples in Mr. Smith's Collection, here taken as holotype, is unlocalised, but its preservation agrees with that of other '*opis*' and '*fissum*' in his collection from the Habye Hills. A large example sent by Mr. J. H. Smith since the above was written, shows the end of the septate portion at about 140 mm. diameter. It was labelled "sub-*anceps* II, Ler-Hamundra-Ellipse."

Subkossmatia discoidea, sp. nov.

(Pl. L, figs. 2a, b).

The holotype here figured has dimensions 83—·40—·30—·31. In its great compression the species thus resembles the finely-ribbed *S. opis*, but its ribbing becomes even coarser and more distant than that of *S. coggin-browni* at a comparatively small diameter. The suture-line shown in fig. 2a (pl. L) is the last one, and it marks a fracture; the details of frilling, however, which probably were comparable to those of the suture-line of *S. coggin-browni* (pl. XLI, fig. 4*c*) are lost. The inner whorls, with the fracture mentioned revealing the last septal surface, are figured separately in fig. 2b (pl. L). They are slightly crushed, but the body-chamber portion and its periphery are sufficiently well preserved to show that the whorl-shape was greatly compressed and the sides almost parallel. The ventral area is evenly rounded but there is a suggestion of tabulation. The umbilical slope is perpendicular at first but not quite so steep at the end; the umbilicus widens out at the same time. The ribs are irregularly bifurcated or single, but, as in many Perisphinctids, a single rib of one side corresponds to the branch of a bifurcating one on the opposite side.

The example figured in pl. XXXV, fig. 7 connects the present species with *S. coggin-browni*, but it is still more closely costate, though more compressed,

than the type of that species. *S. obscura*, like *S. opis*, is far more finely and closely ribbed. The inner whorls of the compressed *S. ramosa*, at a diameter corresponding to the outer whorl of the holotype of *S. discoidea*, are also more closely costate, and there is a distinct sinus forward on the periphery.

Macrocephalites cf. *subcompressus* (non Waagen) figured by Kruizinga (1926, p. 59, pl. VIII, fig. 4), with its *Nothocephalites* suture-line, shows distant resemblance to the species here described, but like some of the varieties of G. Boehm's '*Macrocephalites keeuwensis*' (1912, *e.g.*, pl. XXXVIII, fig. 1) it is intermediate between *Dolikephalites* of the *subcompressus* group and Eucycloceratids like *Subkossmatia*.

A second example has slightly more finely- and closely-ribbed inner whorls and a decided bend in the costae of the outer whorl, but this may be due partly to its poor state of preservation. A worn fragment of a third specimen, by its compression, also seems to belong to the present species.

Horizon.—Callovian, sub-*anceps* bed ii of Mr. J. H. Smith (1913b, p. 420).

Locality.—Ler-Hamundra-Ellipse (3 specimens).

Subkossmatia ramosa, sp. nov.

(Pl. XXXIX, fig. 1; Pl. XLI, figs. 1*a*, *b*).

This form, although known only in fragmentary examples, is sufficiently distinct from the smaller species of *Subkossmatia* above described to be separated specifically. The regularly bifurcating and comparatively distant ribs, strongly projected peripherally, and the compressed whorl-section, with tendency to become tabulate or even grooved on the body-chamber, are perhaps the most important distinguishing features of *S. ramosa*. The suture-line only differs in details from that of *S. coggin-browni* (pl. XXXI, fig. 6), but partly owing to its larger size, *S. ramosa* has the second lateral and auxiliary saddles more distinctly developed. The rise of the suture-line towards the umbilical suture is well-marked, as in all the species of *Subkossmatia*.

S. opis is more closely and finely ribbed at a corresponding size and the periphery of its body-chamber becomes evenly rounded. *S. obscura* and *S. coggin-browni* have more inflated outer whorls and all the species previously described are more involute. The approximate dimensions of the holotype fragment, as completed in the outline fig. 1*a* of pl. XLI, are:—200—·39—·26—·35. The paratype fragment consists of body-chamber only (pl. XXXIX, fig. 1) showing in the impressed dorsal area the ribs of the previous whorl, which are far less sinuate ventrally. They show that *S. ramosa* does not represent merely the fully grown *S. opis*. Some fragmentary or poorly preserved smaller examples, that can only be doubtfully included here, show ribbing comparable to that of the example figured in pl. XXXVIII, fig. 2 or the inner whorls of *S.* sp. ind., referred to below, but still coarser and more distant. They are already transitional to some *Idiocycloceras* recorded below (p. 218) but the specimen No. 28 there referred to is considerably more inflated.

Horizon.—Callovian, *anceps* zone.

Locality.—Khera Hill (holotype) and Ler-Hamundra-Ellipse, sub-*anceps* beds of Mr. J. H. Smith (paratype and two smaller, doubtful examples).

Subkossmatia sp. ind.

(Pl. XXXVI, figs. 1*a*, *b*).

The existence of still another species of *Subkossmatia* is indicated by the large fragment here figured, which differs from *S. ramosa* in its closer and less projected costation and in acquiring a subsulcate periphery already on the chambered portion. The fragment is entirely septate and the suture-line, with strongly projected umbilical elements, greatly resembles that of *S. ramosa*. The whorl-height of 78 mm. corresponds to a thickness of 55 mm., so that the fragment cannot represent an outer whorl of the two more inflated and smaller species: *S. obscura* and *S. coggin-browni*. The different peripheral aspect also prevents identification with *S. opis*, which has less sharp and prominent, if equally bi- and triplicate ribs.

The form described below as *Idiocycloceras singulare* has a somewhat similar, if more distantly costate outer whorl, but a smaller fragment, probably of the species here described, with the peripheral part of the whorl slightly crushed, shows that the present form cannot be separated generically from *S. coggin-browni*. The sharp and prominent secondaries are continuous across the venter, probably to about the smaller end of the septate fragment here figured. A third specimen, septate to a diameter of 150 mm., with the suture-line well shown in places, unfortunately has the periphery broken away and is partly corroded, so that it is not here figured, but it confirms the specific independence of the form now discussed. Fragments like that figured in pl. XXXVIII, fig. 2, and here referred to *S. coggin-browni*, may possibly, represent the inner whorls of a form like the present, but the large example of the former species referred to on p. 213 still has a more rounded whorl-section.

If found isolated, a fragment like that here figured, might easily be misidentified, some Berriasellids, *e.g. Substeueroceras*, showing superficial resemblance (compare Burckhardt, 1900, pl. XXI, fig. 3).

Horizon.—Callovian, *rehmanni* zone ?

Localities.—Ler-Hamundra-Ellipse (J. H. Smith Collection, Nos. 92, 92*a*). A third specimen (No. 95), unlocalised, is marked ' facies is Habye ', but the other two are similarly preserved in a red ironstone matrix.

Genus: Idiocycloceras, nov.

Idiocycloceras perisphinctoides, sp. nov.

(Pl. XXXVI, fig. 3; Pl. XXXVIII, figs. 3*a-c*).

The holotype of this species has dimensions:—90— ·38— ·38— ·39 and shows an almost circular whorl-section with the sides very slightly flattened,

and a steep umbilical wall with rounded edge. The biplicate costae are sharp and prominent and slightly projected but not weakened peripherally. Two or three of the ribs on the outer whorl remain single. The suture-line is degenerate and greatly projected at the umbilical end, but slightly weathered, so that the drawing here given (pl. XXXVI, fig. 3)—which also should show the tops of the three saddles on an ascending instead of a descending line—is probably too simplified. The general plan is that of the various forms of *Subkossmatia* above described and of *I. dubium* rather than of *I. singulare*. The inner whorls, so far as can be seen, resemble those of numerous *biplex*-like Perisphinctoids and are similar to those of the less loosely coiled *I. singulare* and *I. dubium* described below. The last quarter of the outer whorl of the holotype belongs to the body-chamber. The suture-line figured is the fourth from the end.

Sowerby's *Amm. fissus* (1840, pl. LXI, fig. 11) belongs to quite a different stock. It is a species of the *paramorphus* group (now separated as *Sivajiceras* gen. nov. but previously included in *Obtusicostites*). Examples of Sowerby's form, from the *sub-anceps* beds of Khera and other localities in Mr. J. H. Smith's Collection have indeed been correctly labelled '*Stephanoceras fissum*'. This species however, has always been difficult to identify. Blanford (1863, p. 128) compared it to *Blanfordiceras wallichi* (Gray) and Lemoine (1910), while including it in his 'group VI' of *Macrocephalites* on one page (p. 24), owing to confusion with *M. formosus*, identified it with *M. macrocephalus* on another (p. 29). Again an example in the Geological Survey Collection (No. 25639) labelled by Mr. Buckman '*Macrocephalites* cf. *fissus*' represents the young of a *Dolikephalites* of the *typicus* group (*e.g.* Blake's [1905], pl. III, fig. 3).

Horizon.—Callovian, *rehmanni* zone ?

Locality.—Habye (J. H. Smith Colln.). A poorly preserved Khera example (bed No. 15, J. F. Blake Colln. No. 350) previously recorded as *Macrocephalites* ? sp. ind. on account of its resemblance to *Kamptokephalites magnumbilicatus*, may possibly belong to the present species, but it cannot be of later than *diadematus* date.

IDIOCYCLOCERAS SINGULARE, nom. nov.

(Pl. XXVIII, fig. 8; Pl. XL, fig. 5; Pl. XLI, fig. 2).

1875. *Stephanoceras fissum* (non Sowerby); Waagen, p. 134, pl. XXXVII, figs. 1*a*, *b*, only.

1894. *Macrocephalites fissus* (Waagen); Tornquist, pp. 14, 18, 19.

1910. *Macrocephalites fissus* (Waagen); Uhlig, p. 265.

1910. *Macrocephalites fissus* (Waagen); Lemoine, p. 22, text-fig. 35, pp. 24, 37 (non p. 29).

1913. *Stephanoceras fissum* (Waagen); Smith, *b*, p. 420; *c*, p. 423.

1914. *Macrocephalites fissus* (Waagen); R. Douvillé, pp. 362, 3.

Waagen confused with this form some smaller Dhosa Oolite examples, referred to below under *Paryphoceras stephanoides*, so that only his description of the adult stage applies to the present species. He gave the dimensions

of a large example (No. I) as :—132— ·45— ·36— ·30, but the holotype at 162 mm. diameter shows the following measurements :— ·38— ·37— ·33. It is thus doubtful whether any of Waagen's measured specimens belong to the same species as his figured example. Even this was represented with an umbilicus of 24 per cent. instead of 33 per cent. of the diameter, and was wrongly described as having nearly the entire body-chamber. In reality the last five suture-lines indicated in the tracing reproduced in pl. XLI, fig. 2 were taken from the final quarter of the outer whorl, the fourth rib from the end in Waagen's drawing coinciding with the last suture-line. The specimen is thus far from complete.

The suture-line, contrary to Waagen's statement, is unlike that of *Mayaites maya*, and although simplified, does not show the pronounced umbilical projection of that of *I. perisphinctoides*, which has similar inner whorls, but a less prorsiradiate and coarser secondary costation. Since the suture-line is slightly corroded, it is probable that there is more frilling than shown in the drawing, so that the apparent differences between this and the suture-line of the large specimen figured in pl. XL, fig. 5 are probably not of specific importance. On the other hand, the suture-line of the latter example (figured separately in pl. XXVIII, fig. 8), although only the third from the end, is undoubtedly more deeply indented, which, in addition to its larger umbilicus, (37 per cent. at 200 mm. diameter) makes it advisable not definitely to identify this example with Waagen's type. It should be added that the inner whorl of the large specimen figured in pl. XL, fig. 5 is displaced so as to show the comparatively close costation of the periphery. This proves that it cannot represent the adult of *I. perisphinctoides* or *I. dubium*, but Waagen's form, also, at a diameter of 45 mm., has more distant ventral ribs.

Sowerby's *Amm. fissus*, with which Waagen tentatively identified the present form, is discussed below under *Proplanulitidae*. It is probable that such records of *Stephanoceras fissum* as that in Oldham (1893, p. 227), quoted by Dacqué (1910*b*, p. 157), refer to yet different species. The Kantcote specimen recorded by Waagen is probably a *Prograyiceras*. Again *Grayiceras koeneni* (Uhlig, 1910, p. 273, pl. XLV, figs. 1*a-c*) which was considered to be a near Indian relative of '*Simbirskites*' *fissus*, belongs to an entirely different stock.

Horizon.—Callovian, *anceps* zone.

Locality.—Khera Hill (Waagen), wrongly assigned to a high horizon ('about the region of *Aspidoceras perarmatum*') and Ler-Hamundra-Ellipse (sub-*anceps* beds II of Mr. J. H. Smith).

Idiodycloceras dubium, sp. nov.

(Pl. XXXIX, figs. 6*a*, *b*).

This species is based on the fragmentary example (No. 18) here figured which is entirely septate. An additional portion of the holotype (No. 97, J. H. Smith Colln.), smaller than that here figured, was unfortunately not discovered to be part of the same specimen until after preparation of the plate, but together they make up half the shell and show the largest diameter to

have been 153 mm., not 145 mm. as in the restored (and slightly reduced) figure and outline-drawing of pl. XXXIX, fig. 6*a*.

The proportions are approximately :— ·37— ·33— ·38. They do not greatly differ from those of the less compressed *I. perisphinctoides* or the large example figured in pl. XL, fig. 5 and provisionally attached to *I. singulare*. The former species however, differs essentially in its simpler suture-line and blunter and coarser costation ; the latter form shows better agreement in suture-line but, like the holotype of *I. singulare*, it is more closely costate. In the present species, the ribs are regularly bifurcating and the secondaries are much more distinctly bent forward on the periphery than in *I. perisphinctoides* or in the fragmentary *Idiocycloceras* sp. ind. described below, whilst in *I. singulare*, the ventral sinus, although equally pronounced, is narrower owing to the slightly trigonal whorl-shape.

The suture-line has an unusually narrow and long external saddle and an external lobe as deep as the lateral lobe, whilst there is comparatively little umbilical projection. In the fragment referred to below as transitional between the present species and *Idiocycloceras* sp. ind. the suture-line (pl. XLI, fig. 3) is much more like that of *Subkossmatia ramosa*, with wide external saddle and conspicuous umbilical projection. The latter, thus, is as variable a character in a given group as is the peripheral projection of the ribs.

Horizon.—Callovian, lower *anceps* zone.

Locality.—Ler-Hamundra-Ellipse (sub-*anceps* beds of Mr. J. H. Smith).

Idiocycloceras, sp. ind.

(Pl. XXXV, fig. 6 ; Pl. XLI, fig. 3).

A fragmentary example, of which a peripheral view of part of the body-chamber is here given (pl. XXXV, fig. 6), differs from the two species last described, *I. dubium* and *I. singulare*, in its straighter ribs with less pronounced peripheral projection, and from *I. perisphinctoides* in its sharper and closer costation. Another fragment (No. 122) well shows the suture-line (pl. XLI, fig. 3) and is transitional to *I. dubium* in the peripheral projection of the ribs, whilst a further example (No. 28) is a passage form to the large *Subkossmatia* sp. ind. figured in pl. XXXVI, fig. 1, but has only biplicate ribbing, like the first specimen, although with a pronounced peripheral sinus. The suture-line of the last example and that here figured in pl. XLI, fig. 3 are closer to the suture-line of *Subkossmatia ramosa* than to that of *Idiocycloceras singulare*, but in all the forms of the former genus, the inner whorls are finely ribbed.

Horizon.—Callovian, Lower *anceps* zone.

Locality.—Ler-Hamundra-Ellipse (' sub-*anceps* beds ' of Mr. J. H. Smith).

Family : Pachyceratidae S. S. Buckman.

The two genera *Pachyceras* Bayle, and *Erymnoceras* Hyatt, are both represented in the Jurassic Beds of Kachh, if sparingly. It seems advisable to

separate from them those Argovian '*Macrocephalites*' that I had formerly provisionally included in the present family; but the genus *Tornquistes*, attached to *Pachyceras* by R. Douvillé and at first also by Buckman (1918, p. XII) is perhaps referable to Mayaitidae, dealt with below. These, like Pachyceratidae, are probably connected with Cadoceratidae, if not directly with the ancestral Macrocephalitidae; for *Pleurocephalites* still occurs in the *anceps* zone, and in the *fraasi* zone tumid-whorled Quenstedtoceratids occur side by side with *Cadoceras*, whilst forms like '*Macrocephalites*' *greppini* P. de Loriol (1898, p. 71, pl. V, fig. 15) range throughout the Divesian into the Argovian. The remarkable external resemblance of certain compressed forms of *Morrisites* to *Pachyceras* of the *lalandeanum* type, however, is merely a case of homoeomorphy.

The genus *Pachyceras* has been recently discussed in detail by R. Douvillé (1913); *Erymnoceras* is there rejected in favour of *Stephanoceras* Waagen, (=*Stepheoceras* Buckman), but since *St. humphriesianum* (Sowerby) was definitely selected by Mr. Buckman (1898, p. 454) as type, Hyatt was right in giving a new name to the Callovian group of *Amm. coronatus*, Bruguière. R. Douvillé considered that his father's (H. Douvillé's) selection in 1890 of *Amm. coronatus* as genotype of *Stephanoceras* was binding; but his MS 'Course of Palaeontology' was not printed or published and is certainly not to be found in "every important library". It is true that in 1881, already, Nikitin (p. 68) considered the group of *Amm. coronatus* to represent the typical *Stephanoceras*, and that in various text-books *Amm. coronatus*, occasionally mistaken for *Stemmatoceras subcoronatum* (Oppel, *i.e.* d'Orbigny's *Amm. blagdeni*) was figured to illustrate the *coronati*. But the important point to remember is that *Stephanoceras* was primarily intended for v. Buch's section of the *Coronarii* and that Bruguière's *Amm. coronatus* was already in 1830 correctly excluded and grouped with the *Macrocephali* (see Wright, 1880, pp. 190-1).

Although most later authors have thus been misled by the resemblance between the early *Stemmatoceras* and the later Cadoceratid offshoot *Erymnoceras*, the type of *Stephanoceras* clearly should be one of the original *Coronarii*. Haug, in 1907 (p. 1016) referred *Amm. coronatus* to *Pachyceras*, so that Douvillé's restriction of *Stephanoceras* cannot be said to be accepted even in France.

The genus *Tornquistes* Lemoine (genotype: *Macrocephalites helvetiae*, Tornquist, 1894, p. 8, pl. I, figs. 1*a-d*) may be connected with *Pachyceras* by the doubtful form figured by R. Douvillé (1912, pl. II, fig. 7), but it has no connection with either *Kamptokephalites lamellosus* or *Idiocycloceras singulare*, to which Tornquist had compared it. Moreover, Lemoine's genus *Tornquistes* includes certain forms like *T. liesbergensis* (de Loriol, 1896, p. 23, pl. V, fig. 2, pl. VI, figs. 1*a*, 1*a*) that have a suture-line pointing to an origin in common with that of Mayaitidae. *Christolia* Rollier (1909, p. 614, based on *Amm. christoli*, Bedouin) may be a degenerate Pachyceratid, as I suggested in 1919 (p. 172).

Only the following three species are here described:—

Genus *Erymnoceras* Hyatt.

E. dorotheæ, sp. nov.

Genus *Pachyceras* Bayle.

P. indicum, sp. nov.

P. distinctum, sp. nov.

Genus: Erymnoceras Hyatt.

Erymnoceras dorotheæ, sp. nov.

(Pl. XVIII, figs. 4*a*, *b*).

1914. *Holcostephanus* ? sp. Smith (*b*), p. 813.

The unique specimen on which this species is based, was recognised by Mr. Smith as entirely new to the Kachh fauna and promptly recorded. He compared it to *Spiticeras spitiense* (Uhlig) but directed attention to various points of distinction, such as the vertical umbilical wall, crowned by about eleven sharp tubercles that are elongated spirally not radially. The measurements are:—65— ·40— ·43 ?— ·34. The thickness, owing to the end of the contracting body-chamber being worn, was probably slightly under-estimated by Mr. Smith. The septate depressed inner whorls are corroded and the suture-line is unknown.

The form is intermediate between such *Erymnoceras* as *E. renardi* Nikitin sp. (1881, p. 120, pl. IV, figs. 24*a*, *b*) with open umbilicus, and the involute *Pachyceras jarryi* (Deslongchamps MS) and *P. crassum* (R. Douvillé, 1912, pp. 37 and 42, pl. VII) which have lost the coronate umbilical edge, at least on the outer whorls. One of the evolute varieties of *E. coronatum* (Bruguière) in the wider sense, figured by R. Douvillé (1913, p. 31, text-fig. 23*a* only) shows great resemblance to the present species but has more distant ribs and less cadicone inner whorls. This was identified with *E. ajax* d'Orbigny sp., which is probably not identical with the *Rasenia*-like *Amm. ajax* Schloenbach (1865, p. 187, pl. XXXI, figs. 1*a-c*), and was erroneously identified by Loczy (1915, p. 347) with the cadicone *E. coronoides* (Quenstedt). The lectotype of *E. ajax*, figured in the Annales de Paléontologie (1913, pl. IX, figs. 12-13) is not closely comparable to the present species and Petitclerc's coarsely ribbed form (1915, p. 106, pl. XI, fig. 4) is again quite different.

It is interesting to compare the side-view of the present transitional species with the forms figured by R. Douvillé in 1912 (*b*, p. 245, text-fig. 6) to show the passage from the Callovian *Erymnoceras* to the Divesian *Pachyceras*.

Horizon.—Divesian ('*athleta* beds'). In England, large examples of *E. reginaldi* (Morris), bearing impressions of finely-ribbed *Kosmoceras* occur in the *fraasi* zone, together with gigantic *Proplanulites*.

Locality.—Fakirwadi Ridge.

Genus: PACHYCERAS Bayle.

PACHYCERAS INDICUM Spath.

(Pl. XIX, fig. 7; Pl. XX, figs. 2*a-d*).

1927. Supra, pl. XIX, fig. 7.

This species is represented by four examples of which the largest and most complete (pl. XX, figs. 2*a*, *b*) is septate to the end. The smaller specimen figured in pl. XIX, fig. 7 forms the inner whorls of a similar large example, also still septate at nearly 200 mm. diameter, and the fragment depicted in pl. XX, figs. 2*c*, *d*, represents the earlier portion of a third large, but incomplete specimen. The whorl-section is sub-trigonal from an early stage, but tends to become sharpened ventrally at larger diameters. The sides are flattened, with the comparatively faint and blunt, prorsiradiate ribs more or less confined to the outer area and a high and vertical umbilical wall, with rounded edge. This edge is very indistinctly nodate only in the smallest fragment figured and becomes smooth in the later stages. The ribs are continuous across the periphery in the young but towards the end of the largest example here figured even the narrow and almost keeled venter is smooth.

The suture-line is not essentially different from that of *e.g. Pachyceras jarryi* (Deslongchamps MS) figured by R. Douvillé (1912, pp. 39, 40, text-figs. 37-43), and differs from that of *P. lalandeanum* (d'Orbigny) as figured by the same author (text-figs. 47-51, p. 46) and shown in typical Dives specimens before me (B. M. No. 39944), merely in the wider lateral lobe and plumper first lateral saddle.

The species here described is probably merely the Indian equivalent of the European *P. lalandeanum* d'Orbigny sp. (1848, p. 477, pl. CLXXV, figs. 1-3 only). The type figure is idealised and while the original of Bayle's larger drawing (1878, pl. XLIII, fig. 1) differs from the example here figured in pl. XIX, fig. 7, merely in its shallower umbilicus and more distant ribbing, the same author's smaller specimen resembles the third fragment here figured (pl. XX, figs. 2*c*, *d*) but has already lost its umbilical nodes at a much smaller diameter. The two examples referred by R. Douvillé to d'Orbigny's species, however, differ considerably in this respect, so that the earlier or later loss of the nodate umbilical edge is not considered to be of specific importance. In a Weymouth example in the Blake Collection comparable to Douvillé's larger *P. lalandeanum*, but decomposing, the costation of the outer whorl also tends to become irregular. On the other hand a large Dives example (B. M. No. 37077) still septate at nearly 160 mm. diameter, does not differ from the present species except in its suture-line.

Horizon.—Divesian ('*athleta* beds').

Locality.—Ler and Fakirwadi, J. H. Smith Coll.

PACHYCERAS DISTINCTUM, sp. nov.

(Pl. XX, figs. 1*a*, *b*; Pl. XXXVIII, fig. 7).

1924. *Pachyceras* ? sp. nov. ? Spath, pp. 8, 9 and 23 (No. 281).

This form is based on the unique, fragmentary, specimen with rounded umbilical tubercles previously recorded, and it may be defined as more coarsely ribbed than the form above described, with more rounded whorl-section, broader periphery and slenderer first lateral saddle. The measurements are :— 80— ·46— ·52— ·25 and agree with those of *P. jarryi* (Deslongchamps MS) R. Douvillé (='*P. robustum*' of Buckman, 1913, p. 163). In this form, however, the inner whorls are more depressed, and have a wider periphery, and the ribbing of the outer whorl is coarser and the umbilical tubercles are closer.

P. crassum, R. Douvillé (1912, p. 42, pl. VII, figs. 1, 2, 9, 11) has similar inner whorls, but becomes more flattened at a later stage and the umbilical tubercles are first very close and then disappear altogether. Its suture-line, as figured by R. Douvillé (1912, p. 43, text-fig. 46) also has a deeper external lobe. *P. robustum* (Leckenby) refigured by Buckman (1918, pl. CXV) has not only a greater whorl-thickness but a pronounced umbilical edge.

Horizon.—Divesian ('*athleta* beds').

Locality.—Jikadi (bed No. 22), J. F. Blake Colln. (No. 281).

Family : *MAYAITIDÆ*, nov.

The later '*Macrocephalites*', previously stated to belong to a number of 'lineages', were provisionally included in the family Pachyceratidæ. This, however, is now restricted to the genera *Pachyceras* and *Erymnoceras*, which are more closely allied to Cadoceratidæ, whilst *Tornquistes*, with less reduced suture-line, like the genera here described, is probably derived from a tumid Quenstedtoceratid stock. This also gave rise to such forms as '*Macrocephalites*' *greppini* P. de Loriol (1898, p. 71, pl. V, figs. 15, 15*a*, *b*) ; and although *Goliathiceras* and other large Cardioceratids, quoted by Mr. Buckman (1924, p. 46), show resemblance to *Epimayaites polyphemus*, the earlier *Quenstedtoceras*, or more likely transitional forms to *Pleurocephalites pila* (Nikitin) and *P. krylowi* (Milachewitsch, 1880, p. 14, pl. I, figs. 1*a-c*) and other evolute, undescribed Macrocephalitids, occurring as late as the *fraasi* zone, are probably closer to the ancestral stock of Mayaitids. This may account for the remarkable similarity to the earlier Macrocephalitids of, *e.g.*, the large form of *Mayaites obesus*, nov., the suture-line of which is figured in pl. XXXIV, fig. 7, and which, but for Mr. Smith's assurance that it came from the Dhosa Oolite of Walakhavas (and its peculiar matrix) might have been taken to be a mislabelled Khera specimen.

It will be noticed that the early *Mayaites* and *Dhosaites*, in spite of their great similarity to certain involute Macrocephalitids and evolute Eucycloceratids

respectively, are here attached to stocks that are *not* represented in Kachh, but the rare Pachyceratidæ described above are probably similar immigrants from more northern seas if not actually the 'Boreal Province' in Neumayr's sense. The resemblance to the earlier families is thus taken to be accidental and due to similar conditions of existence, and the Mayaitidæ are held to be equivalents of the family Cardioceratidæ, so well developed in the non-equatorial provinces.

The genus *Mayaites* was based on *M. maya* (J. de C. Sowerby), but in its original connotation it comprised a variety of forms which it seems advisable to exclude, now that abundant new material and Waagen's types are available for study. *Mayaites* is thus now restricted to the group of *M. maya* (Waagen) which includes some new species here described, one of them (*M. subkobyi*, sp. nov.) transitional to *Tornquistes*, and the form (*M. obesus*, sp. nov.) wrongly referred by Sowerby to *Amm. herveyi*. All these are characterised by their generally blunt ribs, passing straight across the broad periphery, and by a more or less serial, unprojected suture-line, with great resemblance to that of the earlier Macrocephalitids.

Whether the East African forms of the *olcostephanoides* group belong to the restricted *Mayaites* seems doubtful. The undescribed species previously recorded (1924, p. 10) from Mombasa as transitional in shape and ornamentation between '*M.*' *olcostephanoides* (Tornquist) and *Dhosaites*, the suture-line of which is now figured (pl. XXI, fig. 8), certainly differs from the Indian *Mayaites*, as does Dacqué's '*Macrocephalites*' *rabai* (1910, p. 11, pl. II, fig. 2). Lemoine's '*Macrocephalites*' *subtrapezinus* (non Waagen) and '*Kossmatia*' *uhligi* (1910, pl. IV, figs. 5*a*, *b* and pl. V, fig. 7*a*), may well be true Macrocephalitids; and the former especially is probably closer to the Madagascar form here figured as *Nothocephalites paradoxus* sp. nov. (pl. XXXIX, fig. 8) than to the somewhat homœomorphus *Epimayaites* **tenuicostatus** nom. nov. (=*Macrocephalites palmarum*, var. *tenuicostata* G. Boehm, 1907, p. 92, pl. XXIII, fig. 3) with which I had formerly compared it.

Again that doubtful Madagascar example recorded by Newton (1889, p. 334) as '*Stephanoceras macrocephalum*' and previously (1924, p. 10, 1925*b*, p. 27) described as possibly a new globose form of *Dhosaites*, on account of its ventral sinus cannot be referred to the *elephantoides* group and as it is incomplete (*see* pl. XL, figs. 1*a*, *b*) and does not show a suture-line, it does not help in the elucidation of the affinities of the East African forms of the *rabai* and *olcostephanoides* group. It may be only a worn *Kamptokephalites* of the *dimerus* type.

The later group of *Stephanoceras transiens* and *St. subtumidum* Waagen, and the form wrongly identified by Waagen with Sowerby's *Amm. maya*, with several new species, are now separated as *Epimayaites*, gen. nov., type to be Waagen's large *St. transiens*, refigured by Noetling. Boehm's '*Macrocephalites*' *metroxyloni* (1907, pl. XVII, figs. 4*a-c*), '*M.*' *batavo-indicus* (pl. XVIII), '*M.*' *rotangi* (pl. XX), '*M.*' *palmarum* (pl. XXI, figs. 2*a*, *b* only), also *Epimayaites* **sublem-**

oni, nom. nov. (=*Macrocephalites palmarum* G. Boehm, pars, 1907, pl. XXII, figs. 4*a*, *b*) and **E. sinuatus**, nom. nov. (='*M.*' *palmarum*, var. *alpha* pars, pl. XXII, figs. 1*a*, *b*) all seem to belong to this group. They are distinguished by their sharper and more elegant ribbing with a distinct sinus forward on the periphery, also by the generally modified suture-line, often with an almost Joannitid curve. The forms here grouped in *Epimayaites* may be partly derivatives of *Mayaites* viâ *Epimayaites polyphemus* but it is possible that the compressed forms include descendants of the stock now separated as *Paryphoceras*, and Boehm's '*Macrocephalites*' *cocosi* (1907, pl. XXIII, figs. 1*a*, *b*) may be a transitional species.

This genus comprises the Dhosa Oolite species (*P. stephanoides*, nov.) wrongly identified by Waagen with his (equally misinterpreted) *Stephanoceras fissum*, and two new species, perhaps even the rather special *St. arenosum*, Waagen, although this is also connected, as stated below, with the more macrocephalic *Mayaites*. They have finely costate inner whorls, compressed whorl-shape, and a simplified and slightly inverse suture-line, but are connected by passage forms with the more evolute and coarsely ribbed *Dhosaites*. The latter was originally proposed for the '*elephantinus*-group', then incompletely known; but in 1925 (*a*, p. 159) I definitely selected as genotype Waagen's form [now renamed *D. elephantoides*] which is entirely different from J. de C. Sowerby's *Amm. elephantinus*. *Dhosaites* also includes some new forms, previously described as 'of *Otoites* aspect'; and the coarse and sharp rectiradiate ribbing combined with the loose coiling may be taken to be characteristic. As in *Mayaites* the inner whorls are entirely different from those of the somewhat homœomorphous earlier Macrocephalitids.

The form described by Waagen as *Stephanoceras nepalense* (non Gray) and previously renamed *Dhosaites grayi* [with the apparently related '*Macrocephalites*' *bambusæ* G. Boehm (1907, p. 95, pl. XXV, figs. 1*a-c*)] and the new Tramau River form (No. 322) recorded as *Dhosaites* sp. nov. aff. *grayi* (1924, p. 25) are now separated from the *elephantoides* group as well as from the rectiradiate *Paryphoceras* and included in a new genus *Prograyiceras*. The inner whorls of the genotype (*P. grayi*) show greater resemblance to *Epimayaites*, *i.e.*, to forms previously included in *Mayaites*, not in *Dhosaites*. The still later *Grayiceras* of the Spiti Shales is probably a descendant of the *Epimayaites-Prograyiceras* stock, and is now also included in the family Mayaitidæ. On account of its close resemblance in ornamentation to *Kossmatia*, *Paraboliceras*. *Durangites*, and the more extreme *Paraboliceratoides*, with highly specialised ornamentation, I included *Grayiceras* in a separate family Grayiceratidæ (1925*a*, p. 145), but its suture-line is now known (pl. XXVII, fig. 3) and the latter name will have to be replaced by *Paraboliceratidæ*, this family being distinguished by its Perisphinctoid suture-lines. On the other hand *Macrocephalites waageni* and *M. kitchini*, Uhlig (1910, pp. 270-1, pl. LXXVII, figs. 1—3, 6) are still doubtful and may not be closer to *Epimayaites* than they are to the group of *Grayiceras kœneni* and *G.* sp. ind., figured by Uhlig from the Spiti Shales, and at first associated with his '*Macrocephalites*.'

The following five genera and twenty-eight species of Mayaitids are here described from Kachh :—

Genus *Mayaites* Spath.
M. maya (J. de C. Sowerby).
M. *maya* (J. de C. Sowerby) var. *aperta*, nov.
M. rotundus, sp. nov.
M. jumarensis, sp. nov.
M. obesus, sp. nov.
M. subkobyi, sp. nov.
M. smeei, sp. nov.
M. radiatus, sp. nov.
M.? [*Paryphoceras?*] *arenosus* (Waagen).

Genus *Epimayaites*, gen. nov.
E. polyphemus (Waagen).
E. lemoini (Spath).
E. axonoides, sp. nov.
E. subtumidus (Waagen).
E. pseudindicus, sp. nov.
E. evolutus, sp. nov.
E. excentricus, sp. nov.
E. transiens (Waagen).
E. lautus, sp. nov.
E. falcoides, sp. nov.
E. patella, sp. nov.

Genus *Dhosaites* Spath.
D. elephantoides, nom. nov.
D. otoitoides, sp. nov.
D. primus, sp. nov.
D. sp. ind.

Genus *Paryphoceras*, gen. nov.
P. rugosum, sp. nov.
P. badiense, sp. nov.
P. stephanoides, nom. nov.

Genus *Prograyiceras*, gen. nov.
P. grayi (Spath).
P. tramaunense, sp. nov.

Genus : MAYAITES Spath.

MAYAITES MAYA (J. de C. Sowerby).

(Pl. XXVIII, fig. 5 ; pl. XXIX, fig. 5 ; pl. XXX, fig. 2 ; pl. XXXI, figs. 1*a*, *b* ; pl. XXXII, fig. 6 ; pl. XXXVII, figs. 11*a*, *b*, 12 ; pl. XL, fig. 2 ; pl. XLIX, fig. 6 ; pl. LXVI, fig. 8).

1840. *Ammonites maya* Sowerby ; p. 719, pl. LXI, fig. 8.
1902. *Ammonites maya* Sowerby ; Blake, p. 38.
1910. *Macrocephalites maya* (Sowerby) Lemoine, p. 30, *non* pp. 19-20, *nec* pp. 33, 45.
1924. *Mayaites maya* (Sowerby) Spath, p. 9.

As Waagen pointed out, authors, following d'Orbigny and Oppel, had generally considered this species to be identical with *Macrocephalites macrocephalus*. The differences, of course, were difficult to appreciate from Sowerby's description and reduced figure, and Waagen himself was misled since most of his examples of '*Stephanoceras*' *polyphemus* are probably much closer to, if not identical with, Sowerby's species than is the form he described as '*St.*' *maya*. The holotype is now refigured, also its suture-line, to show that the type of costation and the curve of the lobes are different from those of the species (*Epimayaites lemoini* Spath sp.) assumed by Waagen to be Sowerby's form.

The dimensions of the holotype are:—195—·50—·53—·18 and it thus differs from the lectotype of *Epimayaites polyphemus* (Waagen emend. Noetling) in its more inflated whorl-section, with wider ventral area, and in having a larger umbilicus. The ribs are slightly flexi-costate, with the thickened primary portion concave forwards and the (generally three) secondary branches convex. On the inner whorls the ribs are showing on the rounded umbilical slope, but later this becomes smooth and vertical, with a more distinct if still rounded rim. This feature and the curvature of the ribs are well shown in Sowerby's drawing, but the whorl-section appears too compressed (see pl. XXXII, fig. 6). The suture-line does not differ much from that of true *Macrocephalites*, and shows deep external and first lateral lobes. The second lateral and auxiliary lobes are shorter and there are only three saddles entirely on the whorl-side, half of the second auxiliary (*i.e.*, third lateral) saddle being on the umbilical wall, followed by another bifid saddle that touches the umbilical suture (see pl. XXXI, fig. 1*b*).

There is apparently great variability; and every individual could have been figured as at least a variety, if we insisted on differences in ribbing or proportions rather than on the essential uniformity of an apparently homogeneous and contemporaneous population. The differences seem to be especially marked in the young, and it appears probable that the adults of all the forms of *Mayaites*, as well as of at least some *Epimayaites* acquired those smooth and constricted body-chambers that are no more characteristic of *E. polyphemus* than they are of *e.g.*, the terebrate *macrocephali* referred to by Blake (1905, p. 44).

The small example represented in pl. XL, fig. 2, shows the ribbing of the inner whorls. These are smooth and depressed at first, rounded to a diameter of 25mm. and wider than high again at 40mm. The larger example of pl. XXIX, fig. 5, and pl. XXX, fig. 2, showing the appearance at diameters up to 100mm., belongs perhaps to a slightly more finely ribbed and rather involute variety. The small '*Stephanoceras polyphemus*' figured by Waagen (pl. XXIX, fig. 3) is another evolute type that may well be included in the range of the present species-group. It is slightly more compressed than the typical forms and distinctly more evolute, but the inner whorls are more coarsely ribbed. It is connected with *M. maya* by many intermediate types, but separation as a variety (var. aperta) is perhaps advisable. One of these evolute

varieties in the Blake Collection (No. 275) is even more inflated than the type, whilst the compressed varieties of the same group lead to *Mayaites smeei* on the one hand and to *Paryphoceras rugosum* and even *Dhosaites primus* (pl. XXXVII, fig. 12, pl. XLIX, fig. 6) on the other.

In other examples again the primary bundles may correspond to as many as five secondaries instead of the usual three, whilst in a Barasar specimen of over 200mm. diameter, and with more than half of the outer whorl belonging to the body-chamber, the blunt ribbing (disappearing towards the end) resembles that of the earlier part of Waagen's large '*Stephanoceras*' *polyphemus* (pl. XXIX, fig. 1*a*).

The example represented in pl. XXXVII, figs. 11*a*, *b* is more involute and more coarsely ribbed than the typical forms; it can be considered to be transitional on the one hand to *M. jumarensis* and on the other to forms like that figured in pl. XXXVI, figs. 8, which may be included in *M. obesus*. Examples with compressed whorl-section and finer ribbing than the typical forms on the inner whorls (but not strikingly different at diameters of 100mm. and more) lead to the form described below as *M. radiatus*.

Mayaites? panganensis Tornquist sp. (1893, p. 11, pl. II) does not seem to differ very materially from Sowerby's species, although Tornquist's comparison was based on Waagen's erroneous interpretation of this species. In the absence of comparable material however, it is difficult to identify the Maru forms from the figures. Lemoine's Madagascan '*Macrocephalites maya*' on the other hand, to judge by its Callovian associates, has nothing to do with the species here described.

'*Macrocephalites*' cf. *maya* (Sowerby) Uhlig (1910, p. 269, pl. LXXVII, figs. 4*a-c*), is mentioned below (p. 234) under *Epimayaites;* and Uhlig's later references to the present species (1911, pp. 399, 404) are also due to incorrect determinations.

Horizon.—Upper Divesian? and Argovian, Lower Dhosa Oolite.

Localities.—Sowerby's type came from "Shahpoor or Kuntcote." Its matrix is that of the pink Dhosa Oolite, of *e.g.*, West Juria, but not of the Wagur (Kantcote Sandstone) species. Waagen recorded it from Lodai (at least the var. *aperta*) and Mr. J. H. Smith collected some twenty examples at Fakirwadi and Samatra, three at Ler, one near Nerona, and one at Barasar. The last is marked:—"Many such at Barasar, too heavy to cart away; many in Bhuj Museum." In the Blake Collection the species is represented from West Juria (upper zone, No. 275), Badi (bed 3, No. 271), and the 'upper zone', East of Badi (No. 209).

MAYAITES ROTUNDUS, sp. nov.

(Pl. XXX, figs. 3*a-c;* pl. XLIV, figs. 7*a*, *b*.)

This species differs from *M. maya* chiefly in proportions (136—·47—·72—·20) *i.e.*, in its very depressed whorls, also in losing its comparatively faint primary ribs already at a diameter of a little over 100mm. The rib-curve as a whole is also more projected, but there is no peripheral sinus; the low whorl-sides

gradually round off into the high umbilical wall. The inner whorls of the holotype, figured separately (fig. 3*c*), are less depressed than the outer and the whorl-sides are higher.

The suture-line here figured (pl. XLIV, figs. 7*a*, *b*) has the external half slightly corroded and therefore appears more simplified than that of *M. maya*; it shows, however, the closest agreement in the arrangement of the different elements. The internal (dorsal) portion is of interest on account of its resemblance to that of *Quenstedtoceras* (see R. Douvillé, 1912, p. 25, text-fig. 8, p. 69, text-figs. 74, 75). A portion of the outer whorl, apparently smooth though largely corroded, is preserved and shows that at twice the diameter of the whorls here figured the species was still considerably more inflated than *M. maya*. The globose *M. obesus*, of course, differs entirely in its coarser ornamentation.

Horizon.—Divesian (?) and Argovian (Lower Dhosa Oolite).

Locality.—Fakirwadi Ridge (J. H. Smith Colln.).

Mayaites jumarensis, sp. nov.

(Pl. XLIII, figs. 1*a*, *b*.)

1924. *Mayaites maya* (Sowerby) var., Spath, p. 22.

This species is based on the large Jumara example here figured, of dimensions 188—·49—·53—·18. It differs from *M. maya* chiefly in having a smaller umbilicus and coarser costation, but there are various passage forms. The ribs are also slightly inclined forward in *M. jumarensis* and the suture-lines are distantly spaced and have broader and shorter saddles. The inner whorls, to judge by some Samatra examples in Mr. J. H. Smith's Collection, are similar to those of the coarsely ribbed *M. maya* figured in pl. XXXVII, fig. 11, but have more distant costae; they also resemble the young *M.* cf. *obesus*, represented in pl. XXXVI, fig. 8. The latter species, however, is distinguished by its flexicostae and tumid whorl-shape; and a far greater depression of the whorls also characterises the finely-ribbed *M. rotundus*.

One of the transitions to *M. maya* resembles the var. *aperta* of that species, but is more coarsely costate.

Horizon.—Argovian (Dhosa Oolite).

Localities.—Jumara (bed No. 1, Blake Colln., No. 284); Samatra J. H. Smith Colln., Nos. 8, 98, and G. S. I. No. K-22/186*d* and K-22/282, pars); Fakirwadi (J. H. Smith Colln., No. 64 ?).

Mayaites obesus, sp. nov.

(Pl. XXXIV, fig. 7; pl. XXXVI, fig. 8; pl. XLII, figs. 1*a*, *b*.)

1840. *Ammonites harveyii* J. de C. Sowerby, (*non Amm. herveyi* J. Sowerby), p. 719, Woodcut (*non* pl. XXIII, fig. 5).

1875. *Stephanoceras subtumidum* Waagen (pars), p. 118.

1902. *Ammonites herveyi* Sowerby; Blake, p. 38.

1924. *Mayaites* cf. *subtumidus* (Waagen); Spath, p. 23.

Waagen identified the original of Sowerby's reduced figure with the species he described as *'Stephanoceras' subtumidum* in spite of the fact that it is not 'pigmy-like' and that the ribbing is entirely different. The holotype is now refigured (pl. XLII, figs. 1*a*, *b*) and a new name is necessary since it differs from *M. maya* and its allies as well as from the species described below as *Eximayaites subtumidus*.

The dimensions are 128—·52—·70—·13 and the region of greatest whorl-thickness is just beyond the rounded umbilical rim. The walls of the small and deep umbilicus are high and vertical. The section is somewhat cordiform, although the ventral area is evenly rounded. The large, septate fragment from which the suture-line (pl. XXXIV, fig. 7) was taken, at a diameter of about 200mm., shows a whorl-height of 45%, and a thickness of 60%, so that with increase in size there is less inflation but greater umbilication. The ribs are strongly concave forwards on the inner half of the side and after dividing, rather irregularly, into three secondaries, they show a decided curve backwards on the outer half. On the large fragment already referred to, which was at first taken to be one of the large Khera forms of *Indocephalites*, with similar suture-lines, the ribbing is finer and resembles that of (the considerably smaller) *I. kheraensis*, figured in pl. XIX, fig. 1*a*.

Some examples are less inflated than the type and somewhat transitional to the form described above as *M. jumarensis*. This, however, is typically less flexicostate and more finely ribbed, whilst *M. maya* has a wider umbilicus. There are passage forms, however, also to *M. subkobyi*, described below, with still coarser ornamentation.

The small costate *Trigonia* attached to Sowerby's original does not appear to have been referred to in Kitchin's work (1903).

Horizon.—Upper Divesian and Argovian (Lower Dhosa Oolite).

Localities.—Sowerby's type is from the Hills 12—15 miles north of Bhuj (Col. Pottinger's Colln.), not from Wagur (Shahpoor or Kuntcote); and there is nothing comparable in the Smee, Pottinger and Grant Collections in the B. M. (*ex* Geological Society Colln.) from Eastern Kachh. Mr. J. H. Smith collected this species at Walakhavas, Fakirwadi, Samatra, Lodai. An example transitional to *M. jumarensis* (G. S. I. No. K.-22/181) is also from Fakirwadi, but a smaller, doubtful, specimen (K22/169A) is (wrongly ?) labelled 'Khera Hill.' In the Blake Collection, the species is represented from the "Upper Zone, East of Badi" (No. 277).

MAYAITES SUBKOBYI, sp. nov.

(Pl. XXXVII, fig. 13; pl. XLV, figs. 1*a*, *b*.)

The inner whorls of the holotype here figured (pl. XLV, figs. 1*a*, *b*) have dimensions:—85—·50—·60—·17. There are also preserved portions of the next outer whorl (omitted in the figure) which show that the example was still septate at twice its present diameter. A large septate whorl-fragment of another individual showing the suture-line (pl. XXXVII, fig. 13) is sufficiently

similar in proportions and ribbing to what remains of the outer whorl of the holotype to be included in the present species rather than in the somewhat similar *M. radiatus*. The septate inner whorls, of 54mm. diameter, of a third example, also in the very hard '*arenosus* grit' are not in a satisfactory state of preservation.

The ribs are first sharp, later blunt, and are characterised by their thickened primary portions, generally corresponding to two to three secondaries on the inner, and three to four, more irregular, secondaries on the outer whorls. The ribs are somewhat rursiradiate, but on the figured holotype there is a slight sinus forward on the periphery. Whilst, thus, the lateral ribbing shows a certain resemblance to that of *Tornquistes lobyi* de Loriol sp. (1896, pl. IV, fig. 1), on the earlier half of the outer whorl, the peripheral aspect is more like that of the same author's *T. tornquisti* (ib., pl. II, fig. 2*a*, pl. II, fig. 1), although the sinus is far less pronounced and the ribs are closer. On the inner whorls the primary ribs are shown on the rounded umbilical border; later this edge becomes very pronounced, with a high, smooth, and perpendicular wall and the thickened primaries begin at the edge, as in *M.? horologium* or *M.? panganensis* Tornquist sp. (1893, pl. I, figs. 5, 6; pl. II). The section of the outer whorl is thus different from and more depressed than that of the earlier stage here figured (pl. XLV, fig. 1*b*) and resembles that of *M. obesus*, but is not quite so wide as that of *Indocephalites diadematus* (*see* Waagen's pl. XXX, fig. 4*b*).

The suture-line is very similar to that of *M. obesus* (pl. XXXIV, fig. 7) and differs from that of *M. maya* in its reduced second lateral saddle, situated comparatively close to the umbilical edge. A poorly preserved example, still septate at over 150mm. diameter but showing the inner whorls in section, on account of its more closely-set and curved primary costae may be considered to be transitional between the present species and *M. obesus*.

Horizon.—Upper Divesian? and Argovian (Lower Dhosa Oolite).

Locality.—Fakirwadi. J. H. Smith's Collns., Nos. 6, 75, and 75*a*, and G. S. I. No. K22/184.

Mayaites smeei, sp. nov.

(Pl. XXXVII, fig. 6; pl. XLV, figs. 7*a*, *b*.)

This form is connected by transitions with the evolute and finely ribbed varieties of *M. maya* above referred to, but it is now given an independent specific name, because, by its compression and ventrally projected costation, it may also be taken to link *Mayaites* with forms like *Paryphoceras rugosum*, described below. The holotype has dimensions:—108—·47—·44—·24. Its umbilicus thus is wider than that of any other form of *Mayaites*, except the more coarsely costate and more inflated var. *aperta* of *M. maya* (=Waagen's small '*Stephanoceras polyphemus*', pl. XXIX, fig. 3). The ribs are irregularly trifurcate, concave forward on the evenly rounded umbilical slope and straight

but prorsiradiate on the sides. The peripheral aspect shows a pronounced forward sinus. The whorl-section is evenly rounded but slightly flattened laterally. The example is preserved in the hard, calcareous, '*arenosus* grit', and partly oyster-coated; no suture-line is seen and it cannot be stated whether any part of the outer whorl belongs to the body-chamber.

The small example figured in pl. XXXVII, fig. 6, and others like it cannot definitely be referred to the present species, but they are more compressed and more finely ribbed than the typical *M. maya* at a similar diameter (*see* pl. XL, fig. 2). On the other hand there are examples of *M. maya*, quite typical at larger diameters, that have similar compressed and finely costate inner whorls.

Horizon.—Upper Divesian ? and Argovian (Lower Dhosa Oolite).

Locality.—The holotype is unlocalised but is probably from Ler or Fakirwadi (J. H. Smith Colln., No. 9); smaller examples come from Fakirwadi (J. H. Smith Colln., No. 9*a*) and East of Badi (Upper zone, Blake Colln., Nos. 280, 408).

MAYAITES RADIATUS, sp. nov.

(Pl. XLV, figs. 4*a-c*.)

The inner whorls only of the holotype are here figured and show proportions :—67—·48—·52—·2C. A fragment of the outer whorl, still septate, increases the example by another half-volution to a diameter of 8[illegible]mm. and shows that there was, then, greater depression of the whorl-shape, as in *M. subkobyi*. This change from compressed, finely costate, *arenosus*-like inner whorls, to depressed, inflated outer whorls, with coarse ornamentation, may be considered to be the characteristic feature of the present species.

To a diameter of 50mm. there are periodic, long primary costae, slightly thickened at the rounded umbilical edge, and about five short secondaries between, confined to about the outer third of the lateral area and projected forward as in *M. arenosus*. Later the primaries become coarse and thickened as in *M. subkobyi* and the number of secondaries is reduced; and as in the latter species, there is then a high, smooth, and perpendicular umbilical wall. The suture-line had a shorter lateral lobe and a slenderer first lateral saddle than that of *M. subkobyi* and whilst resembling that of the typical *M.? arenosus* in general appearance, it differs similarly in its short lobes.

The small example figured by Waagen (pl. XXXI, fig. 2) as *Stephanoceras maya* somewhat resembles the inner whorls of the present species although its long ribs are more numerous. The resemblance, however, is confined to the faulty drawing, the ribs of Waagen's original being in reality flexicostate, with long secondaries, as in other *Epimayaites*.

Horizon.—Argovian (Lower Dhosa Oolite).

Locality.—Habye Hills (J. H. Smith Colln. No. 66).

MAYAITES ? (PARYPHOCERAS ?) ARENOSUS (Waagen).

(Pl. XXVIII, fig. 4 ; pl. XXXVII, fig. 7 ; pl. XXXIX, fig. 5.)

1875. *Stephanoceras arenosum* Waagen, p. 121, pl XXXVI, figs. 5*a-c*.
1910. *Tornquistes arenosus* (Waagen); Lemoine, pp. 22, 23, text-fig. 39 ; fig. 44, p. 26 ; p. 38

Waagen had two examples from the typical, hard, grey, calcareous grit of Lodai and one from the Dhosa Oolite of Wanda ; his figured holotype has dimensions 64—·52—·42—·13 but one of the paratypes was stated to show proportions :—97—·45—·38—·18. This latter I have not seen, but as the holotype is incomplete and poorly preserved, it may be assumed that the paratype is in even a worse condition and the differences in the proportions are not, perhaps, of importance. On the other hand the only example among Mr. J. H. Smith's new material that can be compared to the present species, also unfortunately poorly preserved, has somewhat intermediate dimensions (97—·50—·40—·16), but like Waagen's holotype it represents merely the septate inner portion of some larger form. The present species is thus as yet too incompletely known for exact generic identification.

Waagen's illustration shows the primary ribs rather too prominent, especially at the middle of the side. In the additional specimen now available, the ribs are slightly closer than in the holotype and they are distinct only on the outer half of the lateral area. There is thus a resemblance to the much earlier *Nothocephalites semilaevis*. In the suture-line figured by Waagen the umbilical portion is unsuccessfully drawn ; the auxiliary saddle on the rounded edge and the succeeding lobe on the vertical umbilical wall are therefore now illustrated (pl. XXXIX, fig. 5), but it will be seen that the elements of the suture-line are finely divided and serial, at least in Waagen's type. The suture-line here figured (pl. XXVIII, fig. 4, and pl. XXXVII, fig. 7 was taken from a corroded portion of the additional specimen and is thus devoid of the finer frilling ; but the lateral lobe is decidedly shorter than the external, and the very high second lateral lobe also is more reminiscent of the type of suture-line found in the compressed genera described below rather than in *Mayaites*. It is thus probable that *M.? arenosus* is transitional to *Paryphoceras*, but as it is also clearly connected with the species last described (*M. radiatus*), and apparently has similar inner whorls, it may be provisionally left in *Mayaites*.

Lemoine included Waagen's species in the genus *Tornquistes*, but it has neither the degenerate suture-line of the genotype, *T. helvetiae* (Tornquist), nor the characteristic umbilical tuberculation that suggested the comparison of *Tornquistes* to the true *Stephanoceras* on the one hand and to *Gravesia* (=group of *Amm. gravesianus* d'Orbigny) on the other.

Horizon.—Argovian (Dhosa Oolite).

Localities.—Lodai and Wanda (Waagen) ; Fakirwadi Ridge G. S. I. No. K22/179.

Genus EPIMAYAITES, nov.

EPIMAYAITES POLYPHEMUS (Waagen).

1875. *Stephanoceras polyphemus* Waagen; p. 116, pl. XXIX, fig. 2 only (3 in explanation of plate).
1894. *Macrocephalites polyphemus* (Waagen); Tornquist, pp. 14, 18, 25.
1894. *Macrocephalites polyphemus* (Waagen); Pompeckj, p. 254.
1895. *Stephanoceras polyphemus* (Waagen); Noetling, p. 14, pl. XII only.
1910. *Macrocephalites polyphemus* (Waagen); Lemoine, p. 30.
1924. *Mayaites polyphemus* (Waagen); Spath, p. 9.
1924. '*Stephanoceras*' *polyphemus* Waagen; Buckman, p. 46.

Waagen's largest example (figs. 1*a*, *b*) is said to be lost, but Noetling selected the original of fig. 2 (suture-line only) as type of this species and gave its side- and peripheral views. The smallest specimen (Waagen's fig. 3), apparently not seen by Noetling and in any case not referred to, is closer to *M. maya* than to the lectotype of the present species, and it may be added that judging by the rounded earlier whorls of the gigantic example figured by Waagen (figs. 1*a*, *b*) this also probably represented a fully grown *Mayaites* of the *maya* type rather than the restricted *E. polyphemus*.

The latter has proportions 238—·50—·45—·15 and is thus slightly more compressed and slightly more involute than Sowerby's species. Its distinguishing features, however, are the slightly projected, not rursiradiate secondary costation and the subgaleate whorl-section, characters, in which *E. polyphemus* is closer to *Epimayaites* than to *Mayaites*. The suture-line also with its arched lateral and auxiliary elements and the prominent outer branch of the external saddle is that of, *e.g.*, *Epimayaites* of the *lemoini* type, not of the true *Mayaites*.

Noetling's large Mazar Drik form (pl. XI) seems to be a typical *M. maya*, not the species here discussed, whilst an example in the Blake Collection is transitional to *E. lemoini* or *E. excentricus*. It is still septate at a diameter of 220mm. and has slightly closer and finer costation, with the primaries disappearing at about 160mm.

A very large specimen in the Blake Collection, which at a diameter of 365mm. shows half a whorl of smooth body-chamber, has great resemblance to the gigantic *Stephanoceras polyphemus*, figured by Waagen (pl. XXIX, figs. 1*a*, *b*) with a similar tumid outer whorl. This probably does not belong to the present species, however, since there are only three lateral saddles visible on the whorl-side, outside the umbilical edge, as in *E. axonoides* or *E. evolutus* (pl. XXXVII, fig. 5*c*). It is possible that all the more inflated forms of *Epimayaites* produced such '*polyphemus*'-like adults and the gigantic example in the Blake Collection is therefore now provisionally attached to *E. axonoides*.

Macrocephalites olcostephaneides Tornquist (1893, p. 8, pl. I, figs. 1-3) which was considered to be a near relation of *E. polyphemus*, is probably closer to *Mayaites* or even to *Dhosaites* than to the group of forms here included

in the genus *Epimayaites*. On the other hand *E. batavo-indicus* G. Böhm sp. (1907, p. 87, pl. XVIII, fig. 1, pl. XIX, fig. 1), as its author noted, differs from the species here described chiefly in having a smaller umbilicus; its whorl-section is also less compressed.

The South American form recorded by Stehn (1924, p. 85) as *Macrocephalites* cf. *polyphemus* has nothing to do with the Kachh species here described; the latter was definitely described as being strictly confined to the Dhosa Oolite and does not thus occur in the Lower Callovian as Stehn stated.

There is no close connection between the present species and Quenstedtoceratids of the type of *Amm. goliathus* (d'Orbigny) and the writer is at a loss to understand how the 'discovery' of such an unidentifiable large *Cardioceras* as Young and Bird's *Amm. chalcedonicus* (refigured in S. S. Buckman, 1922 pl. CCXCV) seems to reveal this relationship (ib., 1924, p. 46). The acquisition of a similar type of body-chamber in the adult is common to many stocks, but the original of '*Amm. chalcedonicus*' appears to be a particularly bad example to choose for comparison.

Horizon:—Argovian (Upper Dhosa Oolite and [Lower ?] Kantcote Sandstone).

Localities:—Waagen recorded the lectotype of this species from the Dhosa Oolite of Lodai, but the writer is unable to state how many of his other localities have yielded the present species. The transitional species in the Blake Collection (No. 286) apparently from a higher level, is marked 'zone 1, Kantcote'.

EPIMAYAITES LEMOINI (Spath).

(Pl. XXVI, figs. 4*a*, *b*; pl. XXXIV, fig. 1).

1875. *Stephanoceras maya* (non Sowerby) Waagen, p. 113, pl. XXVIII, figs. 1*a*, *b* (2*a*, *b*? pl. XXXI, figs. 2*a*, *b*?).
1893. *Ammonites* (*Stephanoceras*) *maya* Sowerby-Waagen; Oldham, p. 222.
1893. *Macrocephalites maya* (Waagen); Tornquist, p. 12.
1894. *Macrocephalites maya* (Waagen); Tornquist, p. 14.
1910. *Macrocephalites maya* (Sowerby) Waagen; Uhlig, p. 269.
1910. *Macrocephalites maya* (Sowerby) Waagen; Lemoine, p. 19, p. 20 (text-fig. 19), p. 30. non p. 33.

This species is easily recognisable from Waagen's description and figures. The lectotype (Waagen's figs. 1*a*, *b* of plate XXVIII) is corroded on the side not figured and the peripheral view is restored, though apparently correctly. Its thickness amounts to 38% of the diameter, whereas Waagen gave the thickness of an example of 172mm. as almost equal to the whorl-height. This specimen may belong to *E. axonoides* described below. The smallest of Waagen's figured specimens (pl. XXVIII, figs. 2*a*, *b*) is too immature to be definitely identified with the large lectotype; and like the intermediate example figured in Waagen's pl. XXXI, figs. 2*a*, *b*, it may be transitional to some more

compressed form of the *transiens* group, described below. The measurements of these examples compare as follows :—

Lectotype (Waagen's pl. XXVIII, fig. 1) . . .	210	·50	·38	·16
? Paratype I (Waagen, p. 114)	172	·47	·46	·16
,, II (Waagen, p. 114)	48	·48	·42	·17
Pl. XXVI, figs. 4*a*, *b* (transitional to *E. axonoides*) .	133	·48	·43	·17
Pl. XXXIV, fig. 1	75	·48	·44	·19

As in the proportions, there is considerable variability in the ribbing, but this is always distinctly projected peripherally, much more markedly than in *E. polyphemus*. Of the other species described below, *E. axonoides* with increased whorl-thickness is transitional to *E. subtumidus* and also has coarser costation. The compressed *E. transiens*, as Waagen already pointed out, is distinguished by its more numerous and finer ribs, a smaller umbilicus, and a less strongly curved suture-line. *E. palmarum* G. Böhm sp. (1907, p. 90, pl. XXI, figs. 2*a*, *b*) differs in its wider umbilicus and indistinct costation; but *E. sublemoini*, nov. (=*Macrocephalites palmarum* G. Böhm, 1907, pars, pl. XXII, fig. 4 only) is intermediate between that species and the present form.

Macrocephalites waageni Uhlig (1910, non *M. waageni* Kruizinga, 1926, p. 61) and *M. kitchini* which had been associated with the present species by Uhlig and Lemoine may not be so closely allied as seems at first sight. The suture-line of the latter species has projected umbilical elements but its external saddle and the presence of only two laterals suggest affinity with true Macrocephalitids rather than *Epimayaites;* and *Grayiceras* also (to which I tentatively referred the Spiti forms in ignorance of the lobes) has a different suture-line. The Madagascar form recorded by Lemoine as '*Macrocephalites*' *maya* was almost certainly misidentified. Tornquist's '*M.*' *panganensis*, described by its author as in some respects transitional between '*M.*' *maya* and '*M.*' *polyphemus*, is not closely related to the present species.

Horizon.—Argovian (Kantcote Sandstone).

Localities.—Waagen recorded this species from Kantcote and the two specimens here figured as well as an additional example (No. 304) in the Blake Collection came from the river bed to the west of the same locality. One specimen in the same collection (No. 320) is from the Tramau River (zone 1) and was formerly (1924, p. 25) listed as *Mayaites* cf. *transiens*. The associated "*M.* sp. Juv." (No. 321) may however represent the young of that or some other species of *Epimayaites*. Whether Waagen's Dhosa Oolite example from north-west of Jarra belongs to the present species is uncertain, but the higher beds of the Argovian, in that neighbourhood, are brown or greenish and oolitic, not in the form of red ironstone as in Wagur or Eastern Kachh.

Epimayaites axonoides, sp. nov.

(Pl. XXV, figs. 8*a*, *b*; pl. XXXIV, figs. 3*a*, *b*; pl. XLVII, fig. 2; pl. XLVIII, fig. 4; pl. XLIX, fig. 8.)

This species is based on the large example figured in pl. XLVII, fig. 2, and pl. XLVIII, fig. 4, which is still septate at the end. It is connected

by transitions with the more inflated, more coarsely and more radially costate and smaller *E. subtumidus* on the one hand and the more compressed *E. lemoini* on the other. An example intermediate between *E. axonoides* and *E. subtumidus* is figured in pl. XXV, figs. 8*a*, *b*; a transition to *E. lemoini* is represented in pl. XXXIV, figs. 3*a*, *b*. These two specimens and the holotype have the following dimensions :—

Pl. XLVII, fig. 2 (holotype) . . .	193	·52	·53	·15
Pl. XXV, fig. 8	110	·47	·55	·18
Pl. XXXIV, fig. 3 . .	82	·49	·55	·18

These measurements show that whorl-height and thickness become more nearly equal at larger diameters, so that but for the difference in the ribbing, the smaller *E. subtumidus*, with a whorl-thickness of 75% of the diameter, might well have been held to represent merely the inner whorls of an inflated variety of the same species. The whorl section differs from that figured by Parona and Bonarelli (1897, p. 155, text-fig. *d*) and wrongly referred to '*Macrocephalites subtumidus*' merely in greater compression (55% only, not 75%) but that of the true *E. subtumidus* is characterised by a wider peripheral area correctly represented in Waagen's drawing. The ribs are flexiradiate, with strong, curved, primary stems and three to four, later even more secondary branches, forming a distinct sinus forward on the periphery as in *E. lemoini*. The umbilical wall is high and almost smooth. In the apparently allied *E. rotangi* G. Böhm sp. (1907, p. 88, pl. XX, figs, 1*a*, *b* only) the umbilicus is wider and in the more compressed *E. metroxyloni* G. Böhm sp. (1907, p. 80, pl. XVII, figs. 4*a-c*) the ribs are considerably finer. *E. polyphemus*, above described, differs in its coarser and more distant costation, but the inner whorls of this species as of the allied *E. batavo-indicus* (G. Böhm) may not be readily distinguishable from those of the form here described.

The suture-line represented (from an actual tracing) in pl. XLIX, fig. 8 shows great resemblance to that of *E. transiens* (pl. XXVI, fig. 2) and to the suture-lines of the Dutch East Indian forms figured by G. Böhm (1912, pp. 87-93, text-figs. 31-38). In *E. polyphemus* there is an additional lobe which makes it desirable to include in the present species and not in *E. polyphemus* the gigantic example in the Blake Collection, already referred to, with a smooth and tumid body-chamber of the characteristic *polyphemus* type (*i.e.*, Waagen's original figure of pl. XXIX, figs. 1*a*, *b*).

Horizon.—Argovian, Kantcote Sandstone.

Localities.—River Bed, west of Kantcote. One of the specimens in the Blake Collection (No. 287) transitional to *E. lemoini*, is labelled 'zone 1,' Kantcote. The gigantic example, already referred to, in the same red ironstone matrix, is unlocalised but probably also from near Kantcote.

EPIMAYAITES SUBTUMIDUS (Waagen).

(Pl. XXV, fig. 5; pl. XXIX, figs. 6*a*, *b*; pl. XXXI, fig. 7; pl. XXXII, fig. 9.)

1875. *Stephanoceras subtumidum* Waagen, p. 118, pl. XXVIII, figs. 4*a*, *b*.
1894. *Macrocephalites subtumidus* (Waagen); Tornquist, p. 25.
1910. *Macrocephalites subtumidus* (Waagen); Lemoine, pars, pp. 21, 31, text-fig. 27, p. 21.
1924. *Mayaites subtumidus* (Waagen); Spath, p. 9.
Non 1924. *Macrocephalites subtumidus* (Waagen); Roman, p. 62, pl. III, fig. 3.
,, 1928. ,, ,, Nicklès, p. 33.

This form has generally been misinterpreted, *e.g.* by Parona and Bonarelli (1895, p. 155), Simionescu (1905, p. 22, pl. III, fig. 6), Lemoine (1910, p. 31), Model (1914, p. 26) and Loczy (1915, p. 353); and after Waagen I first associated with it the species here described as *Mayaites obesus*. Waagen assumed the holotype of the latter, *i.e.*, Sowerby's original of '*Amm. harveyii*' from 'Shahpoor,' to be from the 'red iron layers' of Eastern Kachh, *i.e.*, from the Upper Argovian, but its matrix is that of the earlier Dhosa Oolite. The only examples available in addition to Waagen's holotype are six specimens in the Blake Collection, of which three are here figured. The largest (pl. XXIX, figs. 6*a*, *b*), still septate at the end, and perhaps corresponding to Waagen's 'variety with trichotome ribs' may be considered to be transitional to some of the other species of *Epimayaites*, *e.g.* the megalomorph *E. axonoides* described above, with less depressed whorl-section and less sharply defined costation. The fragmentary example figured in pl. XXXI, fig. 7 agrees best with Waagen's holotype in the type of ribbing, whilst the third specimen (pl. XXV, fig. 5 and pl. XXXII, fig. 9) again shows a slightly less inflated whorl-section than the typical examples. The suture-line, not described in detail by Waagen, is not distinctly visible in any of the new examples. It is probably essentially like that of *E. axonoides* which is connected with the present species by various transitions.

Forms more or less homœomorphous with the present species occur already in the Bathonian (=group of *Macrocephalites eszetensis*, to which may belong *Sphæroceras ymir* [Oppel] Popovici-Hatzeg, united by Loczy with *E. subtumidus*) and in the Callovian (*Macrocephalites rotundus* in Loczy and *M. subtumidus* in Model), and the conclusions that have been drawn from their distribution in time and space (Loczy, 1915, pp. 353 and 443) are valueless.

Horizon.—Upper Argovian, Kantcote Sandstone.

Locality.—Waagen recorded this species from the red ironstone beds near Kantcote in Wagur and all the specimens in the Blake Collection are from the River Bed, west of the same locality or else are marked 'zone 1,' Kantcote. The transitional specimen figured in pl. XXIX, figs. 6*a*, *b*, is from 'zone 1,' Tramau River.

EPIMAYAITES PSEUDINDICUS, sp. nov.

(Pl. XXIX, figs. 1*a*, *b*.)

1924. '*Mayaites*' (*Dhosaites ?*) sp. nov. (No. 266); Spath, p. 10.

This species is based on the single (unfortunately unlocalised) example here figured, of dimensions 90—·42—·48—·28. It was previously described

as somewhat resembling the evolute varieties of '*Macrocephalites*' *palmarum* and '*M.*' *cocosi* G. Boehm, and it differs from all the species above described in its open umbilicus, and from *E. evolutus* in its inflated whorl-section. The biconcave, sharp, ribs bi- or trifurcate, and occasionally show disconnected secondaries in between; there is a more pronounced peripheral sinus forward than in *E. axonoides* (pl. XXXIV, fig. 3*b*) and the ribs of opposite sides are unsymmetrical as in *E. rotangi* G. Boehm sp. The high umbilical wall is smooth in its lower half; the upper (costate) portion rounds off gradually into the convex whorl-side. The periphery is slightly contracted, giving the whorl-section a subcordiform shape. The inner whorls, as seen in the umbilicus, are smooth and the primary ribs seem to appear at a later stage than in the somewhat similarly umbilicate *E. batavo-indicus* G. Boehm sp. (1907, pl. XIX, fig. 1*b*).

The last species has less close costation and *E. rotangi* (G. Böhm, 1907, pl. XX) to which the present form also shows considerable resemblance, has less flexiradiate ribbing and less peripheral projection. The suture-line, unfortunately, is not seen in the species here described.

E. metroxyloni G. Böhm sp. (1907, pl. XVII, figs. 4*a-c*) is more finely and less sharply ribbed, whilst *E. sublemoini*, above referred to, has a smaller umbilicus and a more compressed whorl-section.

There is considerable superficial resemblance to the species here described as *Indocephalites indicus* (see pl. XXVI, figs. 5*a*, *b*) but this has less sharp ribbing, unprojected on the venter, and, of course, the suture-lines are entirely different in the two stocks.

Horizon.—Upper Argovian, Kantcote Sandstone.

Locality.—Unrecorded. The brown ironstone matrix suggests Tramau River rather than Kantcote, but the specimen is certainly from Wagur.

Epimayaites evolutus, sp. nov.

(Pl. XXXVI, figs. 13, 14; pl. XXXVII, figs. 5*a-c*.)

As type of this species is taken the entirely septate example figured in pl. XXXVII, figs. 5*a-c* which has dimensions:—153—·47—·38—·20. It is distinguished from the species described above by its flattened whorl-sides, more discoidal shape, and low and slanting, smooth umbilical wall. The ribs are not radial, but distinctly inclined forward, slightly biconcave, and strongly projected peripherally, as in the more evolute *E. sinuatus*, nom. nov. (=*Macrocephalites palmarum* G. Böhm, var. *alpha*, 1907, p. 92, pl. XXII, fig. 1*b*). Towards the end of the shell the primary ribs become more distantly spaced and even the secondaries are weakened.

The suture-line shows the prominent outer branch of the external saddle and the general obliquity of the lobes towards the siphonal side, seen in other species of *Epimayaites*.

The smaller example figured in pl. XXXVI, fig. 14 is slightly malformed, as is shown by the unusual reduction of the primary ribs on one side and the excentric umbilicus, but it is certainly more evolute than the somewhat similar young of *E. lemoini*, whilst the more discoidal *E. transiens*, *E. patella*, and *E. falcoides* are not only more involute but also more finely ribbed. Like some still more immature specimens (of which one is figured in pl. XXXVI, fig. 13), also combining discoidal shape with a comparatively wide umbilicus and coarse ribbing, this malformed example may thus be attached to the present species.

E. sublemoini, nom. nov., has a smaller umbilicus and less prominent and distant primary costae, also less inclined ribs; but the immature *Epimayaites* included by G. Böhm (1907, pl. XXI, figs, 1*a*, *b*; pl. XXII, figs. 3*a-c*) in his *Macrocephalites rotangi-palmarum* (transition) and *M. palmarum* show great resemblance to the (perhaps less finely ribbed) young examples here figured.

The immature Jooria specimen figured by Waagen (pl. XXVI, fig. 3) as *Stephanoceras opis* has resemblance to the young of the present species. There is only very slight peripheral projection, however, and like the Badi examples referred to below under *Paryphoceras*, it may represent a new form transitional between the two genera.

Horizon.—Upper Argovian, Kantcote Sandstone.

Locality.—River Bed, west of Kantcote, and 'zone 1' of the same locality (J. F. Blake Colln.). The larger holotype is unlocalised, but probably also from Kantcote.

Epimayaites excentricus, sp. nov.

(Pl. XXXII, fig. 2; pl. XXXVII, fig. 8; pl. XLIV, figs. 4*a*, *b*.)

The large example on which this form is based (reduced to about four-fifths linear in pl. XLIV, fig. 4*a*) had at first been taken by the writer to represent a true *E. polyphemus*, but on comparison with the lectotype figured by Noetling it was found that the differences are conspicuous and probably specific. The ribs are strongly projected forward and pronounced only near the periphery where several of the secondaries may be joined to one particularly oblique rib. The primaries are faint but can only be seen in the umbilicus, the whole of the inner lateral area of the outer whorl being smooth. The secondaries also disappear with the last suture-line, but towards the end of the half-whorl of smooth body-chamber a few coarse and distant peripheral folds reappear, not distinctly seen in the photograph. The aspect then resembles that of the adult *Macrocephalites formosus* figured by Waagen (pl. XXV).

The whorl-section (pl. XLIV, fig. 4*b*), taken at the spot in the side-view (fig. 4*a*) marked with an ×, shows the peculiar transition from the rounded periphery of the inner whorls to the sharpened venter of the body-chamber. The umbilical slope which at first was vertical and had a rounded edge

as in the somewhat similar *Macrocephalites formosus*, on the body-chamber becomes unusually high and overhanging, but contracts again at the end of the shell whilst at the same time the umbilicus widens considerably. The dimensions then are:—215—·43—·40—·19. The suture-line is seen on the side not figured, and although somewhat corroded, it seems to agree with that of *E. polyphemus*.

In *E. polyphemus* there are greater whorl-thickness, prominent primary costation, and less inclination forward of the ribs as a whole, whilst the primary ribs are still visible when the secondaries have almost disappeared. The example referred to above as transitional between *E. polyphemus* and *E. lemoini* or the present species is, however, less distinct in this respect. On the other hand there is a still larger example of the present species in the Blake Collection (No. 273) with apparently just the beginning of the body chamber at a diameter of 215 mm. which shows the subtrigonal whorl-section still more distinctly and seems to confirm the specific independence of the present form, although its preservation is somewhat imperfect. Its suture-line shows good general agreement with that of *E. polyphemus*, there being two lateral and two auxiliary saddles on the inner whorl-side, the last already on the edge, but there is a fifth and smaller saddle on the high and smooth umbilical wall, all describing that peculiar curve found in Waagen's species.

The small example figured in pl. XXXII, fig. 2 and pl. XXXVII, fig. 8 cannot be definitely identified with the two larger examples above discussed. Its ribs have a distinct peripheral sinus and the suture-line shows the *Epimayaites* curve, but the example is corroded and also slightly crushed.

Horizon.—Upper Argovian, Kantcote Sandstone.

Localities.—Kantcote (Zone 1) and "Upper Beds," Gangta Bét.

Epimayaites transiens (Waagen).

(Pl. XXVI, fig. 2; pl. XXVIII, fig. 3; pl XXXVI, fig. 11.)

1875. *Stephanoceras transiens* Waagen, p. 111, pl. XXXII, figs. 2, 3.
1875. *Stephanoceras opis* (Sowerby); Waagen, pars, p. 140, pl. XXXVI, fig. 2 only.
1895. *Macrocephalites transiens* (Waagen); Noetling, p. 13, pl. X, figs. 1, 2.
1910. *Macrocephalites transiens* (Waagen); Lemoine, pp. 19 and 31.
non 1926. *Macrocephalites* cf. *transiens* (Waagen); Kruizinga, p. 53, pl. IX, figs. 3-5.

The large specimen represented in Waagen's restored figs. 2*a*, *b* of pl. XXXII must be taken as lectotype of this species. It was refigured by Noetling who added certain 'strong criticism' to his description of probably a comparable Baluchistan form; but those who do not know the species from actual specimens will profit by the inspection of Noetling's figures perhaps less than by the study of Waagen's original delineation, which does not show quite enough secondary ribs (75 to the half-whorl, instead of about 67). The peripheral view, in any case, is probably fairly correctly restored. Waagen's smaller example (figs. 3*a*, *b*) is quite successfully drawn and well shows the typical ornamentation, but the ventral view of his third specimen, wrongly

referred to '*Stephanoceras opis*' (pl. XXXVI, fig. 2), should show considerably closer costation. The shape is also somewhat incorrectly represented, as Noetling pointed out (1895, p. 18), the left side of the outer whorl being too rounded and the umbilical wall too high and not steep enough. On comparing Waagen's fig. 3*a* of pl. XXXII with the inner whorls of his larger '*St.*' *opis* (above described as *Subkossmatia obscura*) it will be seen that apart from differences in suture-lines and umbilicus, the costation is of a different type, the length of the secondaries being the most obvious distinction.

A number of species, here separated from *E. transiens* to show the variability in this typical Kachh genus, are closely allied; and there are also transitions to the more inflated *E. lemoini* and to the more evolute *E. patella*, whilst *E. falcoides* differs chiefly in its more falciradiate costation. *E. lautus*, with somewhat similar whorl-shape, has less fine and close ribbing. It may also be slightly more evolute than *E. transiens*, the umbilicus measuring 18% of the diameter in Waagen's '*Stephanoceras*' *opis* (pl. XXXVI, fig. 2) and 14% in his small example. In the lectotype it cannot be measured, but Waagen gave 13% as the width of the umbilicus which is probably too small. The whorl-thickness is 36% in the lectotype at 110 mm. and 40% (in Waagen) at 136 mm. diameter, but here again it cannot be measured, the example being too defective. In the more discoidal smaller specimen confused with '*St. opis*', at 80 mm. diameter, the thickness is only 33% as against 32% in *E. lautus*.

The suture-line figured in pl. XXVI, fig. 2 was taken from a gigantic example still septate at 230 mm. diameter. Its earlier whorls agree with the lectotype and there seems to be no doubt about the identification. The three lateral saddles shown do not reach to the umbilical edge but the preservation of this is too unfavourable for the tracing of the remaining elements.

The small example depicted in pl. XXVIII, fig. 3 is slightly more finely ribbed than that of pl. XXXVI, fig. 11, but all the immature specimens of the more compressed species of *Epimayaites* are essentially similar.

Lemoine's Madagascan '*Macrocephalites transiens*' (1910, pl. IV, fig. 6) is probably a form of *Dolikephalites*, as appears to be Siemiradzki's (1894, p. 527) Polish form. The East African '*Macrocephalites*' *stuhlmanni* Tornquist (1893, p. 13, pl. III, figs. 4, 5) which had been compared to '*M.*' *transitus* (sic) also does not seem to be closely allied. On the other hand *E. tenuicostatus*, nom. nov. (=*Macrocephalites palmarum* G. Boehm, var. *tenuicostata*, 1907, p. 92, pl. XXIII, fig. 3) with a suture-line resembling that of the present species, has less distinct primary ribs.

One of the Badi examples (No. 270), formerly referred to the present species, has slightly less projected and coarser ribs and may be transitional to that new species referred to below (p. 249) as intermediate between *Epimayaites* and *Paryphoceras*, or even to *E. lemoini*.

Horizon.—Upper Argovian (Upper Dhosa Oolite and Kantcote Sandstone).

Localities.—Waagen's types came from Lodai and from north-west of Soorka; his third example from the 'Joora' Hills. The West Jooria (upper zone) form in the Blake Colln. (No. 389) previously (1924, p. 25) listed as

'*Mayaites* cf. *transiens*' is badly worn and thus shows a larger umbilicus. The Badi (upper zone) example (No. 270) has already been referred to, and of the seven Kantcote specimens (from the 'River Bed'), mostly immature, some are transitional to the discoidal *E. falcoides* and, perhaps, other species, but the gigantic specimen from the same bed (from which was taken the suture-line figured in pl. XXVI, fig. 2) is indistinguishable from the lectotype.

Epimayaites lautus, sp. nov.

(Pl. XLV, figs. 3*a*, *b*.)

1924. *Macrocephalites* (*Eucycloceras ?*) cf. *subcompressus* (Waagen); Spath, p. 22 (No. 223).

This species is based on the single example here figured, of dimensions:—88—·50—·32—·20, which was first taken to be a Macrocephalitid of the *subcompressus* type on account of its resemblance to forms like *Dolikephalites* and *Eucycloceras* (pl. XXVII, figs. 6, 7). It may be briefly characterised as more coarsely ribbed than *E. transiens*, with generally only two secondaries to each primary and with a considerably straightened radial line. This distinction seems unimportant enough, but the species apparently belongs to a different bed and may thus be only a heterochronous homœomorph of *E. transiens* and be derived from another stock (*e.g. Paryphoceras*).

E. falcoides and *E. patella* have flexuous costae and *E. evolutus* has a wide umbilicus, whilst all the other species of *Epimayaites* are less compressed. Confusion with the earlier Macrocephalitids, however, is easy. The suture-line of the species here described is not traceable distinctly enough for reproduction, but the external saddle and lateral lobes show the *Epimayaites* characters, as represented in the suture-line of *E. transiens* (pl. XXVI, fig. 2) or *E. evolutus* (pl. XXXVII, fig. 5*c*). This is distinctive enough for the identification of well-preserved examples, but in the case of fragments or body-chambers it is important to note that in *Dolikephalites* of the *typicus* group, the costation also tends to become inclined forward with age, so that there is indeed great resemblance to the present form.

Horizon.—Upper Argovian, Dhosa Oolite.

Locality.—The holotype of this species in the Blake Collection (No. 223) was merely labelled 'Jumara,' without a bed. Its matrix, a yellowish to greenish oolite with brown limonite grains, is similar to that of *Mayaites jumarensis*, but differs slightly from the rock in which were embedded *Taramelliceras jumarense* and '*Perisphinctes chloroolithicus*' Waagen.

Epimayaites falcoides, sp. nov.

(Pl. XXXVIII, fig. 6; pl. XL, fig. 6; pl. LXVII, figs. 7*a*, *b*.)

This species is also close to *E. transiens* and differs principally in its larger umbilicus and flexiradiate ornamentation. The smaller example figured in pl. XL, fig. 6, which may be taken as the holotype, shows dimensions:—40—50—·37—·18; in the larger paratype (pl. XXXVIII, fig. 6) the proportions

are :—77—·50—·39—·16. The primary ribs form distinct folds, a feature that is developed in *E. transiens* only at larger diameters, and the whorl sides are convex and not so flattened as in Waagen's species at the same diameter. At the same time the strongly biconvace ribs form a pronounced sinus on the periphery (see pl. LXVII, fig. 7*b*) whereas in *E. transiens*, as in the more coarsely ribbed *E. lautus*, the considerably straighter ribs (which also have sharp primary portions) are not conspicuously projected peripherally.

One of the examples (No. 323) at a diameter of 60 mm. has a whorl-thickness of 42% and may thus be regarded as an inflated variety. It is distinguished from the small '*Stephanoceras maya*' figured by Waagen (pl. XXXI, fig. 2) by its finer costation, but, like it, may be considered to be a passage form between the two species. Waagen's drawing of his smaller example, however, is not successful, the secondary ribs reaching mostly to the middle of the side and even beyond.

Horizon.—Upper Argovian (Kantcote Sandstone).

Locality.—Kantcote. One of the examples (No. 298) is labelled 'Zone 1'; two (Nos. 316 and 317-pl. LXVII, fig. 7) are marked 'above zone 1'; a fourth (No. 306) is from the River Bed, west of Kantcote, and a fifth (No. 323) is unlocalised, but probably from the same locality.

EPIMAYAITES PATELLA, sp. nov.

(Pl. XXXVI, fig. 15 : pl. XLIX, fig. 12).

The holotype of this species, septate to the end, has dimensions :—66—·47—·33—·20. These differ from the measurements of *E. transiens* merely in the width of the umbilicus and a correspondingly greater whorl-height, and are equally close to those of the two species last described. The ribs of *E. patella* are at first fine and close, as in *E. transiens;* later the secondaries are coarser in proportion, but the primaries are similarly bundled, not sharp as in *E. lautus* or strongly flexiradiate as in *E. falcoides*.

The most characteristic feature of the present species, however, is its close resemblance, in ribbing, to the inner whorls of *Subkossmatia obscura* and, in suture-line, to *Nothocephalites asaphus*. On comparison of fig. 12, pl. XLIX with fig. 2 of pl. XXXVII it will be seen that the differences are slight and confined to the auxiliary elements. The ribbing, however, in *N. asaphus*, although projected at first, as in the species here described, becomes almost radial across the periphery of the last half-whorl, whereas in *Epimayaites* (which moreover has primary costation) the ribs may be lost on the body-chamber but no change comparable to that of *Nothocephalites* or *Subkossmatia* has been observed.

The small *Epimayaites* figured by G. Boehm (1907, pl. XXII, figs. 3*a-c*) as *Macrocephalities palmarum* (pars) has a lateral aspect not unlike that of the species here described, but is less compressed. It does not appear to belong either to *E. sinuatus* or to *E. sublemoini*, with which it had been united by its author. *E. tenuicostatum* (G. Boehm, 1907, pl. XXIII, fig. 3) which

had been compared by the same author to Quenstedt's *Amm. macrocephalus compressus* and which shows great resemblance to *Nothocephalites paradoxus* (pl. XXXIX, fig. 8), is more irregularly costate, whilst *E. sublemoini* is far less compressed and less discoidal.

Horizon.—Upper Argovian (Kantcote Sandstone).

Locality.—Kantcote (zone 1). J. F. Blake Colln. No. 296.

Genus: Dhosaites, Spath.

Dhosaites elephantoides, nom. nov.

(Pl. XXV, fig. 9 ; pl. XXXVIII, figs. 8*a*, *b*).

1875. *Stephanoceras elephantinum* (*non* Sowerby) Waagen ; p. 124, pl. XXXI, figs. 3, 3*a* only.
1910. *Macrocephalites elephantinus* (Sowerby) ; Lemoine, p. 29 only.
1924. *Dhosaites elephantinus* (Sowerby) ; Spath, p. 9.
1925. *Dhosaites elephantinus* (Sowerby) ; Spath (*a*), p. 159.

This is the species referred by Waagen to *Stephanoceras elephantinum*, but it differs considerably from Sowerby's original, here refigured and described as *Pleurocephalites elephantinus* (supra, p. 194). The differences, however, are not easily detected on comparison of figures only, or in the case of poorly preserved material, and in the absence of suture-lines or inner whorls. Both Lemoine and the writer (1925*b*, p. 27) went wrong in the identification of Madagascan examples ; but Mr. Smith has collected a number of additional specimens, two of which are here figured, and it is now possible to separate definitely Waagen's Dhosa Oolite form from Sowerby's more or less homoeomorphous Callovian species.

Waagen's description, so far as it is based on his larger examples, and his figure of the lectotype are sufficient to characterise the adult ; but his paratype (pl. XXXII, fig. 4) is less robust and more finely costate. It is now tentatively grouped with the less inflated form described below as *D. otoitoides*, but there are other passage forms. The young *D. elephantoides* here figured show that at this diameter the costation is already as coarse as in the adult. There is one example however, figured in pl. XLIX, figs. 5, *b*, showing the inflated whorl-shape of the present species, which has finer and closer ribs than the type, and a number of other young *Dhosaites* are all slightly different and are grouped with the species below merely on account of their less depressed whorl-section. The young *Mayaites* have a similar aspect but are already more macrocephalic, *i.e.* involute, and more finely-ribbed.

The suture-line is not preserved in the Fakirwadi examples (from the hard '*Polyphemus-Grit*'), but it is probably similar to that of *D. primus*. The dimensions of Waagen's large example are 108—·39—·58—·39, not as quoted in Stehn (1922, p. 78), who followed most previous authors in misinterpreting this species, as already mentioned (supra, p. 195). In the true *Pleurocephalites elephantinus* (J. de C. Sowerby) the whorl-height and width of the

umbilicus are nearly the same, but the thickness amounts to as much as 75% of the diameter. The differences in the ribbing, especially of the young, are so striking, however, that misidentifications of even incomplete examples should no longer occur.

Horizon.—Argovian, Dhosa Oolite.

Localities.—Waagen's type came from Lodai. Three examples were collected by Mr. J. H. Smith at Fakirwadi and the transitional form figured in pl. XLIX, figs. 5*a*, *b* is from Khera Hill.

Dhosaites otoitoides, sp. nov.

(Pl. XLIV, figs. 1*a*, *b*).

1875 ? *Stephanoceras elephantinum* (non Sowerby) Waagen, p. 124, pl. XXXII, fig. 4 only.
1924. *Dhosaites*, sp. nov. Spath, p. 9.

I previously directed attention to some new forms of *Dhosaites* in the Blake Collection, coarser in costation than the typical young *Mayaites* and widely umbilicated, *i.e.* close to the immature '*Stephanoceras*' *elephantinum* of Waagen. The discovery, by Mr. Smith, of a number of additional specimens, in the Dhosa Oolite of various localities, has made it possible to trace the affinity of these curious forms, intermediate between *D. elephantoides* and the compressed forms here referred to *Paryphoceras*.

The holotype of the present species has dimensions :—67—·43—·46—·30. The whorl-section is almost circular, slightly depressed, and the shape in thus far less inflated than that of *D. elephantoides*. The ribbing, however, is of the same type, acute, and more or less regularly bifurcating. As in *D. elephantoides* the ribs form particularly sharp ridges at and just below the point of bifurcation, situated at the middle of the side. The suture-line is not seen in the holotype.

Some examples are more evolute ; others, with slightly compressed whorl-section and closer costation, are transitional to the species described below as *D. primus*. Whether Waagen's immature example, here listed in the synonymy, really belongs to the present form, is somewhat doubtful, for the young *D. primus* and *D.* sp. juv. ind. (Pl. XXXIX, fig. 4) here figured show that there is great variability at diameters of 25mm. and under.

Horizon.—Argovian, Dhosa Oolite.

Localities.—Fakirwadi ('Bowl' =centre of Fakirwadi Ridges in Mr. Smith's meaning) and Samatra.

Dhosaites primus, sp. nov.

(Pl. XXXII, fig. 5 ; pl. XXXVI, figs. 10*a*, *b* ; pl. XXXVII, figs. 1*a*, *b* ; pl. XXXIX, fig. 3 ; pl. XL, fig. 3 ; pl. XLIV, figs. 5*a*, *b* ; pl. XLV, figs. 2*a*, *b* ; pl. XLIX, figs. 3*a*, *b*, 4, 13).

As holotype of this species we may take the example figured in pl. XXXVII, figs. 1*a*, *b* which has dimensions :—78—·42—·41—·31. The whorl-

section is slightly compressed, flattened laterally, and the umbilical slope is steep. The ribs are sharp and generally bifurcate at or just beyond the middle of the side; towards the end of the holotype specimen (the last half-whorl of which consists of body-chamber) there is indistinct trifurcation of two ribs. The branches of opposite sides do not correspond, but join more or less alternately with a very slight forward sinus across the broadly arched venter. The branching resembles that of *Perisphinctes galoi* G. Boehm (1907, p. 98, text-fig. 41). The inner whorls (pl. XXXIX, fig. 3, pl. XL, fig. 3) are again finely costate and show trifurcation, with the secondaries reclined and the primary ribs not so thickened as in the other immature form here figured (pl. XXXIX, fig. 4) or in Waagen's young '*St. elephantinum*.' The suture-line is not distinctly seen in the holotype, but is well shown in other examples and is figured in pl. XXXVI, fig. 10*b* and pl. XLIX, fig. 13. It is characterised by its simple, short lobes, and umbilical projection forward.

The small example figured in pl. XLV, fig. 2 is slightly more inflated than the type. Its dimensions are :—45—·44—·53—·31 and it is a passage form to the species described below and to the coarsely-ribbed variety of *Mayaites maya* figured in pl. XXXVII, fig. 12 and pl. XLIX, fig. 6. On the other hand the compressed specimen represented in pl. XXXII, fig. 5 and pl. XLIX, fig. 4 shows increased peripheral projection of the ribs and a more distinct ventral sinus and may thus be taken to be a transition to *Parypho-ceras*, described below.

D. otoitoides is more distantly costate, and more inflated, but there are various transitional forms.

Horizon.—Argovian, Lower Dhosa Oolite.

Localities.—Fakirwadi (3), Samatra (3), and Wanda (3). The examples from the last locality in the Blake Collection (Nos. 468, 470, 211) are labelled '**zone 1**' and were formerly (1924, p. 23) recorded as '*Mayaites* spp. nov.'

Dhosaites sp. ind.

(Pl. XLIX, figs. 1*a*, *b*, and 2*a*, *b*)

1924. *Mayaites*, sp. nov. (272); Spath, p. 23 (No. 3, Badi.)

Some immature examples of *Dhosaites*, more involute and more 'macro-cephalic' than the last species, are transitional to the biplicate variety of *Mayaites maya* figured in pl. XXXVII, fig. 12 and pl. XLIX, fig 6. They are somewhat poorly preserved and do not show the suture-line, but in their sharp ribbing they bear such close resemblance to *e.g.* the example of *D. primus* figured in pl. XLIX, fig. 3 that their attachment to this species as an involute (and more globose) variety might have been suggested. On the other hand, like the finely-ribbed example of *Dhosaites* figured in pl. XLIX, figs. 5*a*, *b* (and referred to above under *D. elephantoides*), these examples probably indicate the existence, in the Dhosa Oolite, of yet other species of the present genus. It seems advisable at present, not to give distinct specific names, but to await the discovery of more complete adult material.

Horizon.—Argovian, Dhosa Oolite.

Localities.—Fakirwadi (J. H. Smith Colln. No. 71) and Badi (No. 3, J. F. Blake Colln. No. 272).

Genus: Paryphoceras, nov.

Paryphoceras rugosum, sp. nov.

(Pl. XLIV, figs. 2*a*, *b*; pl. XLV, figs. 8*a*, *b*; pl. XLIX, fig. 11).

1924. *Mayaites* cf. *maya* (Sowerby); Spath, pp. 23 and 24.

This species is based on the completely septate specimen figured in pl. XLV, fig. 8, of dimensions:—110—·50—·42—·17. In a paratype, figured in pl. XLIV, fig. 2 the dimensions, at 64 mm. diameter, are:——·50—·45—·20. This apparently just shows the beginning of the body-chamber, but a third specimen again is still septate at a diameter of over 90 mm., so that the form as regards size equalled species of *Mayaites*. The distinctive whorl section has flattened sides, arched venter and high and perpendicular umbilical walls. The ribs begin with a very pronounced backward sweep on the vertical umbilical wall, but do not become distinct until they pass over the sharp rim. They generally trifurcate, slightly below the middle of the side, but the secondaries are as a rule separated from the primaries. The costae are almost radial and there is only very slight projection near the periphery.

The suture-line (pl. XLIX, fig. 11) resembles that of *Mayaites?* cf. *arenosus*, figured in pl. XXXVII, fig. 7, which is equally transitional between *Mayaites* and *Paryphoceras*, as already mentioned, although in other characters. In *M.? arenosus*, however, the ribbing is fainter and blunter whereas in the species of *Paryphoceras* (and *Dhosaites*) the ribs are sharpest and most prominent at the middle of the side, not reduced or absent as in *Mayaites* (?) *arenosus*. The genotype of *Paryphoceras*, namely *P. badiense*, is more flexicostate, with distinct peripheral projection and also has a smaller umbilicus and greater whorl-height and thickness. It shows far more resemblance to *Prograyiceras* than to *Mayaites*.

Mayaites maya (Sowerby) with which I had at first tentatively compared the examples here figured, is distinguished by its macrocephalic shape and less sharp costation.

A corroded Fakirwadi specimen seems to show a tendency on the one hand to thicken the umbilical terminations of the (slightly more distant) primaries and on the other to increase the number of secondary ribs. If correctly identified as being a *Paryphoceras* and not merely a worn *Mayaites* it may be considered to connect the present form with *M.? arenosus* (Waagen).

Horizon.—Argovian, Dhosa Oolite.

Localities.—East of Badi (Upper Zone, J. F. Blake Colln. No. 278); East of Ler (bed No. 10, same collection, No. 283). The example from Col. Pottinger's Collection in the B. M. (No. C. 29789) of which the suture-line

is here figured, is unlocalised. The doubtful example in Mr. J. H. Smith's Collection, above referred to, is from Fakirwadi.

Paryphoceras badiense, sp. nov.

(Pl. XXXV, fig. 9, pl. XL, figs. 7*a*, *b*).

1924. *Dhosaites grayi* Spath (pars), p. 23 (No. 279).

The dimensions of the holotype (pl. XL, fig. 7) and of a paratype (pl. XXXV, fig. 9) compare as follows:—

Holotype (pl. XL, fig. 7)	92	·43	·37	·25
Holotype (pl. XL, fig. 7) . . . . (at)	70	·46	·37	·21
Paratype (pl. XXXV, fig. 9)	70	.46	·37	·21

The whorl-section is compressed elliptical, with an evenly arched venter and low but vertical umbilical wall. The edge of this is rounded and the whorl-sides are flattened. The sharp ribs are biconcave, irregularly bi- or trifurcating and have a distinct sinus forward on the periphery. The primaries begin, first at the umbilical edge, later on the vertical slope, with a very pronounced backward sweep; branching takes place at or below the middle of the side. The suture-line is shown in the (completely septate) paratype and in its unsymmetrical principal lateral lobe and very deep external lobe resembles that of *P. rugosum*. The holotype appears to be septate to at least a quarter of a whorl from the end but the suture-line is not visible except in small disconnected portions.

P. rugosum is less sharply ribbed and shows neither peripheral projection nor lateral curvature of the costae. *Prograyiceras grayi* (Spath) on the other hand, with which I identified the holotype of the present species before I had seen Waagen's original, has similar, if coarser, ribbing, but different inner whorls. There is a corroded Fakirwadi example, which is slightly less closely costate than *P. badiense* and which may be taken to be transitional to *Prograyiceras;* but its inner whorls are too poorly preserved for accurate determination. It is more compressed than *Prograyiceras* and its ribbing also does not show either the very pronounced ventral sinus or the tendency to become coarse with age.

Horizon.—Argovian, Dhosa Oolite.

Localities.—East of Badi (Upper Zone. J. F. Blake Colln. No. 279); Fakirwadi (J. H. Smith Colln.). An example in the Geological Society (*ex* Pottinger-Smee) Collection (Pl. XXXV, fig. 9) is unlocalised.

Paryphoceras stephanoides, nom. nov.

1875. *Stephanoceras fissum* (non Sowerby) Waagen, pars, p. 134, pl. XXXVI, figs. 4*a*, *b* only.

It has already been mentioned (p. 224) that Waagen quite excusably misinterpreted Sowerby's species and united the present (now renamed) Argovian form with the Callovian species above described (p. 216) as *Idiocycloceras*

singulare. As in the case of *Subkossmatia* and the more or less homoeomorphous *Epimayaites* of the *transiens* group the most obvious distinction is the length of the secondary ribs in the later forms, but when the whole development can be studied, *i.e.* in the case of complete examples, there is little difficulty in keeping the two stocks apart. The specific characters can be well observed in Waagen's figure and are mentioned in his description, as far as it applies to the smaller example (pl. XXXVI, fig. 4 only). The statement that the inner whorls were scarcely distinguishable from those of *Mayaites maya* does not now apply since we have restricted this species to Sowerby's original form. In the true *Mayaites*, the innermost whorls are more involute (pl. XXXVII, fig. 6) and more 'macrocephalic,' but in *Epimayaites*, *e. g.* Waagen's young '*maya*' (1875, pl. XXVIII, figs. 2*a*, *b*) or in the more evolute form here figured (pl. XXXVI, fig. 13) there is, indeed, very close resemblance in the young. There are several intermediate forms that can at present only tentatively be placed in *Paryphoceras*, *e.g.* the small '*Stephanoceras opis*' figured by Waagen (pl. XXXVI, fig. 3) or the poorly-preserved '*Mayaites*' aff. *transiens* (Blake Collection No. 407) previously recorded from the 'Upper Zone, East of Badi' (1924, p. 23). The latter differs from the similar evolute forms of *Epimayaites* in its radial costation with apparently a smaller number of secondaries to each primary rib; in Waagen's Joora form, associated with *E. transiens*, which was also mistaken for S. *opis*, the ribbing is even finer than in the present species, there being about four intermediate shorter ribs to only three in *P. stephanoides* at a comparable diameter (25—30 mm.). Waagen's figure is not successful; the umbilicus is even wider than in the form here described and there is similarly scarcely any peripheral projection of the ribs. The resemblance to immature *Epimayaites* is great.

On the other hand by its coarsely-ribbed *Dhosaites*-like outer whorl and development from involute to evolute, the form here described is at once distinguished from *Epimayaites*. As in the two species of *Paryphoceras* previously described the sharp ribs begin on the vertical umbilical wall with a very pronounced backward curve and on the whorl-side the whole of the ribbing tends to incline forward. The ribs, at the middle of the side, however, are raised into a sharp ridge, almost a bulla, as in *Dhosaites*, so that the present species is somewhat transitional to that genus, as *P. badiense* foreshadows the ornamentation of *Prograyiceras*.

Such fragmentary specimens of *Dhosaites primus* as those figured in pl. XXXVI, fig. 10 or pl. XLIV, Fig. 5 show enough resemblance to the species here described to give rise to misidentifications. The coarse *Dhosaites* type of ribbing, however, sets in at a much earlier stage in those examples, although the smaller specimen (pl. XLIV, fig. 5) is associated with another fragment (perhaps of its outer whorl) that suggests reference to *Paryphoceras*. The two stocks are obviously closely allied.

Horizon.—Argovian, Dhosa Oolite.

Locality.—Lodai (Waagen).

Genus : PROGRAYICERAS, nov.

PROGRAYICERAS GRAYI (Spath).

1875. *Stephanoceras nepalensis* (*non* Gray) Waagen, p. 136, pl. XXXV, fig. 2.
1910. *Simbirskites nepaulensis* (Gray) ; Uhlig, pars, pp. 272-3.
1910. *Macrocephalites nepaulensis* (Waagen) ; Lemoine, p. 30.
1924. *Dhosaites grayi* Spath, p. 10.

Uhlig already pointed out that Waagen's Kachh form differed in several points from the true *Grayiceras nepaulense* (Grey, 1832, pl. c, figs. 1-2) or rather *G. blanfordi* Spath (=Uhlig's *Simbirskites nepaulensis*, pl. XLVA, fig. 1) wrongly united with it by Uhlig ; for Gray's type shows the closest resemblance to the Callovian *Subkossmatia*, described above, whilst Blanford's and Uhlig's form is more like certain species of *Epimayaites*. The Kachh form described by Waagen also, as this author pointed out, is close to a species here referred to *Epimayaites*, namely *E. subtumidus* (Waagen), but it develops in a different direction.

The coarsely bifurcate adult stage of the present species in fact, suggested reference to the '*elephantinus* group' (=*Dhosaites*), whilst *Grayiceras blanfordi*, as its inclusion by Uhlig and others in the Hauterivian genus *Simbirskites* proves, develops the type of costation shown in *e.g.* the Speeton example of '*Olcostephanus* (*Simbirskites*)' *discofalcatus* (Lahusen) figured by Pavlow (1892, p. 147, pl. XVIII, fig. 2*a*). It might be mentioned, however, in this connection, as a warning to those who are relying on figures and are not aware of the many pitfalls of ammonite identification, or to those who confine themselves rigidly to forms of only one formation, that the *Simbirskites inversus* (M. Pavlow) and *S. auerbachi* (Eichwald) figured by Karakasch (1907, pl. XIII, figs. 4 and 5) are also very similar to *Idiocycloceras dubium* (pl. XXXIX, fig. 6) and *Subkossmatia coggin-browni* (pl. XLI, fig. 4) described in the present memoir. I mentioned on a previous occasion (1924*b*, p. 82) that Karakasch's *Simbirskites auerbachi* may have been misidentified generically, but if his figs. 1*a*, *b* (pl. XIII) belong to the same species, and with the increased projection of the peripherial ribbing always being more pronounced on the inner whorls, the sequence :—*Subkossmatia* (Callovian)—*Grayiceras* (Upper Kimmeridgian—Tithonian)—*Simbirskites* (Hauterivian) would, indeed, not be so unreasonable as modern work on ammonites has made it appear. It is not possible, however, to perceive in this a way to simplify ammonite nomenclature; the examination of actual specimens reveals that they attach themselves much more naturally to some contemporaneous group of widely different aspect. Homoeomorphy has never yet been found to apply to all the characters and all the growth-stages.

The *subtumidus* like inner whorls of the species here discussed prevent confusion with *Paryphoceras*, *e.g.* the Fakirwadi example referred to under *P. badiense*. In Waagen's side-view, the sudden spacing out of the ribs at the beginning of the outer whorl is due to incorrect restoration by the artist, but otherwise the figure is not unsuccessful and the peripheral view is probably

also correctly restored. The suture-line is not sufficiently well preserved in the holotype for study and I can add nothing to Waagen's description. The resemblance to *Kamptokephalites magnumbilicatus*, noted by that author and by Lemoine is not so close as a casual comparison of figures suggests. G. Boehm's *Macrocephalites bambusae* which Lemoine proposed to include, with the entirely different '*Macrocephalites*' *rabai*, Dacqué, in the synonymy of that species, is characterised by its open umbilicus, comparatively low whorls, and rather coarse costation. I previously considered it to be closely similar to Waagen's '*Steph. nepalense*,' but it is perhaps even more nearly allied to *P. tramaunense* described below.

The small example figured by Waagen in his pl. XXV, fig. 3 is missing. It probably belonged to one of the more discoidal forms of *Epimayaites* here described from Kantcote, but not to the present species or to the equally globose *E. subtumidus*. Numerous such immature specimens occur in the Kantcote Sandstone, but they cannot be accurately determined, even the whorl-thickness being very variable.

Horizon.—Upper Argovian, Kantcote Sandstone.

Locality.—Kantcote (Waagen).

Prograyiceras tramaunense, sp. nov.

(Pl. XXVIII, fig. 7, pl. L, fig. 5).

1924. *Dhosaites* sp. nov. aff. *grayi* Spath, p. 25 (No. 322).

This species is represented by a single example which was figured in peripheral view only (pl. XXVIII, fig. 7) since its lateral aspect did not promise to reveal much owing to the corrosion of its sandy, limonitic matrix. A side-view of a portion of the outer whorl is, however, now added (pl. L, fig. 5) since it shows the characteristic costation, resembling somewhat that of *Idiocycloceras singulare*. There are more distant primaries than in *P. grayi*, and it is to be noted that the coarse secondaries become strengthened, not weakened on the periphery as in *Idiocycloceras*. The present form is also distinguished from *P. grayi* by its more flattened whorl-sides and a correspondingly less inflated shape. The inner whorls unfortunately are destroyed and the suture-line is unknown, but it appears probable that what is here figured of the ammonite represents the body-chamber.

There is a certain resemblance of the peripheral view to that of *e.g.* '*Macrocephalites*' *rabai* Dacqué (1910, p. 11, pl. II, fig. 2). This is due largely to the poor state of preservation of the example on which the present species is based and to the top-left lighting of the photograph. The fold-like ventral lappets of the ribs are more conspicuous even than in *P. grayi* and I do not know of any ammonite with the exception of G. Boehm's '*Macrocephalites*' *bambusae*[1], already referred to, that shows this character. The same author's

[1] Also known in only one example. I previously (1924, p. 10) criticised Boehm's comparison of his form with *Macrocephalites mantavaranus*, but he apparently merely referred to their similarly isolated position.

'*M.*' *cocosi*, with much more delicate costation, is closer to the form here described as *Epimayaites pseudindicus*.

An East African example in the British Museum (N°C. 19664, from 8-10 miles north-west of Mombasa), unfortunately fragmentary, was at first believed to belong to the present species, but is probably transitional from *Kamptokephalites* to *Idiocycloceras*.

Horizon.—Upper Argovian, Kantcote Sandstone.

Locality.—Tramau River, Wagur ('above zone I,' J. F. Blake Colln. No. 322).

Family: *REINECKEIDAE* Hyatt emend.

As originally defined by Hyatt (1900, p. 583) this family included a heterogeneous assemblage of genera, the only common feature being "the presence of a smooth zone along the median plane of the venter", as in all the families of Hyatt's Morphoceratida. Only *Reineckeia* Bayle, itself and the allied genera discussed below are, however, now included in the present family; even *Oecoptychius* Neumayr (for *Naut. refractus* Reinecke)[1] has to be excluded since the peripheral groove is merely a transient feature, as in certain *Erymnoceras*. Mr. Buckman (1920, p. 22) referred *Oecoptychius* to Morphoceratidae; but it is probably merely a homoeomorph of the earlier Stephanoceratid offshoots *Oecoptychoceras* Buckman, of the *truellei* zone (Bajocian) and *Sphaeroptychius* Lissajous, of the Bathonian, and *via Ammonites refractus macrocephali* (Quenstedt, 1887, p. 766, pl. LXXXVI, figs. 51-2) *Oecoptychius* is probably connected with Macrocephalitidae. Similar modified offshoots recur in later beds. The earlier *Parkinsonia* and *Strenoceras* are now included in a separate family Parkinsonidae, whilst Aulacostephanidae represent a specialised offshoot of the family Rasennidae, and *Waagenia*, abundantly represented in Kachh, will be discussed later under Simoceratidae.

Reineckeidae might be taken to be directly connected with the true Stephanoceratids, judging by the general appearance of those constricted forms (*Amm. anceps carinatus* Quenstedt) that according to Krimmel (1886, p. 41) occur already in the *Zigzagiceras* beds, together with *Stemmatoceras*, and the persisting *Polyplectites*. This Stephanoceratid origin of Reineckeids is widely held, but it may be recalled that R. Douvillé (1912, p. 35) again connected Reineckeidae with Perisphinctids, whilst Mr. Buckman (1892, p. 451) considered the *anceps* group to be derived from *Zigzagiceras euryodus*. Loczy (1915, p. 356) after Rollier and Waagen, has lately again connected *Reineckeia* with *Parkinsonia* and *Kosmoceras*, but like Douvillé's (1915) derivation of Kosmoceratids from *Garantiana* and *Strenoceras* (unjustifiably separated from Parkinsonids) this connection may be held to be based only on superficial resemblance.

It has already been mentioned that the Bathonian '*Perisphinctes*' *decorus* Waagen, connects Reineckeidae with Parkinsonids and Morphoceratids; and on account of this transitional character it required generic separation, although it is so far known in only one example. Waagen's species, for which the new genus *Epimorphoceras* is now created, shows close resemblance to *Parkinsonia*

[1] Now found at Nurrha and figured in pl. LXXXI, figs. 5a, b (Raj Nath Coll.). It is described below (P. 277) simply because Part III, was already in page proof.

densicosta Quenstedt sp. (1886, pl. LXXII, fig. 1) or probably still more to that new recticostate form recorded by Roman (1897, p. 47) from the Lower Bathonian. Considering that Parkinsonidae include various grooved offshoots of Perishinctids, some with constrictions, *Epimorphoceras* might have been referred to Parkinsonidae, especially since its suture-line is highly frilled, and has dependant auxiliaries as in many Perisphinctids. Again the ribs of the inner whorls of *Epimorphoceras*, like those of *Reineckeia*, bear small spines, but even this would not separate the genus at once from Parkinsonids, for lateral tubercles are found in **Pseudostrenoceras**, gen. nov. (for *P. hystricoides* Rollier, 1911, p. 290 = *Amm. contrarius* d'Orbigny, 1846, pl. CXLV, figs. 3-4 only = Upper Bathonian, *fide* Lissajous, 1923, p. 53) as well as in **Hemigarantia**, gen. nov. (for the group of *Amm. julii* d'Orbigny, ib., figs. 6-7).

The Upper Bathonian forms of Parkinsonids unfortunately are as yet little known. Late species of *Parkinsonia* have been recorded from the East of France (Wohlgemuth, 1883, Haug, 1907, p. 998, Grossouvre, 1919, p. 383); and the doubtful *P. calloviensis* Loczy (1915, p. 379, pl. IV, fig. 11, pl. VI, fig. 11, text-fig. 88) may be of Upper Bathonian (Oxyceritan) age like a few other earlier forms mixed up with his Callovian Villány fauna. Recent writers, however, like Wetzel (1911) and Nicolesco (1918) who dealt with the Parkinsonids did not discuss the later developments, nor did Mr. Buckman (1920, p. 29) who provisionally included in the family Parkinsonidae even the entirely unrelated genus *Choffatia*, based on the Kachh '*Perisphinctes*' *cobra* Waagen.

Epimorphoceras, however, is morphologically closer to certain Morphoceratids than to the last Parkinsonids just discussed. Waagen very appropriately compared it with *Amm. polymorphus* d'Orbigny and *Amm. sulcatus* Hehl; and he considered it transitional from the group of *Amm. sulcatus* (now *Ebrayiceras*) to the group of *Perisphinctes rehmanni* (now *Reineckeia*). It is important to note in this connexion that Thalmann (1925, p. 23) could find only one certain difference between *Morphoceras* (*Ebrayiceras*) *pseudo-anceps* and *Reineckeia anceps*, namely the position of the point of furcation of the ribs.

But Morphoceratidae have been defined by Mr. S. Buckman (1920, p. 22) as in origin presumably akin to the Sphaeroceratidae, with comparatively simple suture-line. This would exclude at once *Epimorphoceras* with its complex lobes. Moreover, Morphoceratids are commonly found only in the Upper Bajocian (Parkinsonian) and especially in the Lower Bathonian (Zigzagiceratan age). Thus *Ebrayiceras* S. Buckman 1920 (group of *Amm. pseudo-anceps* Ebray sp.) with distinct ventral groove, and general resemblance to Waagen's species, but according to Thalmann (1925, p. 21) very variable, occurs in the Lower Bathonian, together with the true *Morphoceras* (including '*Patemorphoceras*' and '*Dimorphinites*' S. Buckman). It is possible that Morphoceratids persisted into the Middle and Upper Bathonian, and in the description of Quenstedt's *M. inflatum* (*Ammonites parkinsoni inflatus*, 1849, pl. XI, fig. 6, 1886, p. 621) already identified by Oppel (1856, p. 382) with *M. polymorphum*, attention is drawn to the resemblance to *Reineckeia*; but according to Krimmel (1886, p. 34) *M. inflatum* occurs below *Zigzagiceras euryodus* (Schmidt).

Again Hehl's *Amm. sulcatus* (in Zieten, 1830, pl. V, figs. 3*a-c*), considered by Grossouvre (1919, p. 390) to belong to the gens of *Ebrayiceras pseudo-anceps*, of *Zigzagiceratan* age, has been included in *Reineckeia* (by Zittel, 1884, p. 471, after Steinmann) whilst Gemmellaro (1877, p. 145, pl. XIX, fig. 1) referred to the genus *Perisphinctes* a somewhat similar, deeply sulcate Sicilian form (*P. problematicus*) which may be of Middle Bathonian age. Whether all these belong to the same stock as the earlier, Bajocian forms, may be doubted, but the family is as yet insufficiently studied and the presence of a peripheral groove, by itself, is an unsatisfactory and often transient character. There is before me an apparently new Perisphinctid from the Bathonian of Ranville, Calvados (B. M. No. 37329, not inaptly labelled *Amm. planula* Hehl) which might be taken for a Morphoceratid. Its deep peripheral groove extends over the earlier half of the outer whorl (all body-chamber) but is found on dissection to appear only near the end of the septate portion. Yet this form can scarcely be distinguished from '*Perisphinctes*' *arcicosta* Waagen, and can have no connection with the Morphoceratids.

It is probable that Mr. Buckman confused certain Morphoceratids ('*Polysphinctites*' *replictus* S. Buckman, 1922, pl. CCCLIX) with an auriculate, ribbed stock that resembles certain Lytoceratids (*Polystomiceras*) but is derived from such Perisphinctoids as *Leptosphinctes*. This restricted *Polysphinctites* will be referred to below in connection with *Procerites* and the early Perisphinctoids, probably also a polyphyletic assemblage. The group of *Morphoceras transylvanicum* (Simionescu, 1905, p. 28, pl. ii, fig. 3 [=*Asphinctites* S. Buckman *pars ?*] and Grossouvre, 1919, p. 390, pl. XV, figs. 1, 2*a*, *b*) apparently also belongs to Morphoceratidæ, but similar forms with *Morphoceras*-ribbing on the outer whorl may also have been produced by the concentrically coiled Leptosphinctoids (*e.g.* *Amm. tenuiplicatus* Brauns, in Schlœnbach, 1865, pl. XXIX, fig. 5 only). These modified Parkinsonids and Perisphinctids that are conveniently included in the family Morphoceratidæ are thus not closer to *Epimorphoceras*, with tuberculate inner whorls, than were the Parkinsonids, and on the whole it seems advisable to consider it an early Reineckeid, especially as we know a similar, but later, Perisphinctoid offshoot (*Reineckeia* cfr. *decora* Petitclerc [non Waagen] 1917, p. 27, pl. III, fig. 4) which again produced *Reineckeia*-like forms.

Another peculiar genus has to be considered in this connexion, namely *Neuqueniceras* Stehn, based on *N. steinmanni*, Stehn (1924, p. 135, pl. IV, figs. 3*a*, *b*). This was attached to *Perisphinctes* in the wider sense and its suture-line was unknown to Stehn; but there is a large example in the B. M. (No. C. 15108) from 'San Pedro,' Chili, which at a diameter of 108mm. is still septate, and well shows the typical *Reineckeia* lobes, figured in pl. XLVI, fig. 2. As *Neuqueniceras* occurs together with Macrocephalitids it is an early group, but typical *Reineckeia* of the type of *R. antipodum* Gottsche sp. (1878, p. 17, pl. III, fig. 17) occur in the same beds if not already lower (see Stehn, 1924, p. 146). It seems fair to assume that the two genera have a common Perisphinctoid ancestor; for several of Stehn's '*Perisphinctes*' as well as of his

Reineckeia and forms described by other authors (*e.g.*, *Neuqueniceras bodenbenderi* Tornquist sp.) are intermediate, and whilst tuberculation appeared only on the outer whorls of *Neuqueniceras*, it may have arisen first on the inner in some *Reineckeia*, without having been preceded by a costate stage. If we assume derivation from a Stephanoceratid ancestor for the one and from a Perisphinctid for the other, the essential uniformity of the South American assemblage is perhaps more difficult to explain, although they are all *Stephanoceras* derivatives. But similar homœomorphs are still developed in the Uppermost Jurassic (*Himalayites*, ex *Aulacosphinctes*) and these also are so closely allied that we cannot go back to *Reineckeia* for the ancestry of one and to quite a different source for another type closely connected with the first by numerous transitions.

Again, it may be remembered that the Perisphinctoid stock to which belong *Siemiradzkia* and *Grossouvria* produced *Neuqueniceras*-like offshoots once more at a late date, *i.e.* *Subgrossouvria* Spath, and **Pseudopeltoceras,** gen. nov. (for *Amm. chauvinianus* d'Orbigny, 1846, pl. CLXV). According to unfigured Scarborough and Montreuil-Bellay (Maine et Loire) species in the B. M. (Nos. 39312=*Amm. famulus*, Bean MS and C. 14733) this develops inflated *Neuqueniceras*-like body-chambers, with constricted apertures, entirely different from the true *Peltoceras* of the *athleta* group, although it may conveniently be grouped in Peltoceratidæ.

The genus *Reineckeia*, Bayle, is abundantly represented in Kachh, although mostly by fragments.

Bayle (1878, pl. LVI, figs. 1-3) figured three species of *Reineckeia* which are genosyntypes. The lectotype is his *Reineckeia anceps* of fig. 1, which differs in size from Reinecke's type (1818, p. 82, pl. VII, fig. 61), but has been included with it by Petitclerc (1915, p. 90) and Loczy (1915, p. 358) and doubtfully by Parona and Bonarelli (1897, p. 160). The small Franconian form, a typical Uetzing example of which is here figured (pl. XLIV, figs. 6*a-c*) is characterised by its cadicone whorl-shape; in the larger specimens figured by Bayle and d'Orbigny (1846, pl. CLXVII), renamed *R. substeinmanni* Lemoine (1910, p. 9), the resemblance may be slight in the drawings, however beautiful, but a typical Sarthe example of Bayle's form (B. M. No. C. 26248) has cadicone inner whorls that could not be distinguished from the true *R. anceps*. Moreover, one of many Uetzing examples in the British Museum is still septate at 40mm. diameter so that even size is not a distinguishing feature.

Like other highly ornamented ammonites, the forms of *Reineckeia* show an astonishing variability and no two examples are probably identical in all details. Thus we have in this genus a large number of (unnecessary) species often based on single specimens whilst in the contemporary unornamented Phylloceratids there are only few species but many individuals of each.

To the typical *anceps* group of *Reineckeia*, belongs the Kachh *R. arthritica* (Sowerby) and seven allied species [1] whilst for some less tuberculate forms,

[1] A number of new Mexican species have lately been described by Burckhardt (1927), but his important memoir arrived after this part was in page proof.

included by authors in the 'Formenreihe' of *R. greppini*, the generic name *Reineckeites* S. Buckman (1924, p. 33) is used. This genus was created for *R. duplex* S. Buckman (ib., pl. DXXII) which is perhaps specifically identical with *R. stuebeli* (Steinmann), and close to *R. waageni* (Till), typical forms, of the so-called '*greppini*-group' of authors. *Reineckeites*[1] was defined as "differing from *Reineckeia* in the early loss of tubercles and in the almost regular dichotomy of the ribs."

A third stock within the Reineckeids in the wider sense is represented by *Kellawaysites* Buckman (1925, pl. DLXXXVII) which includes the form described below as K. *oxyptychoides*, sp. nov., (pl. XLI, figs. 5*a*, *b*), also the true '*Reineckeia*' *greppini* (Oppel)=*Perisphinctes oxyptychus* Neumayr (1870, p. 151, pl. VIII, fig. 2) Tuberculation is reduced at all stages and the long and close primary ribs give it an altogether perisphinctoid aspect. It is connected, however, by transitions with *Reineckeia* as well as with various forms of finely ribbed *Reineckeites* of the *douvillei* type.

The genus *Collotia* was created by Grossouvre (1917, p. 70) for *C. fraasi* (Oppel) and *C. angustilobata* (Brasil), *i.e.*, the bispinous Reineckeids. In the lower *athleta* beds (=*fraasi* zone) of Weymouth fragments of gigantic *Collotia* have been found (Spath, 1926, p. 324) that show the closest resemblance to certain of the Kachh forms described below. Their reference to *Peltoceras* by various authors is significant in view of the similarly Peltoceratid offshoots of Perisphinctoids discussed above in connection with *Neuqueniceras*, Stehn.

Parapatoceras is referred by Mr. Buckman (1926, p. 21) to a separate family Parapatoceratidae, and he separates from it '*Crioconites*' (for '*Cr.*' *crioconus*, 1925, pl. DXXXVIII, A. B) with "curved whorls just out of contact" a feature scarcely important enough for specific separation, since there are numerous shapes in this variable stock. No two examples have the suture-lines identical and those here figured of Chippenham specimens of the so-called '*Crioconites*' *crioconus* are much more like the suture-line of Mr. Buckman's lectotype of *P. calloviense* (pl. DXXXVII, fig. 1*a*) than of his '*Crioconites*,' so that on the basis of this feature also no separation is possible. Since, moreover, the earlier whorls of *P. calloviense* are indistinguishable from those of *P. crioconus*, or the very similar *P. distans* (Baugier and Sauzé sp., d'Orbigny, 1850, p. 589, pl. CCXXX, figs. 5-8), and since the distinctive features of these 'species' are confined to the more or less straightened outer whorl, there seems no need for further subdivision. *Parapatoceras* also occurs wherever Reineckeidæ are found, from India to the Andes and including the Kellaways Rock of Wiltshire, whilst it is absent where the Kosmoceratids alone occur. There is therefore undoubtedly more reason to suppose that *Parapatoceras*, clearly a development independent of the earlier *Spiroceras*, may be derived from Reineckeidæ than that their origin is to be sought in '*Torricellites*,' i. e., *Kepplerites* and similar local Kosmoceratids (S. Buckman, 1926, p. 21). Hyatt (1900, p. 584) already stated that Spiroceratidæ have sutures

[1] The genus '*Reineckeceras*,' used in Revue de Géologie (vol. V, No. 71, 1924), p. 503, is a misprint for '*Remeleceras*' Hyatt (='*Remaleceras*' of authors).

of Reineckeian type, reduced to the phylogerontic formula of six lobes; and, as in the case of Hoplitidæ, grouped by Hyatt in the same superfamily (Morphoceratida), the "parallelism with Kosmoceratidæ" is undoubtedly "very close," simply because Reineckeids and Kosmoceratid genera like *Sigaloceras* (or *Kepplerites*) are not far removed from their common ancestor. The connection of *Spiroceras* with *Kosmoceras* suggested in recent editions of Zittel's Grundzüge (*e.g.* fifth German edition, 1921, p. 573) is obviously traceable to the earlier Handbuch (1884, p. 482), where *Kosmoceras* still included the Parkinsonidæ.

The (eighty) Reineckeids to be described from Kachh are the following:—

Genus *Epimorphoceras* gen. nov.
- *E. decorum* (Waagen).

Genus *Reineckeia*, Bayle.
- *R. arthritica* (J. de C. Sowerby).
- *R.* sp. nov.? aff. *brancoi* Steinmann.
- *R. tryanniformis* sp. nov.
- *R. indosabauda* Parona and Bonarelli.
- *R.* sp. ind.
- *R. smithi* sp. nov.
- *R. ravana* sp. nov.
- *R. reissi* Steinmann.

Genus *Kellawaysites*, Buckman.
- *K. oxyptychoides*, sp. nov.
- *K. greppini* (Oppel).

Genus *Reineckeites*, Buckman.
- *R. waageni* (Till).
- *R. waageni* (Till) var. *regalis*, nov.
- *R.* sp. nov. ind.

Genus *Collotia*, de Grossouvre.
- *C.* aff. *angustilobata* (Brasil).
- *C. draupadi*, sp. nov.
- *C. kachhensis*, sp. nov.
- *C.* sp. ind. nov?.
- *C.* sp. juv. aff. *fraasi* (Oppel).
- *C.?* (Reineckeia) *octagona*, sp. nov.

Incertæ Sedis.

Genus *Parapatoceras*, Spath.
- *P.* cf. *calloviense* (Morris).

Genus: EPIMORPHOCERAS, nov.

EPIMORPHOCERAS DECORUM (Waagen).

1875. *Perisphinctes decorus* Waagen, 1875, p. 208, pl. LVII, figs. 3*a-d*.

1881. *Perisphinctes decorus* Waagen, ; Steinmann, pp. 283-291.

1905. *Perispninctes decorus* Waagen, ; **Lec**, p. 36.

1910. *Reineckeia decora* (Waagen) Lemoine, p. 10.

Waagen's description of this species needs no amplification, but his drawing of the sectional view (fig. 3) is incorrect in showing compressed inner whorls. Waagen pointed out in his text that the whorls did not become compressed until after a diameter of 25mm.; the innermost whorls shown are, in fact depressed, with the greatest thickness at the slight lateral tubercle. No further example of this species appears to have been found in Kachh or recorded in geological literature, the French specimen described by Petitclerc (1917, p. 27, pl. III, fig. 4) being apparently a *Collotia*. According to its author it was considered by A. de Grossouvre to resemble the young of *C. angustilobata* (Brasil). The unfigured '*Reineckeid*' cfr. *decora* recorded by Riche (1893, p. 312) may belong to the same form, and in any case is associated with a 'Middle Callovian' fauna that is of much later date than Waagen's form.

Horizon.—Lowest Callovian (Patcham Beds), lower *macrocephalus* (*triangularis*) zone.

Locality.—North-west of Jumara (Waagen).

Genus: REINECKEIA, Bayle.

REINECKEIA ARTHRITICA (J. de C. Sowerby).

(Pl. XXXIII, figs. 2*a*, *b*).

1840. *Ammonites arthriticus* J. de C. Sowerby, pl. XXIII, fig. 10.
1875. *Perisphinctes arthriticus* (Sowerby); Waagen, p. 210, pl. LIX, figs. 2*a-c*.
1878. *Simoceras arthriticum* (Sowerby); Gottsche, p. 17.
1881. *Reineckeia arthritica* (Sowerby); *Steinmann*, *p*. 287.
1910. *Reineckeia arthritica* (Sowerby); Lemoine, p. 8.
1911. *Reineckeia arthritica* (Sowerby); Waagen; Till, pp. 2-5.
1915. *Reineckeia arthritica* (Sowerby); Loczy, p. 110 (364), p. 112 (366).
1924. *Reineckeia arthritica* (Sowerby); Spath, p. 11.
1927. *Reineckeia arthritica* (Sowerby); Burckhardt, p. 37.

The holotype is poorly preserved, but here refigured since Waagen's example, in side-view, does not accurately represent the corresponding early stage. It is however, not so badly drawn as I previously suggested. The two figures, in any case, with Waagen's description will enable geologists to recognise Sowerby's species. It does not seem to have been refound outside Kachh, but Loczy thought it not impossible that his *R. crassicostata* represented a corresponding ally in a different zoogeographical province. Like the same author's *R. lata*, however, the Hungarian species has different ribbing on the outer whorl.

D'Orbigny's *Amm. arthriticus* [*artriticus*] (1850, p. 564, pl. CCXXIV) renamed by Steinmann *Reineckeia gigondasensis*, with the tubercles nearer the periphery, was separated already by Waagen from the present species. The French form figured by Petitclerc (1915, p. 92, pl. IX. fig. 4) as *R. antipodum* (Gottsche) may be closer, and considering the variability of all the species of *Reineckeia* it is, perhaps, not of significance that the relative position of the tubercles is different at successive stages in the two forms. The original

South American species, however, differs from *R. arthritica* in its more depressed whorl-section and coronate whorl-shape. According to Stehn (1924, p. 109) the proportions of *R. antipodum* are 84—·26—·36—·54, whilst those of the present species are :—105—·37—·43—·39 (corrected).

R. euactis Steinmann (1881, p. 286, pl. XIII, fig. 5) seems to be another closely allied form, but has less coarsely tuberculate inner whorls and a smaller umbilicus. It shows, however, a similar exaggeration of the lateral tubercle and in comparing the two forms it must be remembered that Waagen's peripheral view shows an elliptical aperture only because the end of his (entirely septate) specimen is fractured and worn. There is a body chamber in Mr. J. H. Smith's collection, representing a shell of about 130-140mm. diameter, which has only three very large rounded tubercles to the half whorl, with a whorl-height of about 50mm. and a thickness of some 60mm.

Horizon.—Callovian (lower *anceps* beds).

Localities.—Waagen recorded three examples from Khera Hill and Sowerby's type is from the same locality (near Chari), also an example transitional to *R. indosabauda* in Mr. J. H. Smith's Collection (No. 4, from his bed No. 7). The East Jooria example (Blake Colln. No. 413) previously recorded as R. cf. *arthritica* (1925, p. 25) is rather poorly preserved, but probably identical with the typical specimens; the body-chamber fragment (J. H. Smith Colln. No. 5 above referred to is unlocalised. A typical fragment in the same collection (No. 720), from the Ler-Hamundra Ellipse, is labelled "sub-*anceps* beds 3 ! with *rehmanni*". More doubtful examples come from the '*anceps*' and '*sub-anceps* beds' of Samatra, Habye and Fakirwadi (J. H. S. Colln. Nos. 3, 16 and 20526) and the two *R.* cf. *nodosa*, Till, previously (1924, p. 22, Nos. 337-8) recorded from bed No. 8 of Jumara, may also belong to the present species.

REINECKEIA sp. nov.? aff. BRANCOI Steinmann.

(Pl. XXXIV, figs. 8*a*, *b*).

cf. 1881. *Reineckeia brancoi* Steinmann, p. 284, text-fig. 4, p. 285.
1913. *Perisphinctes anceps* (Waagen) ; Smith (*a*), p. 211.

The poorly preserved and fragmentary example here figured shows resemblance to Steinmann's species which was described as the most evolute form of the *anceps* group.[1] It is not specifically identical, however, since the inner whorls seem to be considerably more coarsely tuberculate in the Indian fragment, already at a small diameter (25mm.). This indicates affinity rather with *R. arthritica*, of which the example here described may be only an evolute variety, its dimensions being 110—·28—·34—·50, with the whorl-thickness not including the lateral tubercles. *R. franconica* Quenstedt sp. (=*Amm. anceps franconicus*, 1885, p. 633, pl. LXXIV, fig. 39) with a similarly evolute outer whorl, differs in its finely ornamented earlier volutions.

The *Reineckeia* cf. *anceps* figured by Till (1910, pl. XIX, fig. 1 ; 1911, p. 3) and considered to be intermediate between his typical *R. anceps* (non

[1] Several new Mexican species lately described by Burckhardt (1927) are perhaps even closer.

Reinecke=*R. substeinmanni*, Lemoine) and *R. brancoi* is similar to the form here described, but difficult to compare on account of difference in size. Isolated whorl-fragments of the present form could perhaps not be satisfactorily distinguished even from portions of outer whorls of such evolute '*Reineckeia*' as *R. bodenbenderi*, Tornquist (1898, p. 51, pl. X, fig. 1) and *R. caracolensis*, Stehn (1924, p. 104, pl. IV, fig. 2), but their inner whorls show these forms to be *Neuqueniceras*.

Horizon.—Callovian, *anceps* beds.

Locality.—The example here figured, and another fragment (J. H. Smith Colln. Nos. 12 and 19) are from Khera (bed 7).

REINECKEIA TYRANNIFORMIS, sp. nov.

(Pl. XXXIV, fig. 5; pl. XLVI, fig. 1; pl. XLVII, fig. 7).

1913. [*Perisphinctes*] *rehmanni* (*?*) (Oppel); Smith, p. 211.

Mr. Smith, when recording the discovery of the gigantic example here figured (reduced to a little less than four-fifths linear), pointed out that it was septate to the end so that with its body-chamber intact it must have measured considerably over 400mm. Its dimensions are:—350—·28—·28—·50, the thickness including only the base of the rounded lateral tubercles. The whorl-section is depressed at first, as in *R.* '*substeinmanni*' Lemoine (=d'Orbigny's [1848] pl. CLXVII and Bayle's [1878] pl. LVI, fig. 1) or the slightly more depressed *R. anceps* (Reinecke) and *R. rehmanni* (Oppel). The small fragment figured in pl. XXXIV, fig. 5, in fact, cannot be satisfactorily distinguished from a typical French *R. anceps* before me (B. M. No. C. 26248) which although it is still septate at 85mm. diameter does not seem to differ from numerous smaller Uetzing types in the same collection (*e.g.*, No. C-29642). Later the whorl-section of the present species becomes more quadrate and at the end is slightly compressed, elliptical, with the lateral tubercles, now set close to the rounded umbilical edge, giving it a somewhat unusual aspect. The periphery is broadly arched, as in d' Orbigny's figure, and the ribs, on the last portion of the outer whorl, are almost effaced ventrally. This makes it appear as though the costae thickened again at the ventrolateral margins, but there is no sign of an outer tubercle as in *Collotia*. The suture-line has a much more broadly stemmed external saddle than that of *R. rehmanni* (Oppel, 1862, p. 153, pl. XLVIII, figs. 1*a*, *b*), but resembles that of other species of *Reineckeia*. In the later forms, however, *e.g.*, *R. kiliani* Parona and Bonarelli (1897, pl. VI, fig. 3*b*) or '*R.*'. *revili* (ib., pl. VII, fig. 1*b*), the external lobe seems to be appreciably deeper. (Compare also R. Douvillé, 1912, text-figs. 33-36, p. 36).

R. tyrannus Neumayr sp. (1870, p. 150, pl. IX, fig. 1), also based on a gigantic example, is probably close to the form here described, but has a wider umbilicus (57%) and a smaller whorl-height (24%). The principal difference seems to be in the lateral tubercle which in Neumayr's form (with half a whorl of body-chamber) does not move closer to the umbilical edge and becomes elongated and curved. The equally large Villány form figured by Till (1910, pl. XIX, fig. 3, 1911, p. 3) and doubtfully attached to his *R.* cf. *anceps*

(=*R. substeinmanni* Lemoine) is far less closely comparable and may not even belong to the same group.

R. nodosa Till (1910, pl. XIX, figs. 4-6; 1911, p. 4) is more coarsely ribbed than the small example here figured, but is difficult to compare with the large holotype on account of difference in size. *R. indosabauda* has a far less strongly tuberculate early stage and more numerous secondaries than the species here described; its ribs also show a distinct bend at the latero-peripheral edge and the external saddle of its suture-line is more slender.

Horizon.—Callovian, lower *anceps* beds, *rehmanni* zone.

Locality.—Khera Hill, bed No. 6 (J. H. Smith Coll.) The smaller example (pl. XXXIV, fig. 5) is unlocalised.

REINECKEIA INDOSABAUDA, Parona and Bonarelli.

1875. *Perisphinctes rehmanni* (non Oppel) Waagen, p. 206, pl. LVIII, figs. 1, 1*a*, 1*b*.
1897. *Reineckeia indosabauda* Parona and Bonarelli, p. 160.
1905. *Ammonites indosabauda* (Parona and Bonarelli); Collot, p. 26.
1910. *Reineckeia indosabauda* Parona and Bonarelli; Lemoine, p. 9.

The two Chanaz examples quoted by Parona and Bonarelli have the following dimensions:—

(I) 132—·30—·30—·45.

(II) 195—·28—·30—·50.
250—·26—·30—·52.

In the Kachh fragment, the thickness, calculated to a diameter of approximately 185mm., works out at about 38%, so that the whorls seem to be more depressed than in the Savoy specimens identified by Parona and Bonarelli with the Indian holotype. They also describe the whorl-section as nearly circular, whereas in the Kachh example the sides and periphery are slightly flattened and the ventro-lateral edges are distinctly bevelled, giving the whorl-section a suboctagonal outline.

There are only three doubtful, small, additional fragments that may belong to the present species, but they are not sufficiently well preserved to be figured. It is probable, however, that the inner whorls are essentially like those of *R. arthritica* and *R.* sp. nov.? aff. *brancoi* above described, only more delicately ornamented and with about 8 to 10 secondary ribs to each tubercle already at a diameter of 80-90mm. There are thus considerable differences from the form figured by Loczy (1915, p. 362, text-fig. 81) as *R. rehmanni*, which was identified not only with *R. substeinmanni*, but also with the present species. It is not certain, however, that the small fragments belong to the same form as the holotype. In any case it is important to note that there is an indication of a sudden change in the ornamentation of the latter at a diameter of about 80mm. Before the constriction at which this abrupt change takes place, the ornamentation seems to be that of an ordinary *Reineckeia* of the more or less depressed '*anceps*' type.

It may be doubted whether the present form is specifically distinct from *R. rehmanni;* and if Parona and Bonarelli's name is here adopted, it is done only in view of the different interpretations given to Oppel's species. I cannot agree with Loczy (1915, pp. 360-363) that this was based on d'Orbigny's pl. CLXVII, for Oppel (1857, p. 556) distinctly separated d'Orbigny's forms (pls. CLXVI and CLXVII) from his *Amm. rehmanni* (p. 551) and the type-figure (Oppel, 1862, p. 153, pl. XLVIII, figs. 1*a-c*) indicates the characteristic change in ornamentation, even if Oppel went too far in saying that the inner whorls were untuberculate. Moreover, Loczy's account is somewhat contradictory and the inner, coronate whorls he describes (p. 363), with less coarse but much more closely set ribs, seem to me to be assignable to the true *R. anceps*, as represented by Uetzing topotypes, more clearly than the example figured in his pl. VIII, fig. 1. Till was much nearer the mark when he stated (1911, p. 2) that Waagen's form was in any case very close to Oppel's *Amm. rehmanni.*

Lemoine's inclusion of the present form in the synonymy of his Madagascan *R. anceps*, var. *greppini*, which apparently misled Petitclerc (1915, p. 91), seems to be due to an error.

Horizon.—Callovian, lower *anceps* beds (*rehmanni* zone). Oppel, in his last Ardèche paper (1865, p. 319) again confirmed *Amm. rehmanni* to be of pre-*anceps* date.

Locality.—Waagen's type came from Khera Hill; the matrix is that of the beds above the Golden Oolite. The doubtful smaller examples above referred to (J. H. Smith Colln. Nos. 18, 721, 722) were found at Habye and the Ler-Hamundra Ellipse (sub-*anceps* beds 2, but not embedded).

Reineckeia sp. ind.

A body-chamber fragment is distinguished from all the forms here described by its depressed whorl-section, but it is too incomplete to be figured or identified specifically. It is much more finely ribbed than R. *arthritica* and there must be as many as ten strongly prorsiradiate ribs to each lateral tubercle, whilst the umbilical slope is only finely striate. The unusually wide ventral area has a distinct smooth median zone, more conspicuous than in the far more distantly costate *R. euactis*, Steinmann (1881, pl. XIII, fig. 5), *R. antipoda* Gottsche sp. (1878, pl. III, fig. 6), or the same author's *R.* cf. *rehmanni* (ib. pl. VIII, fig. 4). Tornquist's *R. paucicostata* (1898, pl. IX, fig. 11) also has a far too distant costation, but it is possible that larger whorls of Stehn's *Reineckeia multicostata* (non Petitclerc) would show comparable ornamentation. Stehn's original (1924, p. 113, pl. III, fig. 2) is small and shows a compressed whorl-section, but an example of 68mm. diameter (B. M. No. C. 22442 from Caracoles, Chili) seems to show how the tubercles move to the middle of the side with corresponding widening of the ventral area. It is not suggested that the present fragment belongs to Stehn's species and

it may only be an extreme form of the *indosabauda—rehmanni* group, above described, with the ribbing unusually close in the vicinity of the mouth-border.

Horizon.—Callovian, *anceps* beds.

Locality.—Khera Hill, bed No. 7 (J. H. Smith Colln. No. 13 A).

Reineckeia smithi sp. nov.

(Pl. XXVII, figs. 1*a*, *b*).

1913. *Perisphinctes anceps* Waagen; Smith (*a*), p. 211.

The holotype of this species, complete to the mouth-border, has dimensions:—150—·34—·29—·42. These are not unlike those of various other forms of *Reineckeia;* and considering the large number of types already in existence, it may seem unnecessary to create a new species for the Indian examples here described. I had, at first, considered the present form to represent, perhaps, the Indian equivalent of d'Orbigny's *Amm.* '*anceps*' (=*R. substeinmanni,* Lemoine) as interpreted by *e.g.*, Petitclerc (1915, p. 90); but comparison with actual specimens shows that the two species cannot be united. The dimensions of a magnificent French example (B. M. No. C. 13925), with over half a whorl of body-chamber, are:—166—·32—·35—·47, as against 181—·30—·36—·48 in d'Orbigny's idealised drawing. The form here figured is not only more compressed and more involute, but it differs chiefly in the degeneration of its tubercles and ribs on the body-chamber.

On the inner whorls, the ornamentation is that of *R. arthritica,* as represented in pl. XXXIII, fig. 2, but more delicate; and the tuberculation increases, if somewhat irregularly, to a diameter of about 80mm. Then, there is an untuberculate primary, rib, forming a sharp ridge, followed by a single costa and constriction, and after three more prominent rounded tubercles (with five to six secondaries each) the ribbing becomes altogether irregular and the tubercles on the primary ribs, if present at all, become small or elongated. The whorl-section shows a corresponding change from that of *R. substeinmanni* to the compressed type of *Reineckeites.* The peripheral furrow is well-marked at the beginning of the outer whorl but tends to become effaced near the aperture; the suture-line is seen only in small portions on the inner whorls.

R. robusta, Till (1910, pl. IV, figs. 8-9, 1911, p. 6) has similar dimensions at a smaller diameter, but different ornamentation and is not so comparable as might be assumed from its description as transitional between the *anceps* and *greppini* groups. Till considered it to be close to *R. kiliani* Parona and Bonarelli, identified with *Amm. micromphalus* Quenstedt (1886, pl. LXXX, fig. 4) which is said to be badly drawn but which looks like a *Neuqueniceras.* Yet Till (p. 2) calls Steinmann's *R. lifolensis* another 'passage form,' though this belongs to a different group and like the present species, has a more 'coronate' early stage. Reuter (1908, p. 120) was probably right in including *R. lifolensis* in the true *R. anceps;* and Petitclerc's (1915, p. 97) small examples, like Bukowski's (1887, p. 132) Polish specimens, may well

belong to the same species, but not the French examples figured by Petitclerc (1918, pl. XVIII, figs. 3-4) and Couffon (1919, pl. XV, figs. 12, 12*a*). All these are certainly no more identical with the Indian form here described than is *R. robusta.*

Horizon.—Callovian, *anceps* beds.

Localities.—The holotype (G. S. I. No. K-22-202) and another fragmentary example (No. 6) are from bed 7 at Khera Hill; one (No. 10) is unlocalised and a fourth doubtful (transitional) fragment (No. 7) is from Samatra (all J. H. Smith Coll.)

Reineckeia ravana, sp. nov.

(Pl. XXIX, figs. 3*a*, *b*).

The holotype here figured shows the following dimensions 90—·40—·39—·31. The primary ribs are somewhat irregular and consist of a sharp ridge with a terminal point, rather below the middle of the side, but it can be observed in at least two places that three successive ribs pass from fine to medium to coarse, to start the cycle again with an almost untuberculate primary. The sectors, however, are not separated by constrictions, and the secondary ribs (three or four to each primary) are fairly uniform and distinctly interrupted on the periphery. The sides are slightly flattened and the whorl-section is compressed, elliptical, with a rounded umbilical slope. The last third of the outer whorl belongs to the body-chamber, but the suture-line is not exposed well enough for description or delineation.

This species is somewhat intermediate between *R. smithi* and *R. reissi* and differs from the former chiefly in its less prolonged '*arthritica*'-stage, and from the latter in its more robust tuberculation and regular secondary ribbing. Whilst *R. smithi* shows a development from tuberculate to costate *R. reissi* and *R. ravana* appear to change but little with age. The last is probably closer to *R. smithi*, however, than to the somewhat similar *R.* cf. *hungarica* figured by myself from Tunisia (1913, pl. LII, fig. 3). Till's Hungarian species, or at least the adult example later figured by Loczy (1915, pl. IX, fig. 1) is a *Reineckeites*, and less closely comparable, but the Tunisian form, ike the Algerian example (B. M. No. C. 10568) referred to in its description (pp. 543 and 559) and perhaps Till's *R.* cf. *hungarica* (1911, pl. I, fig. 3 only), belonging to the transitional group between *Reineckeia* and *Reineckeites* (that also includes such forms as '*R. anceps*' of Couffon [1919, p. 206, pl. XVII, fig. 4] and *R. reissi*, described below), seem to be its nearest allies.

Horizon.—Callovian, *anceps* beds.

Locality.—The holotype (G. S. I. No. K-22/282) is one of a suite of 57 ammonites labelled "Samatra and Fakirwadi". The matrix of specimens of *Reineckeites* from both these localities does not differ from that of examples out of the ironstone nodules of the *anceps* beds at Khera Hill.

Reineckeia reissi, Steinmann.

1875. *Perisphinctes anceps* (Reinecke) ; Waagen, *pars* ; p. 207, pl. LIX, fig. 1.
1881. *Reineckea, reissi*, Steinmann ; p. 291.
1893. *Reineckeia reissi* Steinmann ; Riche p. 312.
1905. *Reineckeia anceps* (Reinecke—Waagen) Collot, p. 26.
1910. *Reineckeia anceps* (Reinecke) var. *greppini* (Oppel) ; Lemoine, p. 10, pl. V, fig. 4.
1911. *Reineckeia anceps* (Reinecke); Till, p. 2.
1913. *Reineckeia anceps* (Reinecke) ; Spath, p. 559.
1927. *Reineckeia, reissi*, Steinmann ; Burckhardt, p. 41.
1928. *Reineckeia, reissi*, Steinmann ; Stefanini, p. 21, pl. VIII, fig. 4.

Loczy (1915, p. 360) stated that Waagen erroneously figured as *R. anceps* (pl. LIX, fig. 1) a different form in which one recognised at once Oppel's *R.* (*Ammonites*) *rehmanni*. Yet on p. 367 he admitted that he was unable to decide whether *R. reissi* (based on the same Kachh form) and *R. kiliani*, Parona and Bonarelli, ought to be united, whilst (on p. 362) he included in the synonymy of *R. rehmanni* only Waagen's pl. LVIII, fig. 1, here referred to *R. indosabauda*. Again on pp. 444 and 453 *R. anceps* and *R. kiliani* are listed from Kachh (Cutch), but not *R. rehmanni*, so that we must ignore Loczy's criticism. On the other hand, Lemoine, partly owing to confusion of plates not only cites Waagen's '*Perisphinctes*' *rehmanni* in the synonymy of his *Reineckeia anceps*, var. *greppini* (=*R. reissi* Steinmann) but also lists the same forms again in different groups. Petitclerc (1915, p. 91), does not simplify matters by describing this same *R. anceps* var. *greppini* (Oppel) of Lemoine as a different form from *R. greppini* (Oppel)[1] and he, moreover, lists *Amm. rehmanni* in the synonymy of the former.

Going back to Steinmann, it seems clear that Waagen's Kachh example must remain the type of *R. reissi*. This figure is accurate enough to enable students to recognise the adult form, but the innermost whorls are not visible. Having now examined the holotype, I take these to be similar to, if not identical with, the Sinde example here figured (pl. XXXIII, fig. 7). That is to say the '*anceps*' stage is lost at a diameter of between 20 and 40mm. and the succeeding trifurcate '*reissi*'-stage persists to the body-chamber, when multi-division may appear, without, however, reducing the tuberculate, primary ribs. In consequence of the larger number of secondaries, the tubercles may appear more distant and thus wrongly suggest 'rejuvenation' instead of 'degeneration.' If Loczy held that almost every specimen of *Reineckeia* could be given a separate specific name, we may go further and maintain that each represents a distinct lineage or genus in Mr. Buckman's sense. Such a distorted view of ammonite-genealogy and classification will not appeal to those who have abundant material from many parts of the world, any more than the equally prevalent tendency to ignore the variability of

[1] *R. oxyptycha* (Neumayr, 1870, pl. VIII, fig. 2) is cited again as a separate form on p. 101, but listed in the synonymy of *R. greppini* on p. 94.

a species. Lemoine's Madagascan example is here held to be a typical *R. reissi* in spite of slight differences in the (reduced) illustration.

The figured *R.* '*kiliani*,' Parona and Bonarelli, placed by Lemoine in a different group, is probably closely allied to the form here described; and it has already been mentioned that Loczy (1915, p. 366) cited *R. reissi* in the synonymy of his *R.* '*kiliani*,' which, after Parona and Bonarelli and Till, he again identified with Quenstedt's (typical) '*Amm. plicomphalus*.' The Chanaz *R.* '*kiliani*' has slower coiling and apparently retains the early coronate stage to a larger diameter. Loczy's figure (pl. VIII, fig. 2) does not greatly resemble Parona and Bonarelli's Savoy specimen, but a comparison with fig. 7 of pl. XXXIII, shows that the Indian form is still less coarsely ornamented.

Petitclerc's '*R. anceps* var. *greppini*' (1915, pl. X, fig. 1) is intermediate between *R. reissi* and *R. substeinmanni*' but there are several large French forms of this type before me that cannot well be attached to any described 'species.' On the other hand a Portuguese example (B. M. No. C. 29263, from Cape Mondego) is somewhat transitional between the present species and *Kellawaysites greppini* (Oppel) and may perhaps belong to Till's *Reineckeia transiens* (1911, p. 8, pl. II, fig. 8).

R. straussi Weithofer sp. (1889, p. 762, pl. II, figs. 2-4) was compared by G. von dem Borne (1891, p. 17, pl. IV, fig. 13) with Waagen's form and seems to differ only slightly, but Parona and Bonarelli's (1897, p. 165, pl. VII, figs. 2, 2*a*, *b*) Chanaz example is more finely ribbed.

Horizon.—Callovian, *anceps* beds.

Locality.—Joora Hills (Waagen). Two fragmentary and doubtful examples (J. H. Smith Colln. Nos. 15 and 33) from the 'Ler-Hamundra Ellipse' may belong to *R. reissi*, but seem more compressed.

Genus: KELLAWAYSITES, S. S. Buckman.

KELLAWAYSITES OXYPTYCHOIDES, sp. nov.

(Pl. XLI, figs. 5*a*, *b*).

The Samatra example on which the present species is based has the following dimensions:—133—·34—·27—·41. These are the proportions of *Amm. greppini* Oppel, as interpreted by Loczy (1915, p. 372) who had abundant material and since Till (1911, p. 7), who examined Neumayr's type, states that the ventral view was incorrectly represented, (*i.e.*, with too great a whorl-thickness), there seems little reason for separating the present species from Neumayr's *Perisphinctes oxyptychus* (1870, p. 151, pl. VIII, fig. 2), later united with Oppel's *R. greppini* (1871, p. 249). Even if Neumayr's figured example be not so perfectly identical with Oppel's type as he assumed, we may accept his interpretation, since *R. greppini* is a well-defined species; it is before me for example in an unmistakable Chanaz specimen (B. M. No. C. 10565). As in Neumayr's figure, the constrictions (present according to Till) are little conspicuous, but the ribbing is considerably stronger than in the Samatra form here discussed. In the latter the terminal tubercles of the fine primary costæ are scarcely noticeable (and then on only a few of the

ribs) even on the inner whorls and the secondaries are faint, blunt, and *not* thickened, on the cast as well as on the test. Moreover, there is repeated secondary bifurcation of the ribs at the outer quarter of the whorl-side; and the rib-curve as a whole is slightly different, as can be seen on comparison of the figures. The peripheral interruption of the costæ is scarcely marked on the outer whorl and the comparatively high umbilical wall is almost smooth, especially near the end. The suture-line is visible on the outer whorl which is still completely septate, and it shows the typical *Reineckeia* characters and dependent auxiliaries.

A smaller, fragmentary example from the same locality (but preserved in the usual red and yellow ironstone matrix, not the dark grey dolomitic limestone of the holotype) is interesting since it is still more perisphinctoid, resembling somewhat Parona and Bonarelli's '*Perisphinctes*' *choffati* (1897, pl. VIII, fig. 3.) It shows scarcely any distinction between primary and secondary ribs, especially on the inner whorl, and the costæ are also straighter as a whole, and perhaps slightly more closely spaced.

The examples figured by Till as *Reineckeia* cf. *greppini* (1911, pl. II, figs. 4-7) are not closely comparable to the Samatra form and Lissajous's Macon '*R. oxyptycha*' (1912, p. 50, pl. VI, fig. 10) seems too coarsely and distantly costate. The Savoy example of '*R.*' *greppini* figured by Petitclerc (1915, pl. XI, fig. 2), and identified by Parona, seems slightly more evolute and less finely ribbed even than the typical examples of Oppel's species, but his pl. VIII, fig. 5 is still more distinct from the true *Kellawaysites* which may account for the separation of '*R. greppini*' from '*R. oxyptycha.*' The same author's '*R. anceps* var. *greppini*' (pl. X, fig. 1) has already been referred to as belonging to the *reissi* group.

Tornquist's '*R.*' *pseudogoweriana* (1898, p. 53, pl. IX, fig. 2) of dimensions:—68—·35—·37—·38 has a more circular whorl-section and more distinct lateral tubercles, but it is difficult to compare the undescribed and poorly illustrated inner whorls.

K. multicostatus Petitclerc sp. (1915, p. 98, pl. XII, fig. 2) which does not seem to differ much from the true *K. greppini*, has more distinct primaries, also *K. multicostatus* Buckman (1925, pl. DLXXXVII, *non* Petitclerc ? *nec* Stehn) which is tuberculate to quite a considerable diameter. Some more degenerate unnamed forms of the same type from the Lower Oxford Clay of Chippenham (B. M. Nos. 25290, 37661) equally retain the coronate stage unusually long and then suddenly change to a perisphinctoid *greppini*-like outer whorl. '*Reineckeia*' *eusculpta* Till, or at least the adult Villány form attached by Loczy (1915, pl. VIII, fig. 5) to that species, is more evolute and the ribs are more regularly bifurcating.

Horizon.—Callovian, *anceps* beds.

Localities.—Samatra ('Black Rocks,' J. H. Smith, 1912*b*, p. 1349, and '*anceps* beds'). A large, septate fragment, with the suture-line well displayed, and a smaller example, perhaps slightly more coarsely ribbed than the type, are from the sub-*anceps* beds 2 of the Ler-Hamundra-Ellipse (J. H. Smith Colln.)

KELLAWAYSITES GREPPINI (Oppel).

1862. *Ammonites greppini* Oppel ; p. 154.
1870. *Perisphinctes oxyptychus* Neumayr, p. 151, pl. VIII, fig. 2.
1870. *Perisphinctes greppini* (Oppel) ; Neumayr, p. 249.
1911. *Reineckeia greppini* (Oppel) ; Till, p. 8.
1913. *Reineckeia greppini* (Oppel) ; Spath, p. 559.
1915. *Reineckeia greppini* (Oppel) ; Loczy, p. 372.
1927. *Reineckeia greppini* (Oppel) ; Burckhardt, p. 40.
1928. *Reineckeia greppini* (Oppel) ; Stefanini, p. 24.

A Khera whorl-fragment, entirely septate, was at first included with the previous form but the secondaries thicken towards the periphery and, after first being prorsiradiate, they again become reclined towards the ventral groove. At the size of the holotype of *K. oxyptychoides* the lateral tubercle is also still distinct in this fragment, so that it may be listed separately. Moreover there is a second Khera example, also a septate fragment of an outer whorl, which has slightly more distant secondaries and thus is still less close to the form above described. It is not complete enough to be figured but shows good agreement with typical examples of Oppel's species.

Horizon.—Callovian, *anceps* beds.

Locality.—Khera Hill bed No. 7 (J. H. Smith, Colln., Nos. 14 and 23).

Genus : REINECKEITES S. S. Buckman.

REINECKEITES WAAGENI (Till).

(Pl. XXVI, fig. 3 ; pl. XXXIV, fig. 9 ; pl. XXXV, figs. 3, 5*a*, *b* ; pl. XXXVI, figs. 7*a-e* ; pl. XXXVII, figs. 3, 4, 9 ; pl. XXXIX, fig. 9 ; pl. L, figs. 3*a*, *b*).

1875. *Perisphinctes anceps* (Reinecke) ; Waagen, p. 207, pars, pl. LVII, fig. 4.
1896. *Reineckeia anceps* (Reinecke) ; Sémenow, p. 96 (pars).
1911. *Reineckeia waageni* Till, p. 29 (pl. V, fig. 11 ?)
1913. *Reineckeia waageni* Till ; Spath, p. 559.
1915. *Reineckeia waageni* Till ; Loczy, p. 368.
1924. *Reineckeia* cf. *anceps* (auct.) juv., Spath, p. 21, No. 365.
1927. *Reineckeia* sp. nov. Burckhardt, p. 41.

As type of this species must be taken the Kachh example figured by Waagen, and Till's uncertain, pathological, Hungarian form was ruled out already by Loczy. Whether, however, the latter's description of *R. waageni* as a close ally of *R. robusta* Till is correct, seems doubtful, and the species may rather be described as intermediate between *R. stuebeli* Steinmann (based on d'Orbigny's [1849] pl. CLXVI, figs. 3-4 only) and forms like *R. eusculpta* Till. The last is difficult to recognise from the type figure (Till, 1911, pl. I fig. 9) and Loczy (1915, p. 376) wrongly identified it with Bayle's [1879] pl. LVI, fig. 2, which Lemoine (1910, p. 9) obviously in error, included in *R. lifolensis* Steinmann. Whilst *R. stuebeli* with an identical peripheral aspect, has more regularly bifurcating costae on the outer whorl, *R. eusculpta*, or

at least the large example referred to this species by Loczy (1915, pl. VIII, fig. 5) has a shorter tuberculate stage and closer ribbing throughout.

Waagen's figure well represents the adult form; and the peripheral view of an additional adult example is illustrated in pl. XXXVII, fig. 9. This like a few more of the twenty-three specimens and fragments before me, is slightly more closely costate and more involute than the type, but at present it does not seem advisable to separate them even as varieties. The four immature specimens figured in pl. XXXV, fig. 3, pl. XXXVI, figs. 7*a-e*, and pl. XXXVII, figs. 3 and 4 are, perhaps, too small to be definitely identified with the larger holotype; and there are a number of other 'species' of *Reineckeites* that have a similar early stage. The small examples are attached to the present form merely because this seems to be the commonest of all the Reineckeids in Kachh. Similarly the fragments figured in pl. XXVI, fig. 3, and pl. L, figs. 3*a*, *b*, are slightly different from the type at the same diameter, whilst the fragment of which the peripheral view is represented in pl. XXXIV, fig. 9 shows a smaller whorl-thickness. This last example is pathological, but no two specimens are strictly identical and the forms of Reineckeids, as of other highly ornamented ammonites, have to be interpreted correspondingly widely.

The comparatively well preserved example figured in pl. XXXV, figs. 5*a*, *b*, and pl. XXXIX, fig. 9, differs slightly from the type in proportions (87—·33—·29—·44, as compared with 82—·31—·26—·47), and in whorl-section but does not seem sufficiently distinct for specific separation. We may designate this variety :—

var. *regalis* nov.

and the Sinde specimen figured in pl. XXXIII, fig. 7, above (p. 265) compared to *R. reissi*, is transitional between this variety and the restricted *Reineckeia*. The specimen figured in pl. XXXVII, fig. 9 (which, however, is more compressed) is again a passage form between the type and the variety. It is probably also close to *Reineckeia revili* Parona and Bonarelli (1897, p. 165, pl. VII, figs. 1, 1*a*, *b*), but this species has its tubercle more at the middle of the side and is similarly less 'catagenetic' than *R. waageni*. On the other hand *R. enodis*, Tornquist (1898, p. 184, pl. IX fig. 1) shows considerably greater reduction of the costation, whilst the same author's *R. espinazitoensis* (ib., p. 185, pl. IX, fig. 3) is more coarsely and distantly ribbed.

Reineckeia cf. *greppini* (Oppel), Till (1911, p. 7, pl. II, figs. 4-6) differs slightly in its closer costation and Bukowski's *R.* cf. *stuebeli* Steinmann (1887, p. 133, pl. XXVII, fig. 3) has more inflated inner whorls. *R. douvillei*, Steinmann (1881, p. 289, pl. XII, figs. 2-4, 8) is closely allied, especially the example figured by Steinmann in his fig. 8. The type (Steinmann's fig. 4) has a slightly different type of ribbing, apparent in the Hungarian specimen figured by Loczy (1915, p, 375, pl. XIII, fig. 1) as well as in some French examples illustrated by Petitclerc (1915, p. 93, pl. X, figs. 2 and 4), but others preserved in the British Museum (*e.g.* Nos. 37336, and C. 26445 from the

Sarthe) do not seem to me to be separable from *R. stuebeli*. Petitclerc's *R. paronai* (1915, p. 99, pl. XII, fig. 3) which probably is not specifically distinct from his *R. douvillei*, differs in its closer and rursiradiate ornamentation.

Parona and Bonarelli (1897, p. 164) doubtfully included Waagen's form in the synonymy of *R. greppini;* and Uhlig (1881, p. 392, pl. VII, fig. 6) figured a young example, resembling the Khera specimen represented in our plate XXXVII, fig. 3, which he considered indentical with the inner whorls of the holotype of *R. greppini*. The larger whorls are quite different in the two species, but it is to be noted that Till himself, although (on p. 7) he renamed Waagen's form and put it in he transitional group B, later (p. 13) stated that it might be named *R.* cf. *greppini*.

Reineckeia palfyi Till (1911, p. 14, pl. II, figs. 9, 10) which was said to resemble d'Orbigny's type figure of *R. stuebeli*, is characterised by its much more delicate and close costation, among other features. The Chilian form figured by Stehn (1924, p. 111, pl. VII, fig. 2) as *R. stuebeli*, seems to be less distinctly tuberculate than d'Orbigny's type and has a number of single costæ at a comparatively small diameter, but it is probable that *R. waageni* is merely the Indian equivalent of this widely distributed *R. stuebeli* in it more comprehensive interpretation. This is known from *e.g.* the Lower Oxford Clay of Weymouth, Dorset, and Tytherton, Wilts. (pl. XXXIV, fig. 6), but there is considerable variability in the duration of the early coronate stage. A small Peterborough example (collected by Dr. R. Brinkmann of Göttingen and presented by him to the British Museum) could be compared even to *R.* '*kiliani*' Parona and Bonarelli, and *R. robusta* Till; but it probably belongs to the same common species (*R. stuebeli*) as the Weymouth example figured by Mr. Buckman (1924, pl. DXXII) under an unnecessary new name. On comparison of the Tytherton specimen (pl. XXXIV, fig. 6) with the example of *R. waageni* figured in pl. XXVI, fig. 3, it will be seen that the differences are slight indeed, and the typical examples are even more distinctly tuberculate. The French examples of *R. stuebeli* figured by Petitclerc (1915, p. 101, pl. VI, fig. 2, pl. IX, fig. 5, pl. X, fig. 3) seem to be slightly more coarsely ribbed, but those who have handled abundant material will know that there are many transitional forms and perhaps not a single example that agrees with d'Orbigny's somewhat diagrammatic figure.

Horizon.—Callovian, *anceps* zone. In Wurtemberg and Bavaria comparable forms occur in the '*jason*' (= '*calloviense*' =*anceps*) zone as well as in the next higher '*castor* and *pollux*' zone (Dr. Model Coll. in B. M.).

Localities.—Waagen's type came from Khera Hill near Chari, and four examples in Mr. J. H. Smith's Collection (his bed 7) and one in the Blake Collection (bed 3) are from the same locality. Other specimens come from Habye (2), Samatra (1), Walakhavas (1) and Fakirwadi (12). The last localities are in the Charwar Range whence Waagen recorded a specimen, not examined by the writer, and the preservation, in red ironstone nodules, seems to be

the same. One example, from the Ler-Hamundra-Ellipse, is labelled: "sub-*anceps* beds 2"; another, doubtful, specimen, in an unusual, crumbling gypsum and yellow ochre matrix, is unlocalised.

REINECKEITES sp. nov. ind.

(Pl. XXXIII, figs. 1*a*, *b* Pl. L, fig. 4).

1924. *Reineckeia* cf. *greppini* (Oppel)='*anceps*,' Waagen, pars, Spath, pp. 12 and 25 (No. 404).

A fragmentary specimen (Pl. XXXIII, fig. 1), previously doubtfully referred to *R. greppini* (Oppel), has the following dimensions:—67—·34—·31(?)—·39. It is, however, rather poorly preserved and no definite identification is possible. There are three to four secondary ribs to each tubercle and the characteristic feature so far as can be seen, is the change in the position of this tubercle from near the middle of the side to the umbilical edge. The latter is broken away, however, on the side figured and the opposite side is worn and corroded so that the restored whorl-section (fig. 1*b*) is somewhat diagrammatic. Moreover, the suture-line is not distinctly seen, but the final half-whorl seems to belong to the body-chamber. This is certainly represented in the larger specimen figured in pl. L, fig. 4, of dimensions:—100—·34—·22 (?)—·40. The inner whorls are badly preserved but seem to agree with the first example; on the outer whorl, the ribbing is degenerate as in some Villany forms, and even biconcave forward, without trace of tuberculation.

In the persistence of coarse tuberculation to a comparatively large diameter, the present species is comparable to such a form of *Reineckeia* as that figured by Loczy (1915, pl. VIII, fig. 2) as *R.* '*kiliani*,' but Parona and Bonarelli's example (1897, p. 162, pl. VI, fig. 3) is quite different. Nothing really similar to the present form, however, seems to have been figured in geological literature, although the peculiar aspect of the smaller specimen is partly due to its defective preservation. *Reineckeites segestanus* Gemmellaro sp. (1869-71, p. 42, pl. VIII, figs. 1—3, 1872, p. 25), which is more evolute, seems to have less tuberculate early whorls, and therefore is closer to *R. waageni*. Its outer whorl also is quite different.

A third example (from Fakirwadi) in a gritty matrix is equally doubtful but belongs to yet a different form. It has coarse, bifurcating costæ like Petitclerc's *R. stuebeli*, above referred to (p. 270), but is more involute. Its poor state of preservation again prevents accurate determination.

Horizon.—Callovian, lower *anceps* zone.

Locality.—East Jooria, 'lower zone' (Blake Colln. No. 404). The gritty conglomeratic matrix of the second example agrees with that of the '*sub-anceps*' beds of Fakirwadi of Mr. Smith, below the red ironstone beds of the upper *anceps* zone. The specimen figured in pl. L, fig. 4 and a comparable fourth example are from the Ler-Hamundra-Ellipse (sub-*anceps* beds 2).

Genus : COLLOTIA, de Grossouvre.

COLLOTIA aff. ANGUSTILOBATA (Brasil).

(Pl. XXXIII, figs. 10*a*, *b*).

1849. *Ammonites anceps* Reinecke ; d'Orbigny, pars, p. 462, pl. CLXVI, fig. 5 only.
1896. *Peltoceras angustilobatum* Brasil ; p. 6, pl. III.
1905. *Reineckeia angustilobata* (Brasil) ; Collot, p. 25.
1908. *Peltoceras angustilobatum* (Brasil) ; Maire, p. 150.
1911. *Peltoceras angustilobatum*, Brasil ; Rollier, pp. 296, 335.
1912. *Reineckeia angustilobata* (Brasil) ; R. Douvillé, p. 9.
1917. *Reineckeia angustilobata* (Brasil) ; Petitclerc, pars, p. 29, pl. III, figs. 5-7, pl. IV, fig. 1, pl. VIII, fig. 11.

Collot and Petitclerc, who discussed this species in considerable detail, probably interpreted it rather comprehensively. There are four Kachh forms of *Collotia* with coarsely bituberculate outer whorls that resemble Brasil's species ; only that represented in pl. XXXIII, fig. 10 is now provisionally attached to it, since it has the whorl-thickness exceeding the height. The dimensions of the holotype were given by Brasil as follows :—350—·26—·34—·54 Even when taking the whorl-thickness to include only the base of the prominent lateral spines, it equals or exceeds the height, whilst Petitclerc's measurements (275—·25—·21—·50 ; 380—·26—·20—·56 ; 400—·27—·18—·57) indicate compressed shells, like the three following species. The fragment here figured is probably not identical with the Calvados species ; and a Weymouth body-chamber example (B. M. No. C. 30392) has the inner tubercles moved to the whorl-sides and the bullæ spaced distantly already at a smaller diameter than the (septate) Kachh fragment. These differences are not of much importance in a variable group like the present, but there are almost certainly a number of species—as ammonite-species go—and the forms described below differ still more considerably and cannot all be included in one large species, although at present there are only fragments available for study.

The suture-line has a slightly less complicated lateral saddle than that figured by Brasil, but this is due partly to slight corrosion of the fragment here represented.

Brasil included his form in the genns *Peltoceras* and compared it to *Amm. eugenii* (Raspail) d'Orbigny, a form that is close to Waagen's *P. propinquum*. It is interesting to note that the Kachh fragments were also identified by Mr. J. H. Smith as *Peltoceras*, as K. Mayer had referred his *P.* '*odysseus*' (MS., *fide* Rollier) to the same genus.

Horizon.—Divesian, *athleta* beds (*fraasi* to *duncani* zone ?). In Normandy, *Collotia angustilobata* is said to occur in the lower *athleta* beds (R. Douvillé, 1912, p. 9) as well as in the higher *lamberti* (=*athletoides*) zone (Brasil), whilst Collot placed it at the upper limit of the 'Callovian' (below the *renggeri* marls).

Locality.—Ler (J. H. Smith Colln. No. 54).

Collotia draupadi sp. nov.

(Pl. XXXIII, figs. 6*a-c*; pl. XXXIV, figs. 10*a*, *b*).

A new name may be proposed for this Kachh form in spite of the fact that it is represented only by the septate whorl-fragment here figured (pl. XXXIII, fig. 6) and a body-chamber portion of 90mm. length, which fits on to the smaller fragment as represented in fig. 6*b* (sectional view). The peripheral view (fig. 6*c*) represents the impress of the dorsal area of the smaller fragment (fig. 6*a*). The outer whorl shows good agreement with the examples figured by d'Orbigny (1849, pl. CLXVI, fig. 5 only, apparently considerably reduced) and by Petitclerc (1917, pl. IV, fig. 1) but the compressed whorl-section and low position of the umbilical tubercle prevent identification with Brasil's type of *C. angustilobata*, above referred to.

On the penultimate whorl, the costation is very irregular, except peripherally, and whilst one of the primary ribs has no inner tubercle, the outer tubercle (at the umbilical suture of the succeeding whorl) seems to be equally confined to some of the ribs. This outer tubercle of the inner whorl was unfortunately omitted in the sectional view represented in pl. XXXIII, fig. 6*b*. All the ribs, unequal and indistinct on the whorl-side, are strongly prorsiradiate, and they tend to become equally strong on the peripheral area; on the innermost whorl seen the ribbing was comparatively close, with a smooth ventral zone.

The penultimate whorl of Petitclerc's fig. 1 (pl. IV) has a far more pronounced inner tubercle and even on the preceding whorl the lateral ribbing is more distinct than in the Kachh form. The *fraasi*-like example attributed by Petitclerc (pl. III, fig. 7) to the same form (*C. angustilobata*) is entirely different, but there is perhaps greater resemblance to *Kellawaysites greppini* (Oppel = *Perisphinctes oxyptychus* Neumayr, 1870, pl. VIII, fig. 2). Rollier (1911, p. 335) already directed attention to the similarity of the inner whorls of '*Peltoceras odysseus*' to Neumayr's form and even included *Reineckeia reppini* in the same group.

The suture-line could be completely exposed (pl. XXXIV, figs. 10*a*, *b*) and shows the deep umbilical lobe characteristic of Reineckeids, whilst the internal elements are also similar to those of *e.g. Reineckeia tyranniformis* (pl. XLVII, fig. 7).

C. aff. *angustilobata*, above described, differs in its wider whorl-section, *C.* sp. ind. nov.? in its peripheral aspect. *C. kachhensis* remains comparatively finely ornamented to a much larger diameter and *C.* ? (*Reineckeia*) *octagona* has a coarsely coronate early stage.

Horizon.—Divesian, '*athleta* beds'.

Locality.—Walakhavas (J. H. Smith Colln. No. 34, labelled '*Pelt*[*-oceras*], *prop*[*inquum*']).

Collotia kachhensis sp. nov.

(Pl. XLII, figs. 2*a*, *b*).

In addition to the fragment here figured, which is still entirely septate, there are two similarly large, chambered, portions of which one retains the penultimate whorl. This differs considerably from that of the species last described and in spite of a certain resemblance in the cross-section of the outer whorls, these fragments may well be separated specifically. The ornamentation of the outer whorl is less robust than that of *C. angustilobata* and its allies and the inner tubercle especially is less prominent than the outer. There is resemblance of the earlier whorls to Neumayr's *Perisphinctes oxyptychus* (1870, pl. VIII, fig. 2), and the peripheral view particularly is similar, although the ribs are still closer in the present form. We know, however, that Neumayr's drawing was incorrectly represented with a greatly exaggerated whorl-thickness (Till, 1911, p. 7) whereas in the form here described, the widely-rounded ventral area, with its wide, depressed, median zone is a characteristic feature. Moreover, there are apparently no inner tubercles on the primary ribs which seem to be indistinct and irregular as in (the coarsely ribbed) *C. draupadi*, and the resemblance to the forms of the *greppini*-group is therefore probably superficial.

The suture-line (at a larger diameter than that of *C. draupadi* figured in pl. XXXIV, fig. 10) is extremely complex, like that of *C. angustilobata* figured by Brasil (1890, text-fig. on p. 40).

The form described below and a comparable Weymouth fragment are somewhat intermediate between the present species and *C. draupadi* and differ chiefly in their slightly stronger and more distant ribbing.

Horizon.—Divesian, lower '*athleta* beds' (*fraasi* zone ?).

Localities.—Samatra (G. S. I. No. K22/159: '*Aspidoceras*'), Habye ('*Peltoceras*'), and Fakirwadi (Bowl, J. H. Smith Colln. No. 45 : '*P. semirugosum.*')

Collotia sp. ind. nov.?

(Pl. XXIV, figs. 5*a*, *b*).

The entirely septate fragment here figured is somewhat intermediate between the more coarsely ornamented *C.* aff. *angustilobata* and *C. draupadi* on the one hand and the more finely ribbed *C. kachhensis* on the other. It is listed separately chiefly because there are other examples like it, also a body-chamber fragment from the Oxford Clay of Weymouth (Pottery, B.M. No. C. 30393) which seems to belong to the same species. Another Kachh fragment, with slightly closer peripheral ribbing, is still more distinctly transitional to *C. kachhensis*, but has coarse lateral and umbilical tubercles, whilst a third and more doubtful example is again closer to *C.* aff. *angustilobata*, although its whorl-section cannot be accurately determined. In the figured specimen, the comma-shaped inner tubercles or primary ribs show a curiously exaggerated

forward projection towards the umbilical suture. The suture-line is well shown in the same example and extremely complex and interlocking.

I previously (1926, p. 324) directed attention to the occurrence of similar gigantic species of *Collotia* in the Oxford Clay of Weymouth, and it is interesting to note that there they are associated with forms (*Peltoceras*, *Kosmoceras*, *Cadoceras*, and early *Quenstedtoceras*) that indicate the *athleta* (*duncani* and *fraasi*) beds.

Horizon.—Divesian, '*athleta*' beds. The doubtful example above referred to is labelled 'Dhosa Oolite' and is preserved in the same hard, compact limestone that yielded the large *Mayaites obesus* referred to on p. 229 and attributed to the Upper Divesian. According to Mr. J. H. Smith it is difficult to separate the Dhosa Oolite Shales (below the Dhosa Oolite limestone) from the underlying '*athleta* beds' and these again merge gradually into the '*anceps* beds,' below, with a line of slabs with fucoid markings and pelecypods as a provisional dividing line.

Localities.—Walakhavas ('*athleta* beds'), Fakirwadi ('*anceps* beds'), and Ler ('Dhosa Oolite'), J. H. Smith Colln. Samatra (G. S. I. No. K-22/142: '*Peltoceras propinquum*').

Collotia sp. juv. aff. fraasi (Oppel).

(Pl. XLII, figs. 3*a*, *b*).

1924. Gen. nov. ? (Perisphinctoid) Spath, p. 24 (No. 493).

The small example here figured may represent the inner whorls of one of the four forms previously described but it is impossible to assign it to any one of them and it seems preferable to list it separately. It differs from the Wurtemberg example of *C. fraasi* (Oppel) figured in pl. XXXI, figs. 3*a*, *b*, chiefly in its more inflated whorl section, but it has the same suture-line, early coronate stage, and the same type of ribbing already at a very small diameter, also the same smooth ventral zone and oblique contrictions. The Kachh example, however, has fewer single costæ. *C. fraasi* (Oppel, 1865, p. 154, pl. XLVIII, figs. 4 [lectotype], 5-6) is extremely variable, as will be seen on comparing the figures of Oppel with those given by Quenstedt (1887, pl. LXXXVII, *e.g.*, figs. 15, 17, 19-21=*Amm. parkinsoni anceps*) and by Grossouvre (1917, pl. X, figs. 20—23). Petitclerc's (1917, pl. III, fig. 7, pl. IV, fig. 1) apparently widely different examples of *C. angustilobata* (Brasil) show that the inner whorls of other forms of *Collotia* may also have a prolonged ribbed stage between the early coronate and the late bituberculate stages. It seems futile to give names to each of the endless varieties of the Wurtemberg form; and with A. de Grossouvre we may leave them all in *C. fraasi* until zonal collecting disprove their apparent contemporaneousness.

Till's *Reineckeia* aff. *fraasi* (1911, p. 16, pl. II, fig. 11) has a more depressed whorl-section than the Kachh example, but may only be a young *Reineckeites*, whilst Loczy's (1915, p. 378, pl. VIII, fig. 7) even more doubtful form is still far less comparable to Oppel's species.

Horizon.—Divesian, '*athleta* beds'. The example was associated with *Lunuloceras lairense* (Waagen) figured on pl. XIV, fig. 1. Reuter (1908, p. 127) records *C. fraasi* from his *castor* and *pollux* zone, Maire (1908, p. 150) from his *athleta-ornatum* zone.

Locality.—Ler (bed No. 8, J. F. Blake Colln. No. 493).

Collotia ? (Reineckeia) octagona, sp. nov.

(Pl. XXIX, figs. 7*a-c*, pl. XXXIV, figs. 4*a*, *b*).

This species is based on the example figured in pl. XXIX, fig. 7, of dimensions :—80—·33—·38—·44 ?. The inner whorls, unfortunately, are not preserved, nor is the suture-line, and more than half of the outer whorl belongs to the body-chamber. The prominent lateral tubercle is reminiscent of that of *R. arthritica*, but there are generally only three secondary ribs to each with an occasional shorter intermediate one. The peripheral groove is also very distinct and deep, whilst the most important features are the characteristic octagonal whorl-section and the development of an almost tuberculate ventro-lateral edge. In the holotype, the outer nodes are indicated only near the end of the specimen, but in the body-chamber fragment figured in pl. XXXIV, fig. 4, although closer to the inner tubercle, these nodes are quite conspicuous. It is possible that this second example which also seems to come from a higher bed, belongs to a different form, still more definitely transitional to some of the associated *Collotia* described above. The ornamentation of its (impressed) dorsal area, however, is the same as that of the holotype and it is to be noted that the secondary bifurcation of the ribs at the outer tubercle is also already indicated in the last costa of the typical specimen.

There does not seem to exist a figure in geological literature of a Reineckeid which passes directly from a coarsely coronate stage to a bituberculate stage as does the species here described. The more robust varieties of *Collotia fraasi* (*e.g.* Oppel's, 1865, pl. XLVIII, fig. 5 or Grossouvre's, 1917, pl. X, figs. 20-21) show weakening of the early '*anceps*' stage, as in the contemporary *Reineckeites* of the *stuebeli*-group, whilst *Collotia ?* (*Reineckeia*) *octagona* seems far more closely comparable to *Reineckeia rehmanni* or *R. indosabauda*. In some examples of this group, as also in *R. arthritica*, the rectangular whorl-section and apparent thickening of the ribs at the ventro-lateral angle, indeed, suggest incipient bituberculation. There is a French form before me (B. M. No. C. 26263) with general resemblance to *R. robusta*, Till (1910, pl. XIX, fig. 8), in which some of the secondary costæ branch again at the ventro-lateral edge, but there is as yet no distinct outer tubercle; and the form can only be considered to be transitional between *R. rehmanni* (Oppel) and the present species. Since the latter thus seems connected directly with the early *Reineckeia* whilst *Collotia fraasi*, like the associated *Reineckeites* of the *stuebeli* group, are probably derived from the *anceps* group s.s., generic separation of the form here described from the other forms of *Collotia* seems desirable and we might leave it provisionally even in *Reineckeia*. The few forms so far known

are probably not representative of Reineckeid evolution and it seems rash to establish lineages in Hyatt's meaning; but since the polyphyletic character of so many genera is now being recognised we may well retain *Collotia* for all the Reineckeids that develop bituberculation, whether directly, like *C ?. octagona*, or more indirectly, like *C. fraasi.*

Horizon.—Callovian, *anceps* beds (upper ?).

Localities.—Fakirwadi (G. S. I. No. K-22/282, pars, and J. H. Smith Colln. No. 26). The last example (pl. XXXIV, fig. 4) is labelled '*anceps*-mound,' but has the buff limestone matrix of the *athleta* beds.

Incertae Sedis.

Genus PARAPATOCERAS Spath.

PARAPATOCERAS cf. CALLOVIENSE (Morris).

(Pl. XXXIII, fig. 3). XCVII, ha 3a-c.

1875. *Ancyloceras calloviense* (Morris); Waagen, p. 212, pl. LVI, fig. 3.
1894. *Ancyloceras (?) calloviense* (Morris); Hyatt, pl. XI, fig. 41.
1897. *Patoceras calloviense* (Morris); Roman, p. 55.
1907. *Ancyloceras* sp. cf. *calloviense* (Morris); Courty, pl. IV, fig. 3.
1912. *Patoceras calloviense* (Morris); Lissajous, p. 18, pl. II, fig. 18.
1919. *Patoceras calloviense* (Morris); Couffon, p. 223, pl. XVII, figs. 9, 9*a-f.*
1923. *Ancyloceras calloviense* (Morris); Stehn, p. 138.
1924. *Parapatoceras calloviense* (Morris); Spath, p. 12.
1924. *Patoceras calloviense* (Morris); Roman, p. 69, pl. III, fig. 15.
1925. *Ancyloceras calloviense* (Morris); Gerth, p. 33.
1925. *Parapatoceras calloviense* (Morris); Buckman, pl. DXXXVII.
1925 ? *Crioconites crioconus* Buckman, pl. DXXXVIII A, B.

Waagen's illustration is diagrammatic and the original (the only one of his seven examples forwarded to the writer) is now refigured (enlarged x2), but on account of its poor state of preservation specific identification is impossible. The suture-line is not seen, but is probably of the same simplified, though variable, type as the suture-lines of Chippenham specimens figured in pl. XL, figs. 4*a*, *b*. There are no additional examples of this genus either in the Blake Collection or among the thousands of ammonites sent by Mr. J. H. Smith.

Horizon.—Callovian, *anceps*-zone. The matrix is a red ironstone, like that of other *anceps*-zone forms. At Chippenham, Wilts, where *P. calloviensis* is found in abundance, apparently only *Pseudocadoceras* occurs in actual association on the same slabs.

Locality.—Nurrha (Waagen).

Genus Oecoptychius, Neumayr.

Oecoptychius refractus (Reinecke).

(Pl. LXXXI, figs. 5*a-c*.) *

1818. *Nautilus refractus* Reinecke p. 66, pl. III, figs. 27-30.
1825. *Ammonites refractus* (Reinecke) ; de Haan, p. 132, No. 70.
1878. *Oecoptychius refractus* (de Haan) ; Neumayr, p. 68.
1880. *Scaphites refractus* Münster ; Wright, p. 226, text-fig. 125 (after Chenu).
1886. *Ammonites refractus* (Reinecke) ; Quenstedt, p. 763, pl. LXXXVI, figs. 37-50.
1890. *Ammonites refractus* (Reinecke) ; Glangeaud, pl. III, figs. 3-7.
1897. *Oecoptychius refractus* (Reinecke) ; Parona and Bonarelli, p. 159.
1904. *Oecoptychius refractus* (de Haan) ; Lissajous, p. 779, text-figs. 1-5.
1919. *Oecoptychius refractus* (de Haan) ; Spath, p. 172.
1919. *Oecoptychius refractus* (Reinecke) ; Couffon, p. 57, pl. XV, figs. 9-9*d*.
1924. *Oecoptychius refractus* (de Haan) ; Roman, p. 106, pl. XI, figs. 5, 5*a*, 5*b*.

Two typical examples of this well-known species (discussed and figured in many works besides those cited in the above synonymy) were discovered by the writer in the matrix of the large Perisphinctid illustrated in pl. LXXIX, fig. 5. The figured example is almost complete, but the apertural lappets are not preserved ; the second specimen is of the same size but the last half-whorl is damaged. The suture-line (pl. LXXXI, fig. 5*c*) differs slightly from the illustrations given by Quenstedt, Couffon, and Roman, but among a number of Bavarian and Wurtemberg examples before me there is considerable variation in the details of the lobes, obviously of no significance in this extreme development.

Horizon.—Callovian-Divesian, *fraasi* zone (lower ?). The matrix is that of the black shales with *Phlycticeras waageni* (see p. 91) above the red *anceps* beds (with *Parapatoceras*).

Locality.—Nurrha (bed 2, Raj Nath Coll.).

* The part containing this plate will be published subsequently.—Editor.

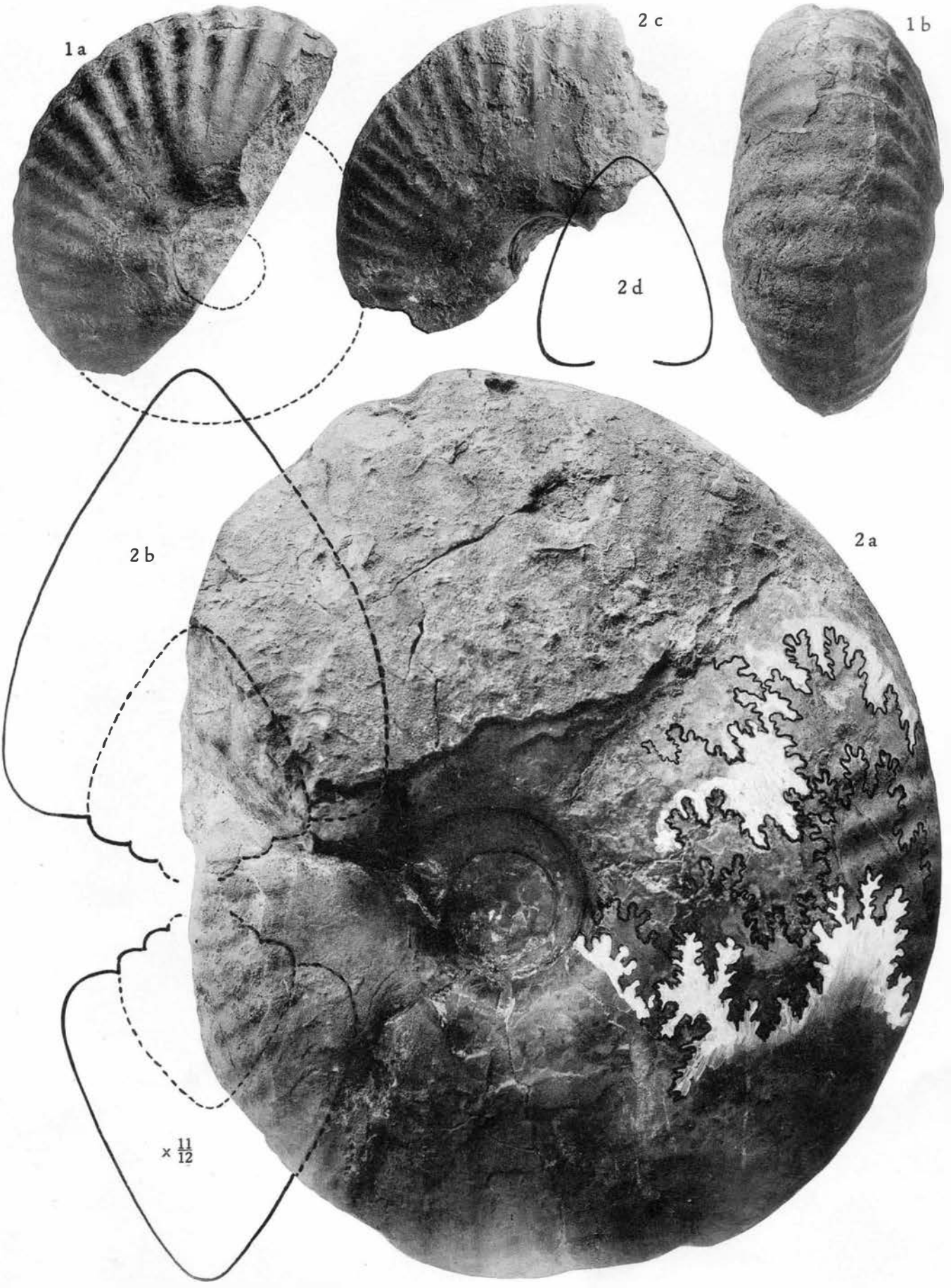
PLATE XX.

FIGS. 1*a-b*. ***Pachyceras distinctum***, sp. nov. Side-, and peripheral views of holotype. From the Divesian (upper '*athleta* beds') of Jikadi, bed No. 22 (Blake Colln. No. 281). (For suture-line see pl. XXXVIII, fig. 7.) (p. 222.)

FIGS. 2*a-d*. ***Pachyceras indicum*** Spath. Side-view and sectional outline of paratype (*a*, *b* reduced $\times\frac{11}{12}$) from Ler, and of earlier portion (*c*, *d*) of an incomplete example, from Fakirwadi. Divesian, upper *athleta* beds. (J. H. Smith Colln.) (p. 221.)

Geol. Surv. of India

Plate XX.



H. G. H., photo.

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PLATE XXI.

FIGS. 1*a*, *b*. *Macrocephalites triangularis*, sp. nov. Side-, and peripheral views of holotype from bed 13 or 14*a* of Jumara. Lower Callovian, *triangularis* zone (= Patcham Group). (J. F. Blake Colln. No. 218.) (p. 180.)

FIGS. 2*a*, *b*. *Macrocephalites formosus* (J. de C. Sowerby). Side-, and peripheral views of an immature example from bed No. 10, Jumara. Lower Callovian, *diadematus* zone. (J. F. Blake Colln. No. 236.) (p. 177.)

FIG. 3. *Indocephalites aff. transitorius*, sp. nov. Immature example from bed No. 11 of Jumara. Lower Callovian, *dimerus* zone. (J. F. Blake Colln. No. 227.) (p. 183.)

FIGS. 4, 5. *Indocephalites kheraensis* Spath. Inner whorls (4) of an example from the Golden Oolite of Khera (J. H. Smith Colln.) and peripheral view (5) of the holotype, figured in pl. XIX, figs. 1*a-c*. Lower Callovian, *diadematus* zone. (For suture-line of fig. 4 see pl. XXII, fig. 2). (p. 184.)

FIGS. 6*a*, *b*. *Indocephalites chrysoolithicus* (Waagen). Side-, and sectional views of a typical example from the Golden Oolite of Khera. Lower Callovian, *diadematus* zone. (J. F. Blake Colln. No. 257.) (p. 186.)

FIG. 7. *Indocephalites diadematus* (Waagen). Sectional view of a fragmentary example from the same bed. (J. H. Smith Colln.) (p. 188).

FIG. 8. *Indocephalites* sp. nov. ? External suture-line of the specimen (B. M. No. C. 10988) from Mombasa, Kenya, (Callovian ?) referred to in 1924, p. 10, as *Mayaites ?* sp. nov. cf. *olcostephanoides ?* (Tornquist). (p. 223.)

Surv. of India

Plate X

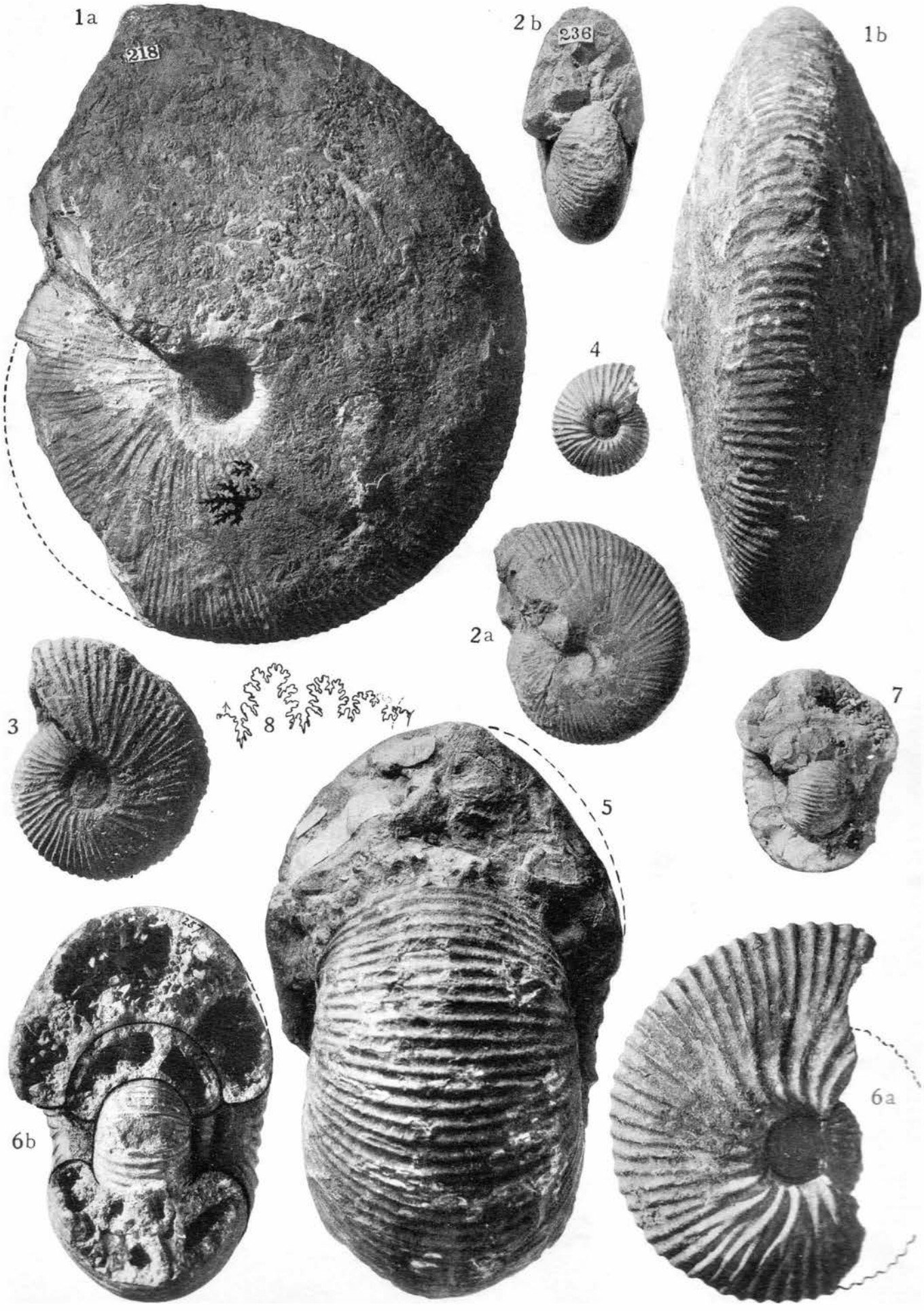

PLATE XXII.

FIGS. 1*a*, *b*. *Indocephalites* sp. Side-, and peripheral views of an example less inflated and less evolute than *I. kheraensis* and transitional to *I. transitorius*. From the Lower Callovian, *diadematus* zone, probably of Khera (B. M. No. C. 25664). (p. 183.)

FIG. 2. *Indocephalities kheraensis* Spath. Suture-line, enlarged (x4) and diagrammatic, of the inner whorls of a large specimen (figured in pl. XXI, fig. 4). Golden Oolite, Khera. (p. 184.)

FIGS. 3*a*, *b*. *Macrocephalites madagascariensis* Lemoine. Side' -and peripheral views of a completely septate example from bed 13 or 14*a* of Jumara. Lower Callovian *triangularis* zone (=Patcham Group). (J. F. Blake Colln. No. 217.) (p. 181).

Geol. Surv. of India

Plate XX

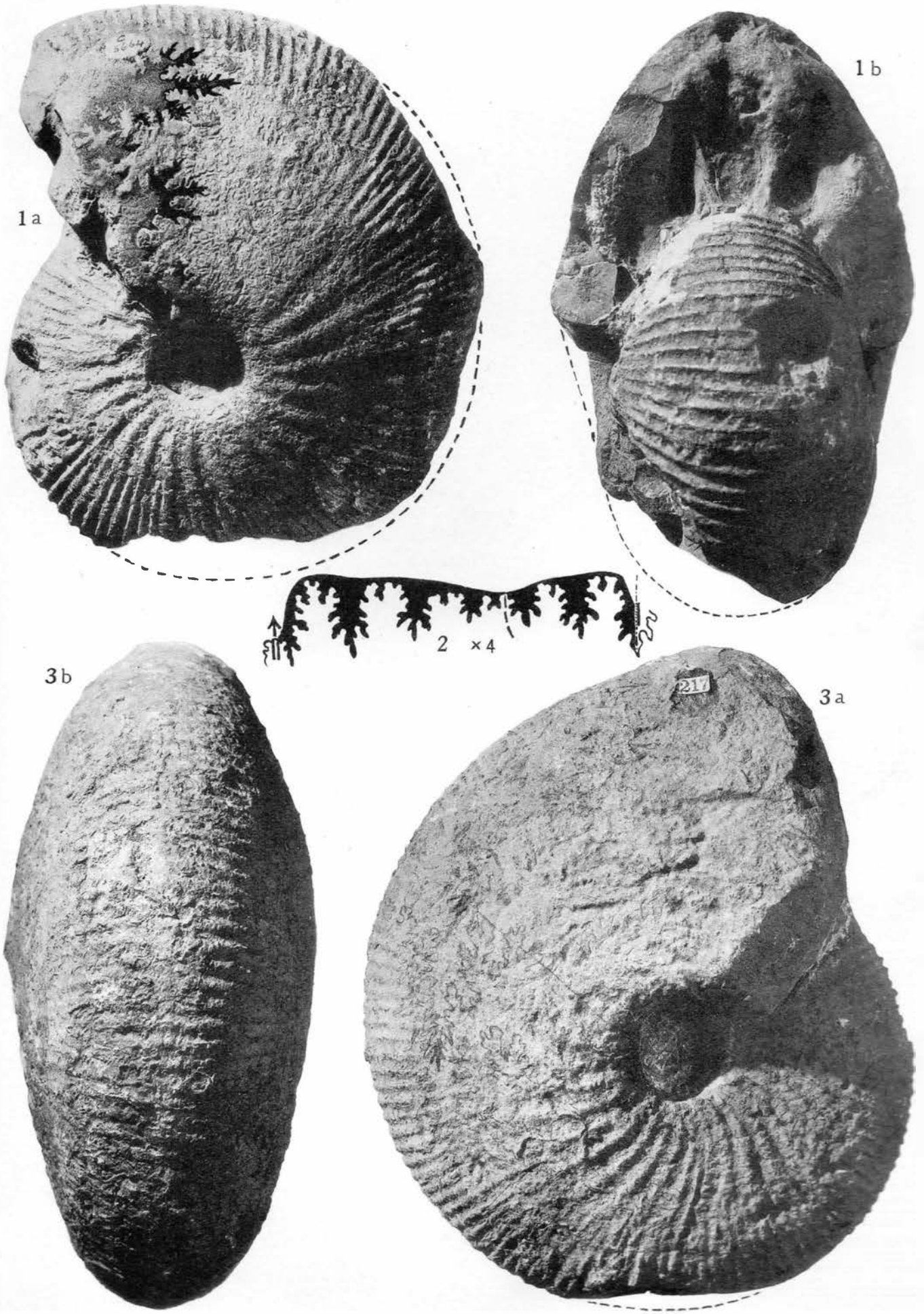

PLATE XXIII.

FIGS. 1*a*, *b*. ***Macrocephalites formosus*** (J. de C. Sowerby). Side-, and peripheral views of holotype from the Golden Oolite (Lower Callovian, *diadematus* zone) of Khera. (B. M., Geol. Soc. Colln. No. R. 9978.) (p. 177.)

FIGS. 2*a*, *b*. ***Indocephalites*** aff. *transitorius*, sp. nov. Side-, and peripheral views of a completely septate, unlocalised, example, transitional to *Macrocephalites madagascariensis*. Lower Callovian, *diadematus* zone ?. (For inner whorls see pl. XXXII, fig. 1.) (B. M. No. C. 92.) (p. 183.)

FIG. 3. ***Pleurocephalites elephantinus*** (J. de C. Sowerby). Part of external suture-line, at diameter of 45 mm., traced directly from holotype (represented in pl. XXIV, figs. 1*a*, *b*). Lower Callovian (*diadematus* zone ?), probably from Khera. (B. M. Geol. Soc. Colln. No. R. 9977.) (p. 194.)

FIGS. 4*a*, *b*. ***Eucycloceras*** cf. *eucyclum* (Waagen). Side-view and outline whorl-section of fragmentary inner whorls from bed No. 10, Khera, Callovian, *rehmanni* zone ? (J. F. Blake Colln. No. 250.) (p. 209.)

Geol. Surv. of India

Plate XXIII.

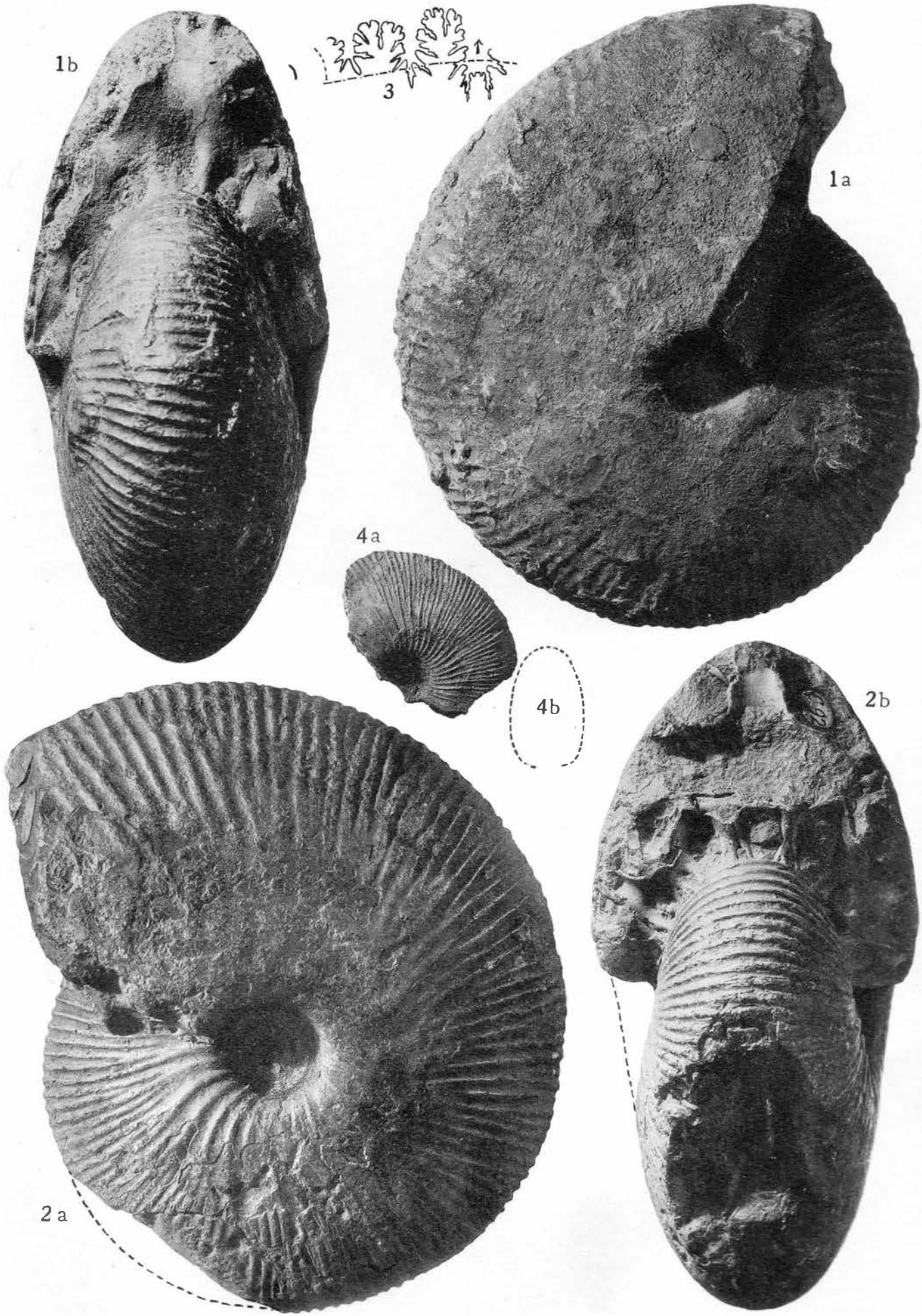

PLATE XXIV.

Figs. 1*a*, *b*. *Pleurocephalites elephantinus* (J. de C. Sowerby). Side, and peripheral views of holotype, probably from Khera. Lower Callovian, *diadematus* zone ?. (B. M., Geol. Soc. Colln. No. R. 9977.) (p. 194.)

Figs. 2*a*-*c*. *Macrocephalites formosus* (J. de C. Sowerby). Suture-lines at diameters of 75 and 110mm. and outline whorl-section of an unlocalised example apparently from Kachh. Lower Callovian, *diadematus* zone. (B. M. No. C. 28851.) (p. 177.)

Fig. 3. *Kamptokephalites lamellosus* (J. de C. Sowerby). Outline whorl-section of earlier part of a Habye example, agreeing with Waagen's pl. xxxiii, fig. 1. Lower Callovian, *diadematus* zone. (J. H. Smith Colln.) (p. 198.)

Fig. 4. *Pleurocephalites habyensis*, nom. nov. External (last two) suture-lines of a Habye example. Lower Callovian, *dimerus* zone ?. (J. H. Smith Colln. No. 55. (p. 192.)

Fig. 5. *Collotia* sp. ind. nov. ? Peripheral view and outline whorl-section of a fragmen from the Divesian (lower '*athleta* beds'=*fraasi* zone ?) of Walakhavas (J. H. Smith Colln.). (p. 274.)

Figs. 6*a*-*c*. *Indocephalites transitorius*, sp. nov. Side, and peripheral views of inner whorls and outline section of outer whorl of a Golden Oolite example from Khera. Lower Callovian, *diadematus* zone. (J. H. Smith Colln. No. 47.) (p. 183.)

Fig. 7. *Indocephalites* aff. *chrysoolithicus* (Waagen). Side-view of a completely septate example with closer ribbing than the type, from Khera (bed No. 4=Golden Oolite). Lower Callovian, *diadematus* zone. (G. S. I. No. $\mathbf{K.\frac{28}{197}}$.) (p. 186.)

Geol. Surv. of India

Plate XXIV

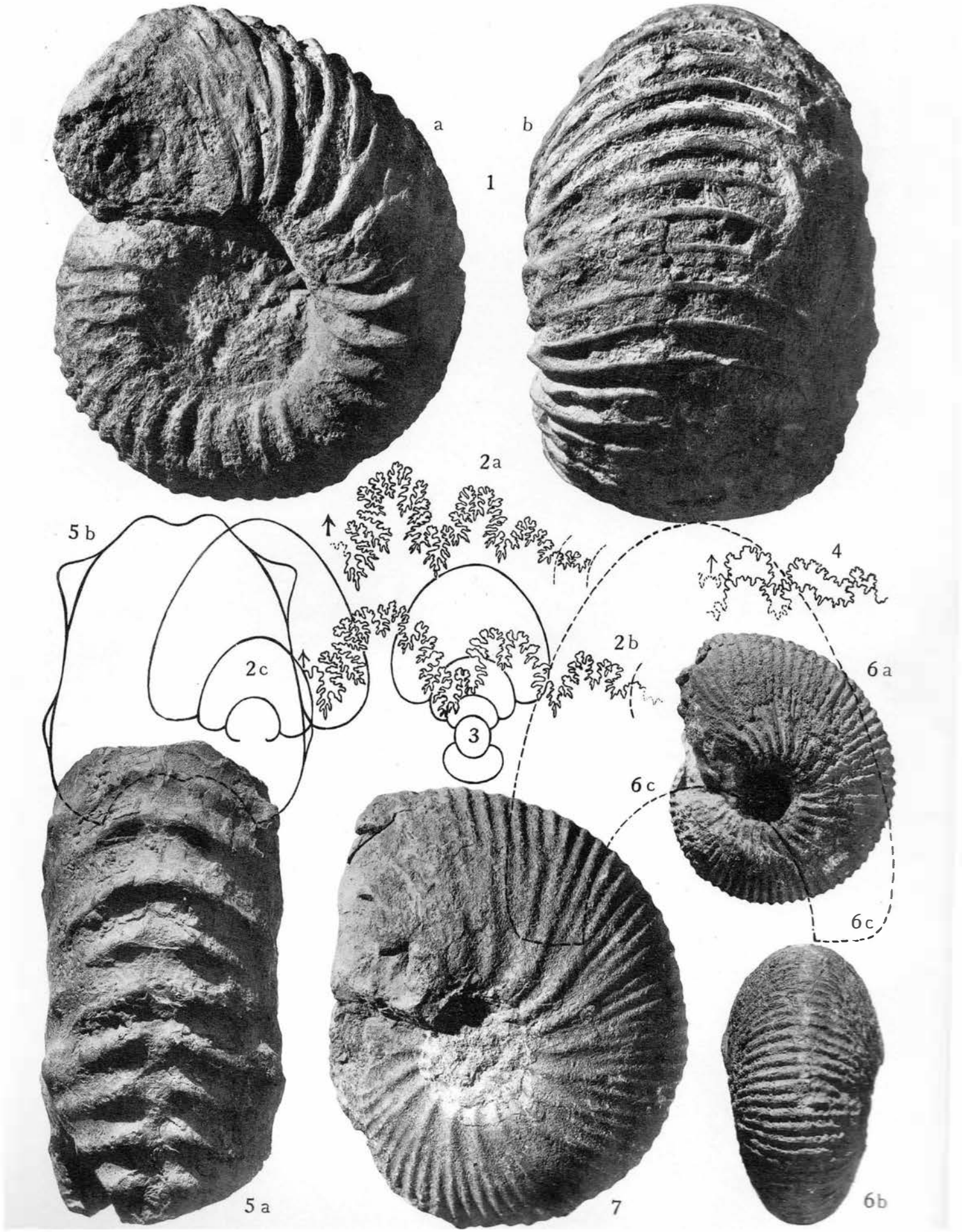

PLATE XXV.

FIG. 1. *Indocephalites* aff. *chrysoolithicus* (Waagen). Peripheral view of an example transitional to *I. diadematus* (Waagen) from the Lower Callovian (*diadematus* zone= Golden Oolite) of Khera Hill. (See pl. XXVI, figs. 6.) (G. S. I. No. K. $\frac{99}{160}$.) (p. 186.)

FIG. 2. *Macrocephalites chariensis* (Waagen). External suture-line of the example figured in pl. XXXV, fig. 8. From the Lower Callovian (*diadematus* zone) of *Habye*. (J. H. Smith Colln. No. 45.) (p. 179.)

FIG. 3. *Indocephalites sphæroidalis*, sp. nov. Side-view of inner whorls of holotype. From the Lower Callovian, *dimerus* zone ?, of Khera ('lowest beds exposed'). See pl. XXVI, fig. 1, and pl. XXVII, fig. 2. (J. H. Smith Colln. No. 88.) (p. 191.)

FIG. 4. *Eucycloceras eucyclum* (Waagen). Side-view of a typical example from the Callovian, *rehmanni* zone ?, of Khera (bed No. 10). (J. F. Blake Colln. No. 246.) (p. 209.)

FIG. 5. *Epimayaites* aff. *subtumidus* (Waagen). Peripheral view of an example slightly less inflated than type. From the Upper Argovian (Kantcote Sandstone). River Bed, west of Kantcote. (For side-view see pl. XXXII, fig. 9.) (J. F. Blake Colln. No. 303.) (p. 237.)

FIG. 6. *Indocephalites* sp. juv. aff. *diadematus* (Waagen). Peripheral view (with aperture worn away on each side) of inner whorls of an example transitional to *I. chrysoolithicus*. (Lower Callovian, *diadematus* zone) of East Badi (loose, lower zone?). (J. F. Blake Colln. No. 269.) (p. 188.)

FIGS. 7*a-b*. *Kamptokephalites* aff. *lamellosus* (Waagen). Side-view (*a*) and peripheral aspect of inner whorls only (*b*) of a Habye example. Lower Callovian, *diadematus* zone ?. (J. H. Smith Colln. No. 128.) (p. 198.)

FIGS. 8*a*, *b*. *Epimayaites* aff. *axonoides*, sp. nov. Side-, and peripheral views of an example transitional to *E. subtumidus* (Waagen). From the Argovian (Kantcote Sandstone). River Bed, west of Kantcote. (J. F. Blake Colln. No. 300.) (p. 235.)

FIG. 9. *Dhosaites elephantoides*, nom. nov. Side-view of a slightly- worn, incomplete, example from the Dhosa Oolite (Argovian) of Fakirwadi. (J. H. Smith Colln.) (p. 244.)

Geol. Surv. of India

Plate XXV.

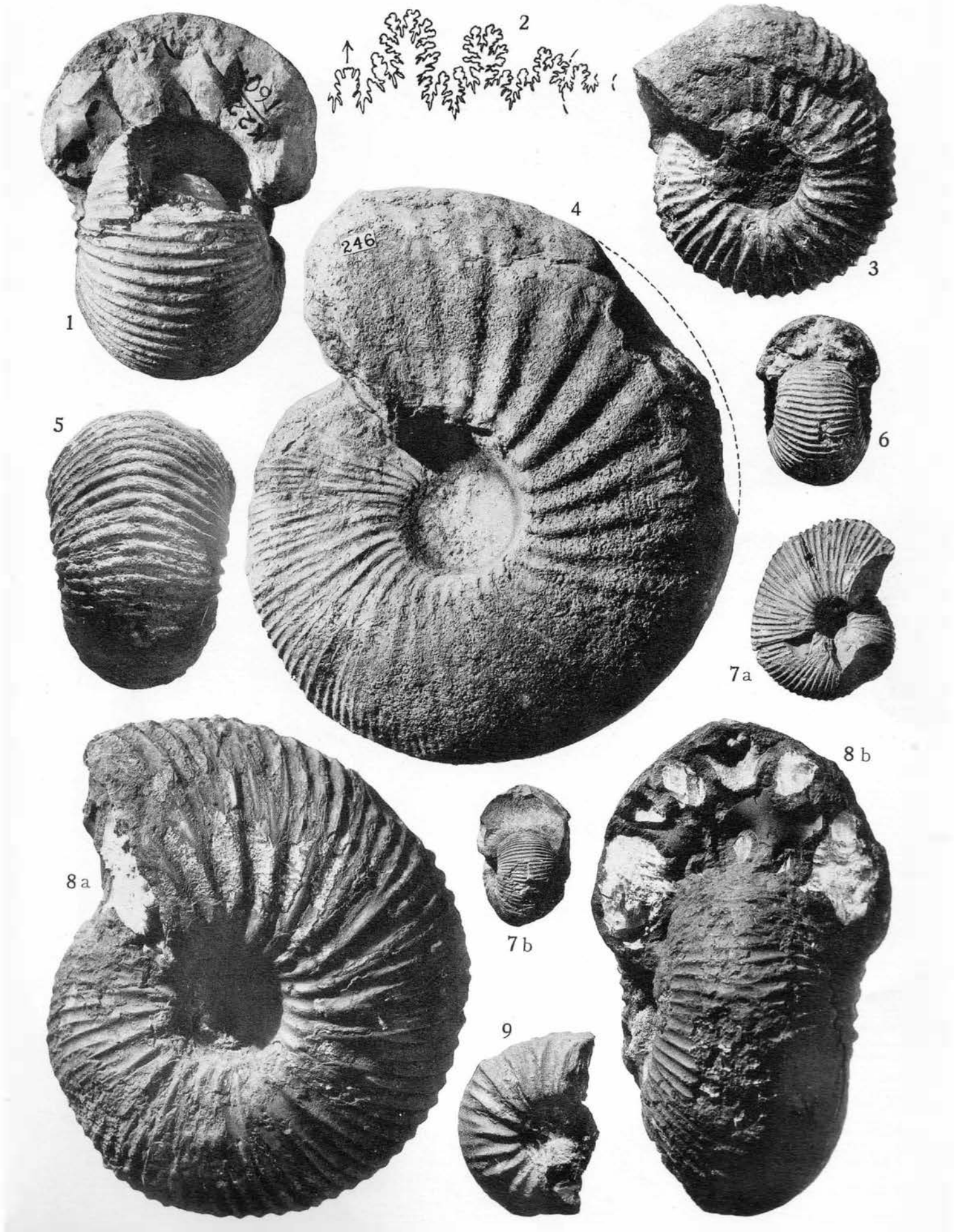

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PLATE XXVI.

FIG. 1. *Indocephalites sphæroidalis*, sp. nov. Peripheral view of inner whorls of holotype, represented in pl. XXV, fig. 3. Khera. (J. H. Smith Colln. No. 88.) (p. 191.)

FIG. 2. *Epimayaites transiens* (Waagen). Suture-line of a large example from the River Bed, east of Kantcote. Argovian, Kantcote Sandstone. Umbilical portion (on the right) incomplete. (J. F. Blake Colln. No. 289.) (p. 240).

FIG. 3. *Reineckeites* aff. *waageni* (Till). Side-view of a fragmentary example from the Callovian, *anceps* beds, of Walakhavas. (J. H. Smith Colln. No. 27.) (p. 268.)

FIGS. 4*a*, *b*. *Epimayaites* aff. *lemoini* (Spath). Side-, and peripheral views of an example transitional to *E. axonoides* sp. nov. From the River Bed west of Kantcote. Argovian, Kantcote Sandstone. (J. F. Blake Colln. No. 291.) (p. 234).

FIGS. 5*a*, *b*. *Indocephalites indicus*, sp. nov. Side-and peripheral views of holotype from Jumara, bed No. 11. Lower Callovian, *dimerus* zone. (J. F. Blake Colln. No. 231.) (p. 189.)

FIG. 6. *Indocephalites* aff. *chrysoolithicus* (Waagen). Side-view of the Khera example (transitional to *I. diadematus*) figured in pl. XXV, fig. 1. (G. S. I. No. K. $\frac{3\ 2}{1\ 6\ 0}$.) (p. 186.)

Geol. Surv. of India

Plate XXVI.

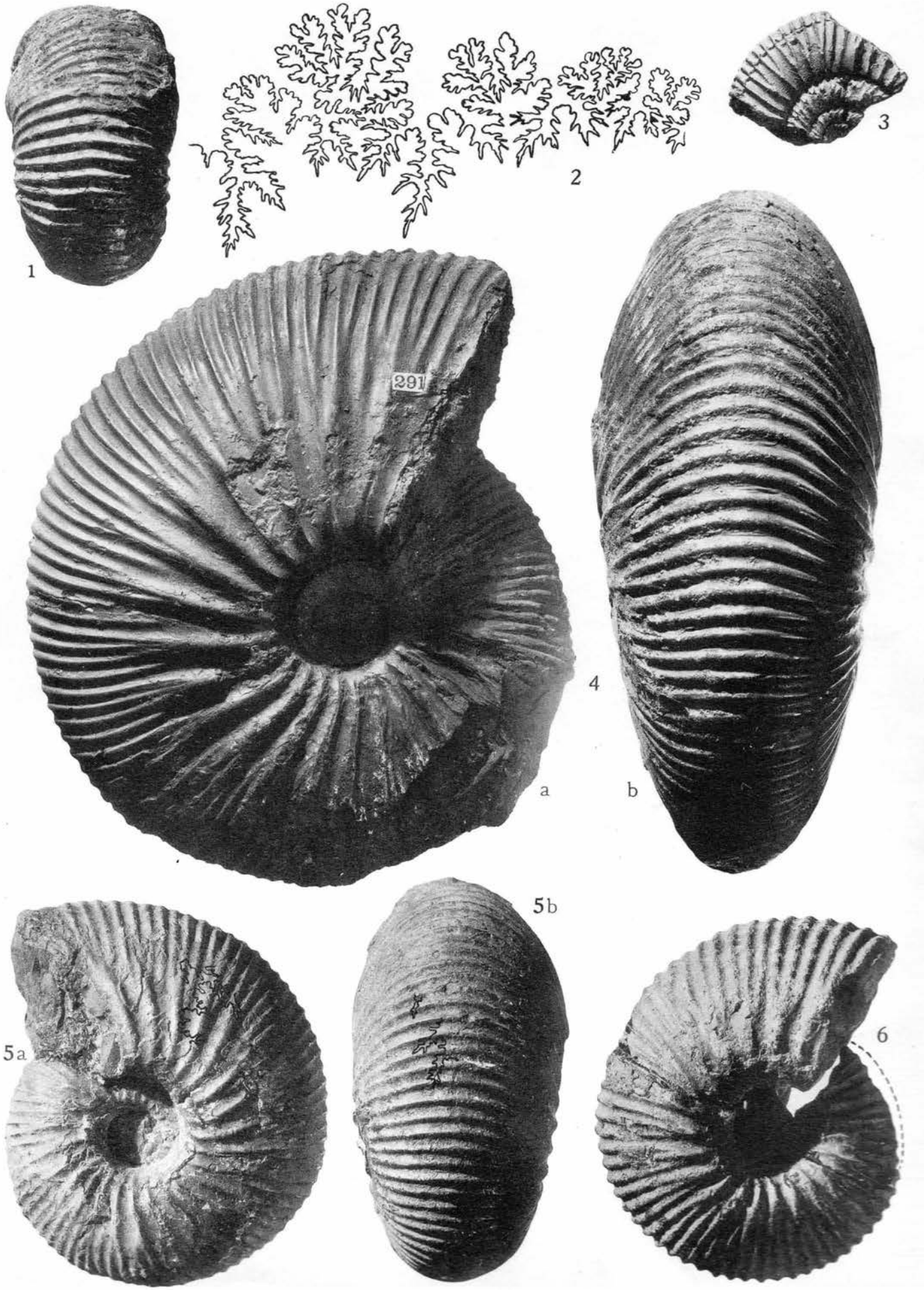

PLATE XXVII.

FIGS. 1*a*, *b*. *Reineckeia smithi*, sp. nov. Side-, and peripheral views of holotype from the Callovian, *anceps* zone of Khera Hill (bed No. 7). (G. S. I. No. K. $\frac{22}{202}$.) (p. 263.)

FIG. 2. *Indocephalites sphæroidalis*, sp. nov. External suture-line of (unfigured) outer whorl of the example represented in pl. XXV, fig. 3 and pl. XXVI, fig. 1, from the lowest beds (*dimerus* zone) of Khera. (J. H. Smith Colln. No. 88.) (p. 191.)

FIG. 3. *Grayiceras blanfordi* Spath. External suture-line of holotype (*Amm. nepaulensis*. Blanford, non Gray, 1865, pl. XIV, fig. 1) from the Spiti Shales, probably Tithonian. (B. M. No. C. 25182.) (p. 224.)

FIG. 4. *Dolikephalites* sp. nov.? ind. (*subcompressus* group ?) Side-view of inner whorls of a Golden Oolite example, probably from Khera. B. M. No. C. 30500. (*ex* Col. Pottinger Colln.) (p. 202.)

FIG. 5. *Indocephalites indicus*, sp. nov. Tracing of external suture-line of holotype (pl. XXVI, figs. 5*a*, *b*). Jumara. (J. F. Blake Colln. No. 231.) (p. 189.)

FIG. 6. *Eucycloceras pilgrimi*, sp. nov. Side-view of holotype from Callovian, *rehmanni* zone, of Khera (bed No. 10). (For peripheral view see pl. XXIX, fig. 2.) (J. F. Blake Colln. No. 248.) (p. 209.)

FIGS. 7*a*, *b*. *Eucycloceras eucyclum* (Waagen). Side-, and peripheral views of nearly complete, small example from same horizon and locality. (J. F. Blake Colln. No. 249.) (p. 209.)

Geol. Surv. of India

Plate XXVII.

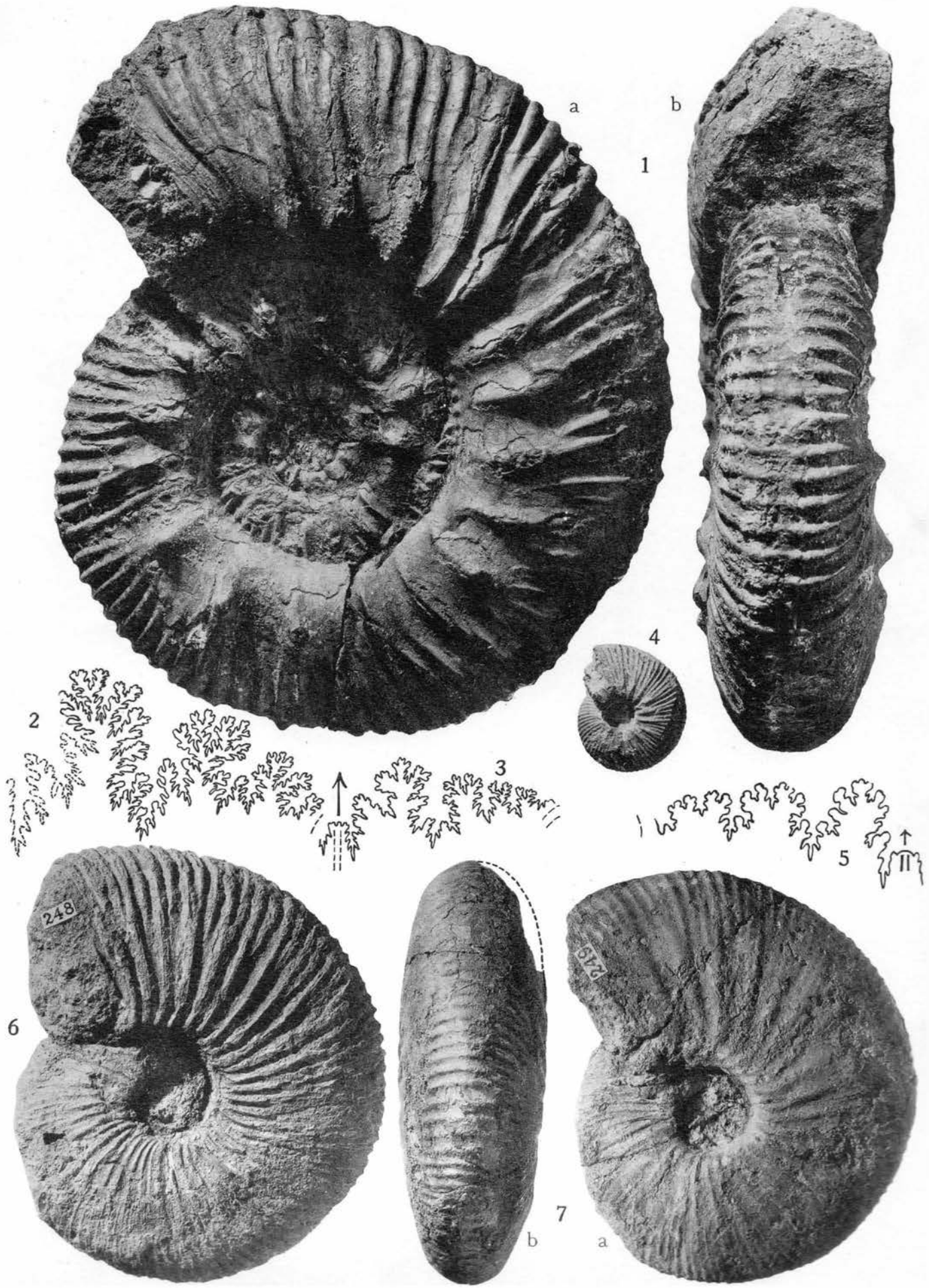

PLATE XXVIII.

Figs. 1*a*, *b*. ***Indocephalites gibbosus***, sp. nov. Side-view and outline whorl-section of holotype, from the Lower Callovian (*dimerus* or *diadematus* zone) of Jumara (beds 9-11). (J. F. Blake Colln. No. 229.) (p. 190.)

Figs. 2*a*, *b*. ***Nothocephalites asaphus***, sp. nov. Side-, and peripheral views of holotype, from the Callovian, rehmanni (*diadematus* ?) zone of Khera (bed No. 10). (For suture-line see pl. XXXVII, fig. 2). (J. F. Blake Colln. No. 265.) (p. 208.)

Fig. 3. *Epimayaites* aff. *transiens* (Waagen). Side-view of immature example from the River Bed, west of Kantcote. Argovian, Kantcote Sandstone. (J. F. Blake Colln. No. 309.) (p. 240.)

Fig. 4. *Mayaites ?* (*Paryphoceras ?*) aff. *arenosus* (Waagen). Tracing of external suture-line (slightly worn) of a doubtful example from Fakirwadi. Argovian, Dhosa Oolite. (G. S. I. No. K. $\frac{22}{179}$.) (p. 232.)

Fig. 5. *Mayaites* aff. *maya* (J. de C. Sowerby). Suture-line (diagrammatic and enlarged × 2·5) of the immature, transitional example, figured in pl. XXXVII, figs. 11*a*, *b*. Argovian (Dhosa Oolite) of Fakirwadi. (G. S. I. No. K. $\frac{22}{183b}$.) (p. 225.)

Figs. 6*a-c*. *Kamptokephalites ?* sp. ind. Peripheral view, outline whorl-section and part of suture-line of a fragmentary Khera example. Lower Callovian, *diadematus* zone ? (J. H. Smith Colln. No. 27.) (p. 198.)

Fig. 7. *Prograyiceras tramaunense*, sp. nov. Peripheral view of holotype from the Upper Argovian of the Tramau River, Wagur ("above zone I"). See also plate L, fig. 5. (J. F. Blake Colln. No. 322.) (p. 251.)

Fig. 8. *Idiocycloceras* aff. *singulare*, nom. nov. External suture-line (incomplete at umbilical end) of example figured in pl. XL, fig. 5. Callovian ("sub *anceps* beds II") Ler-Hamundra-Ellipse. (J. H. Smith Colln.) (p. 216.)

Geol. Surv. of India

Plate XXVI

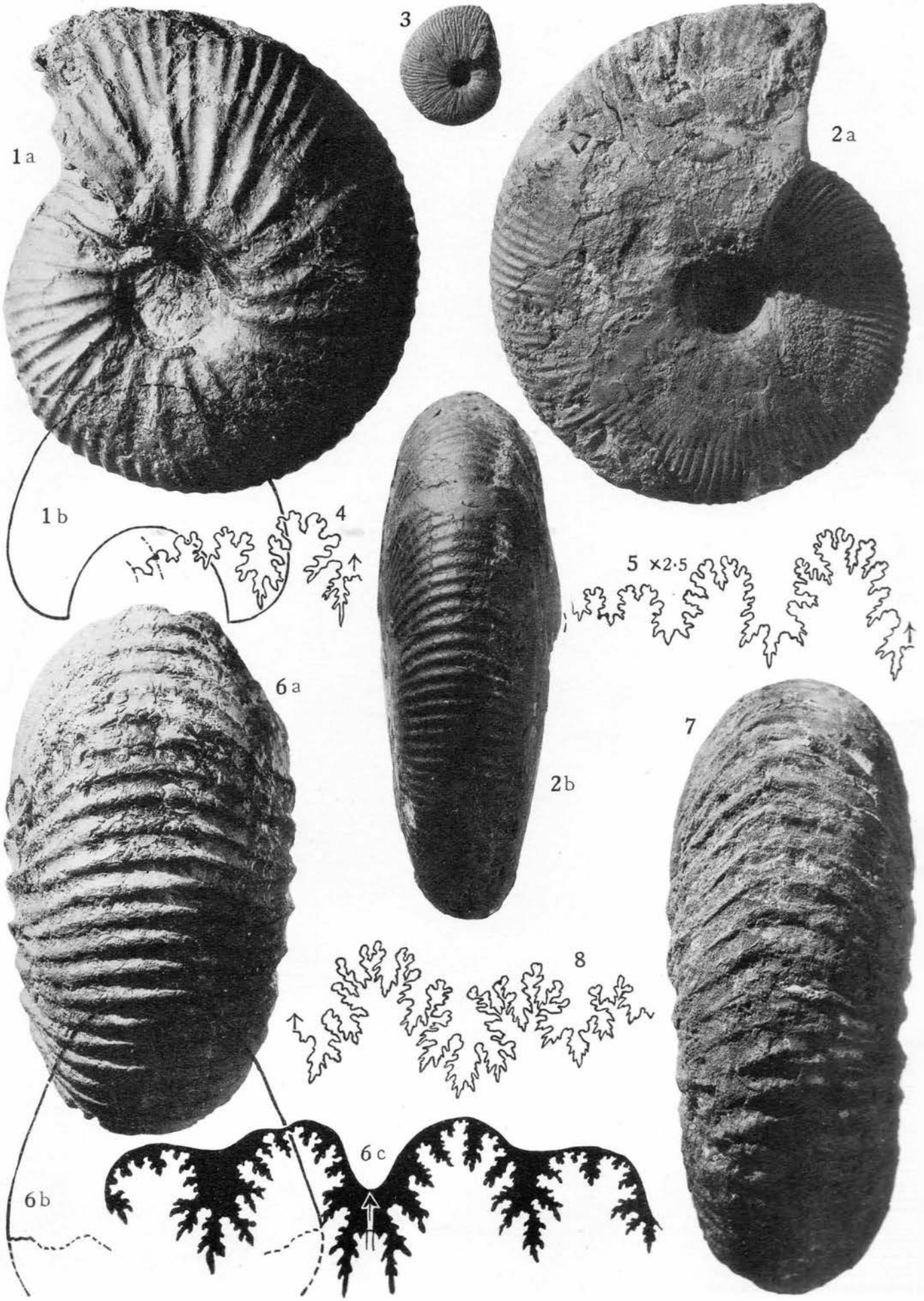

PLATE XXIX.

FIGS. 1*a*, *b*. *Epimayaites pseudindicus*, sp. nov. Side-view and outline whorl-section of holotype, from Kantcote (?). Argovian, Kantcote Sandstone. (J. F. Blake Colln. No. 266.) (p. 237.)

FIG. 2. *Eucycloceras pilgrimi*, sp. nov. Peripheral view of example figured in pl. XXVII, fig. 6. Khera. (J. F. Blake Colln. No. 248.) (p. 209.)

FIGS. 3*a*, *b*. *Reineckeia ravana*, sp. nov. Side-view and outline whorl-section of holotype from the Callovian, *anceps* beds, of Fakirwadi (?). (G. S. I. No. K. $\frac{22}{282}$, pars.) (p. 264.)

FIG. 4. *Kamptokephalites dimerus* (Waagen). Peripheral view of example figured in pl. XXX, fig. 4. Lower Callovian *dimerus* zone, of Jumara, bed No. 11. (J. F. Blake Colln. No. 233.) (p 197.)

FIG. 5. *Mayaites* aff. *mayo* (J. de C. Sowerby). Side-view of an example with finer ribbing than type. Argovian (Dhosa Oolite) of Samatra. (For peripheral view see pl. XXX, fig. 2.) (G. S. I. No. K. $\frac{22}{186}$, pars.) (p. 225.)

FIGS. 6*a*, *b*. *Epimayaites* aff. *subtumidus* (Waagen). Side-view and restored outline whorl-section of a transitional example from the Argovian ('zone I') of the Tramau River. (J. F. Blake Colln. No. 319.) (p. 237.)

FIGS. 7*a-c*. *Collotia ?* (*Reineckeia*) *octagona*, sp. nov. Side-, and peripheral views and outline whorl-section of holotype from the Callovian *anceps* beds, of Fakirwadi. (G. S. I. No. K. $\frac{22}{282}$, pars.)(p. 276.) The lateral tubercles in fig. 7*c*. are drawn too prominent; the whorl-thickness is only 38% of the diameter.

Geol. Surv. of India

Plate XXIX.

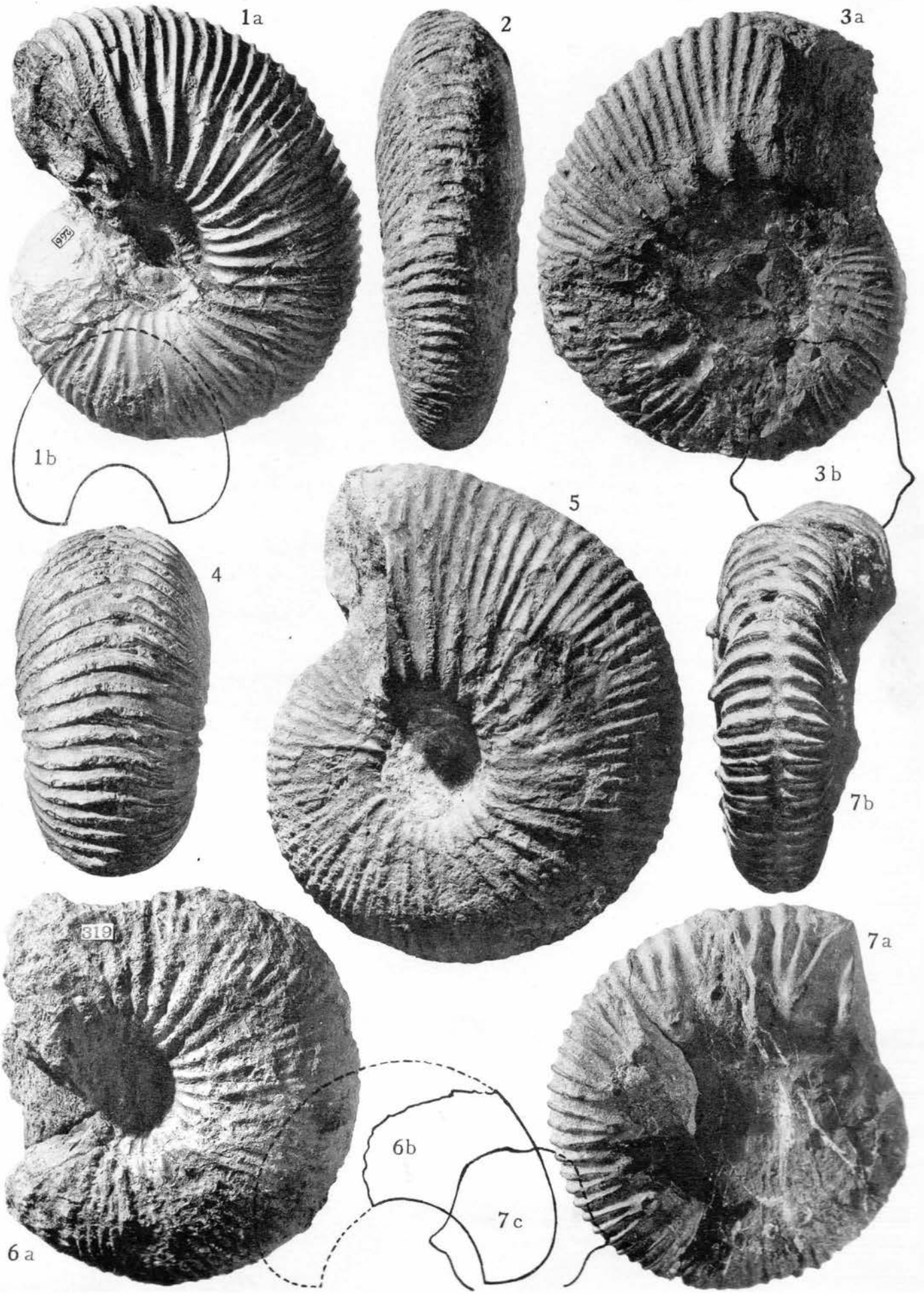

PLATE XXX.

Fig. 1. *Nothocephalites semilævis* (Waagen). Side-view of inner whorls of holotype (Waagen's pl. XXVIII, fig. 3). See also pl. XXXIII, fig. 12. Callovian, *rehmanni* zone ?, near Soorka. (G. S. I. No. $\frac{1}{9\,9\,6}$.) (p. 207.)

Fig. 2. *Mayaites* aff. *maya* (J. de C. Sowerby). Peripheral view of example figured in pl. XXIX, fig. 5. Dhosa Oolite, Samatra. (G. S. I. No. K.$\frac{2\,2}{1\,8\,6}$, pars.) (p. 225.)

Figs. 3*a-c*. *Mayaites rotundus*, sp. nov. Side-, and peripheral views of outer and inner whorls of holotype from Dhosa Oolite (Argovian) of Fakirwadi. (For suture-line see pl. XLIV, figs. 7*a*, *b*.) (J. H. Smith Colln.) (p. 227.)

Fig. 4. *Kamptokephalites dimerus* (Waagen). Side-view of the Jumara example in the Blake Colln. (No. 233) figured in pl. XXIX, fig. 4. (p. 197.)

Fig. 5. *Kamptokephalites* aff. *dimerus* (Waagen). Last suture-lines of a Habye example at diameter of 55mm. Lower Callovian, *dimerus* zone. (J. H. Smith Colln. No. 22.) (p. 197.)

Fig. 6. *Pleurocephalites habyensis*, sp. nov. Suture-line (last, at diameter=65mm.) of a Habye example. Lower Callovian, *dimerus* zone ? (J. H. Smith Colln. No. 14.) (p. 192.)

Geol. Surv. of India

Plate XXX.

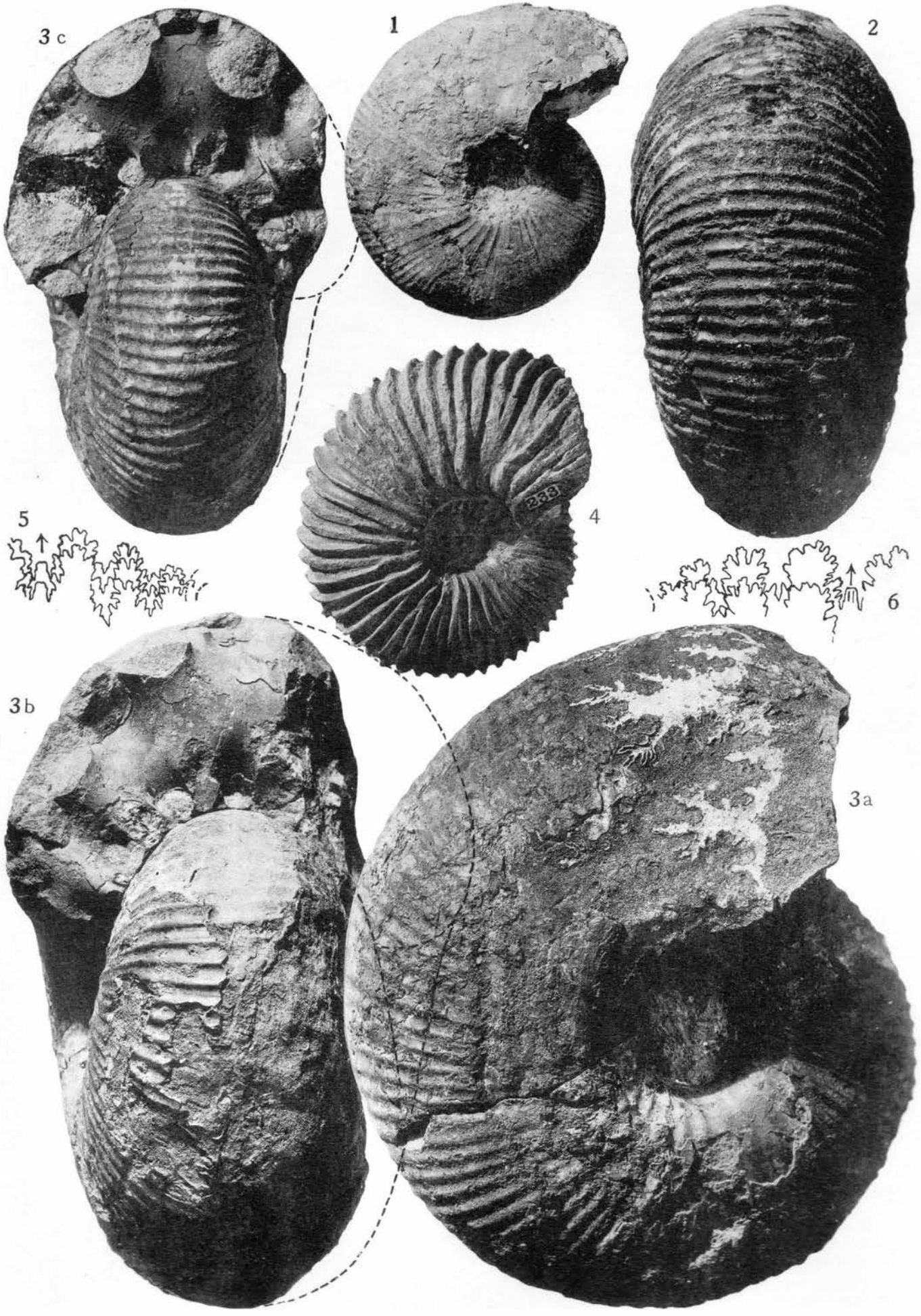

PLATE XXXI.

Figs. 1*a*, *b*. *Mayaites maya* (J. de C. Sowerby). Side-view and part of external suture-line of holotype. Argovian. Locality doubtful. (The external saddle is omitted in fig. 1*b*, the deep lobe on the left being the first lateral lobe.) For peripheral view see pl. XXXII, fig. 6. (B. M. ex Geol. Soc. Colln. No. R. 10074.) (p. 225.)

Figs. 2*a*, *b*. *Pleurocephalites* aff. *elephantinus* (J. de C. Sowerby). Side-, and peripheral views of a small Habye example, resembling *P. pila* (Nikitin, in Sémenow, 1896, pl. II, fig. 2). Lower Callovian, *diadematus* zone? (J. H. Smith Colln.) (p. 194.)

Figs. 3*a*, *b*. *Collotia fraasi* (Oppel). Side-, and peripheral views of a Wurtemberg example agreeing with Petitclerc's (1917) pl. X, fig. 22. For comparison with the Kachh example figured in pl. XLII, fig. 3. (B. M. No. C. 29220.) (p. 275.)

Fig. 4. *Indocephalites* aff. *kheraensis* Spath. Peripheral view of inner whorls of a Golden Oolite example, transitional between *I. kheraensis* and *I. transitorius*. Khera, bed No. 14. Lower Callovian, *diadematus* zone. (J. F. Blake Colln. No. 239.) (p. 184).

Fig. 5. *Indocephalites diadematus* (Waagen). External suture-line of a large Golden Oolite (Khera) example from Col. Pottinger's Colln. (B. M. No. C. 29221.) (p. 188.)

Fig. 6. *Subkossmatia coggin-browni*, sp. nov. External suture-line of an unlocalised fragment from the Callovian, sub-*anceps* beds. (J. H. Smith Colln. No. 22.) (p. 212.)

Fig. 7. *Epimayaites subtumidus* (Waagen). Side-view of a typical example from the Argovian (Kantcote Sandstone) River Bed, west of Kantcote. (J. F. Blake Colln. No. 302.) (p. 237.)

Geol. Surv. of India

Plate XXXI.

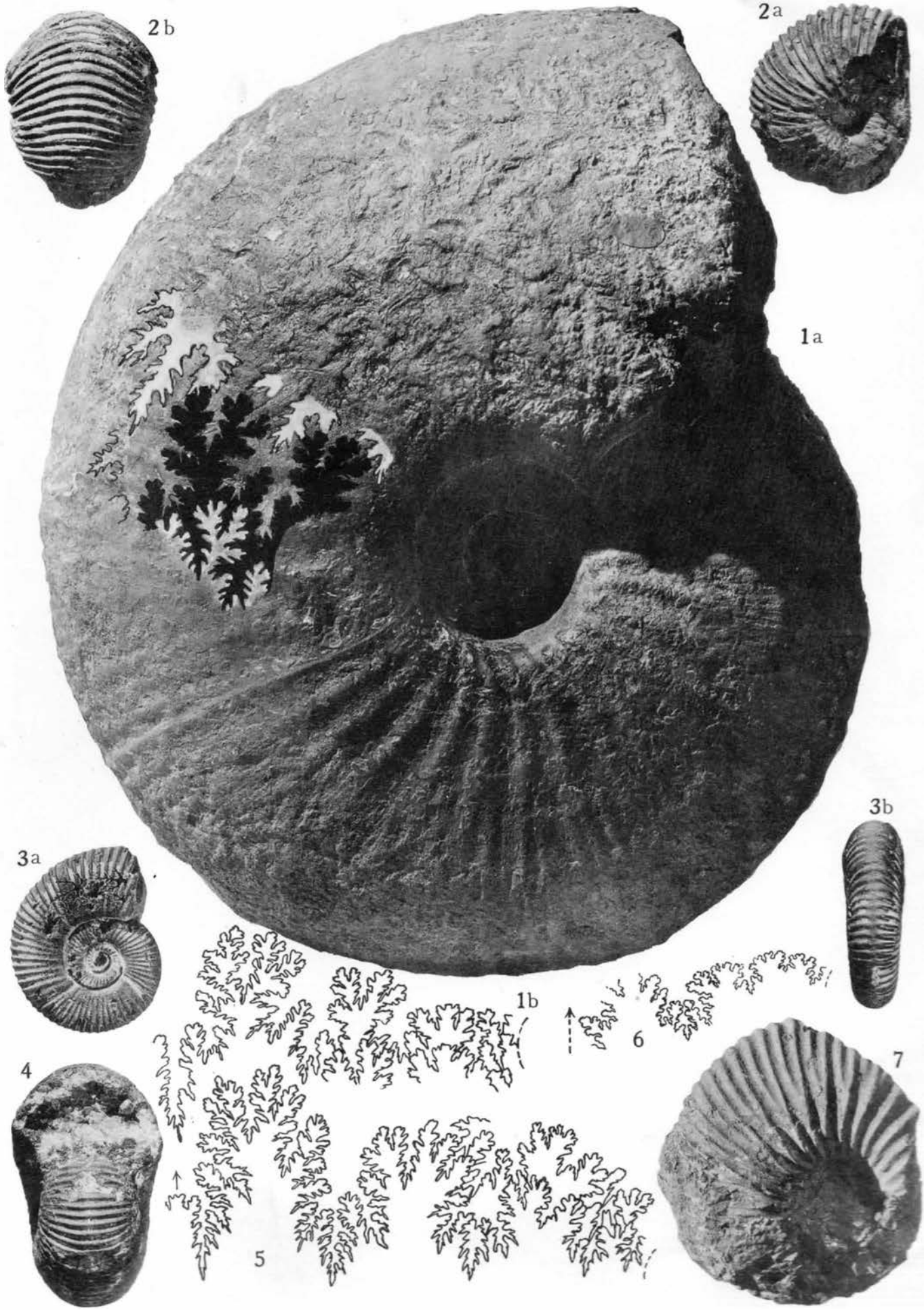

PLATE XXXII.

Fig. 1. *Indocephalites* aff. *transitorius*, sp. nov. Side-view of inner whorls of the (unlocalised) example transitional to *Macrocephalites madagascariensis* figured in pl. XXIII, figs. 2*a*, *b*. Lower Callovian, *diadematus* zone? (B. M. No. C. 92.) (p. 183.)

Fig. 2. *Epimayaites* cf. *excentricus*, sp. nov. Side-view of a doubtful and corroded, immature example from the Argovian ("Upper Beds") of Gangta Bét. (For peripheral view see pl. XXXVII, fig. 8). (J. F. Blake Colln. No. 274.) (p. 239.)

Fig 3. *Kamptokephalites etheridgei*, sp. nov. Plaster cast of Etheridge's "*Stephanoceras*, allied to *S. lamellosum*" (1890, p. 175, pl. XXIX, fig. 1) from the Lower Callovian, Strickland River, New Guinea. (Compare '*Macrocephalites keeuwensis*, G. Bœhm, *delta*, var. *bifurcata*,' 1912*a*, pl. XLIII, figs. 4*a-c*. '*M*'. *cf. chrysoolithicus* (non Waagen) and '*M*'. *waageni* (non Uhlig) in Kruizinga, 1926, pl. IV, figs. 1, 2 and pl. IX figs. 1, 2.) (p. 200.)

Fig. 4. *Dolikephalites flexuosus*, sp. nov. Plaster cast of Etheridge's "*Stephanoceras*, allied to *S. calloviense*" (1890, p. 175, pl. XXIX, fig. 5) from the Lower Callovian, Strickland River, New Guinea. (Compare '*Macrocephalites keeuwensis*, G. Bœhm, *typus*, 1912*a*, pl. XXXVI, figs. 3*a*, *b*.) (p. 210.)

Fig. 5. *Dhosaites* aff. *primus*, sp. nov. Peripheral view of the transitional Samatra example figured in pl. XLIX, fig. 4. Argovian, Dhosa Oolite. (G. S. I. No. K. $\frac{22}{170}$.) (p. 245.)

Fig. 6. *Mayaites maya* (J. de C. Sowerby). Peripheral view of holotype figured in pl. XXXI, fig. 1. (B. M. ex Geol. Soc. Colln. No. R. 10074.) (p. 225.)

Figs. 7*a*, *b*. *Indocephalites* aff. *transitorius*, sp. nov. Side-, and peripheral views of a small example (with body-chamber) from the Lower Callovian, *dimerus* zone. Jumara (bed No. 11). (J. F. Blake Colln. No. 224.) (p. 183.)

Fig. 8. *Pleurocephalites*, sp. ind. Side-view of a Madagascar example of the *elephantinus*-group (South Afr. Mus. Colln. No. 8061) identical with one of the Madagascar *Pleurocephalites* recorded in Spath, 1925*b*, p. 14. (p. 195.)

Fig. 9. *Epimayaites* aff. *suotumidus* (Waagen). Side-view of the example figured in pl. XXV, fig. 5, from the River Bed, west of Kantcote. (J. F. Blake Colln. No. 303.) (p. 237.)

Geol. Surv. of India

Plate XXXII.

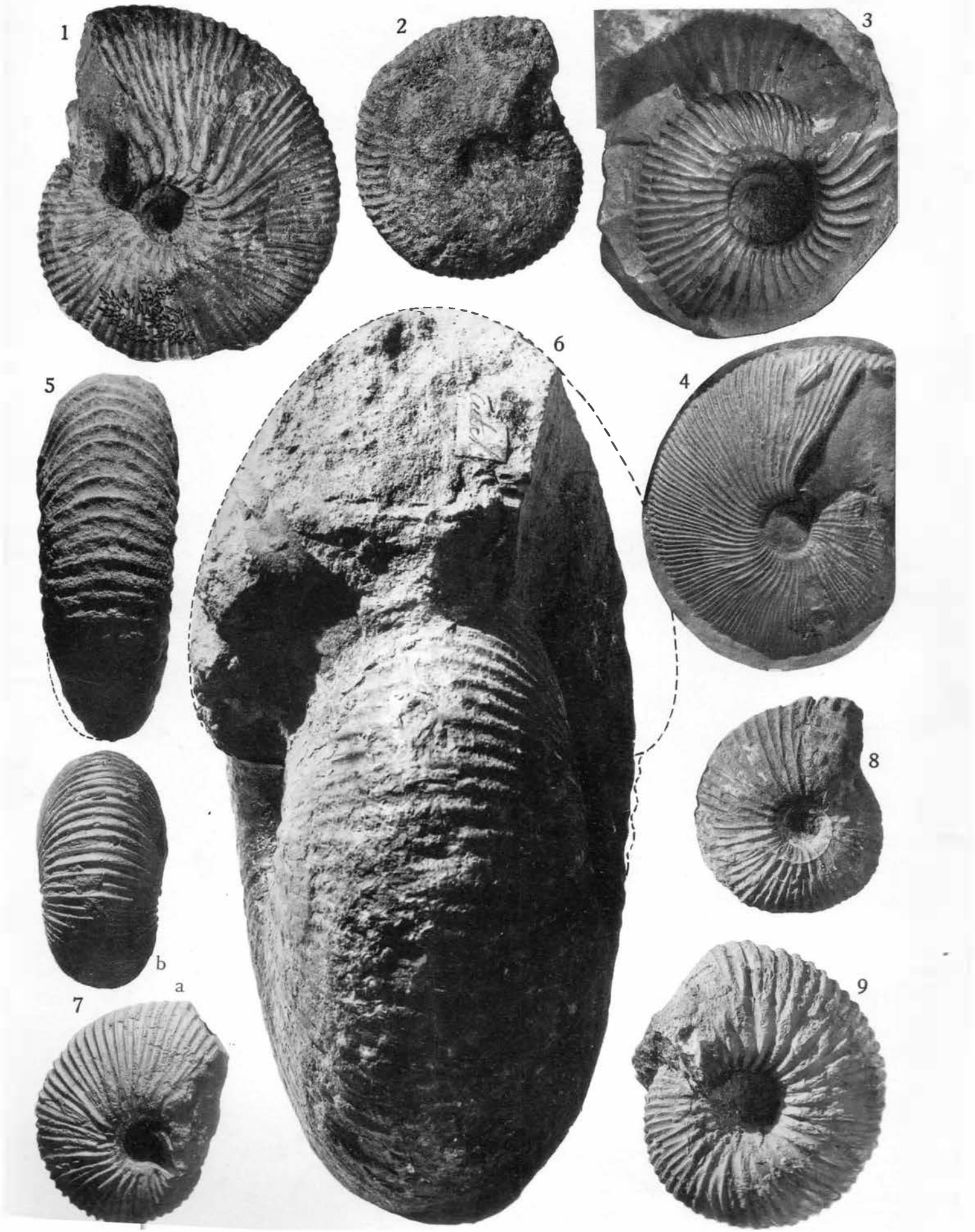

PLATE XXXIII.

FIGS. 1*a*, *b*. *Reineckeites*, sp. nov. ind. Side-view and outline whorl-section of the example previously (1924, p. 12) recorded as *Reineckeia* cf. *greppini* (Oppel) Lemoine, from the 'Lower zone,' East of Jooria. (Callovian, *anceps* zone.) (J. F. Blake Colln. No. 404.) (p. 271.)

FIGS. 2*a*, *b*. *Reineckeia arthritica* (J. de C. Sowerby). Side-view and outline whorl-section of holotype from the Callovian, *anceps* beds, of Khera. (B. M. ex Geol. Soc. Colln. No. R. 9981.) (p. 258.)

FIG. 3. *Parapatoceras* cf. *calloviense* (Morris). Enlarged view (×2) of the example figured by Waagen (1875, pl. LVI, fig. 3). Callovian, *anceps* zone. Nurrha. (G. S. I. No. $\frac{2}{98}$.) (p. 277.)

FIG. 4. *Macrocephalites leei*, nom. nov. External suture-line of a Wurtemberg example (B. M. No. 22361) agreeing with Quenstedt's (1887) pl. LXXVI, fig. 11 (with wrongly drawn umbilical slope). Lower Callovian, *macrocephalus* beds. (p. 169.)

FIG. 5. *Pleurocephalites tumidus* (Reinecke). External suture-line of a topotype from the Lower Callovian (*rehmanni* zone ?) of Uetzing, Bavaria. (B. M. No. C 29324.) (p. 171.)

FIGS. 6*a*-*c*. *Collotia draupadi*, sp. nov. Side-view of inner whorl (*a*), sectional outline of inner and outer whorls (*b*) and cast of dorsal (impressed) area of the former (c). Divesian '*athleta*' beds. Walakhavas. For suture-line see pl. XXXIV, figs. 10*a*, *b*. (J. H. Smith Colln. No. 34.) (p. 273.)

FIG. 7. *Reineckeia* aff. *reissi* Steinmann. Side-view of an example from Jessulmir, Sinde., Callovian, *anceps* zone. (B. M. No. C 23542, Maj.-Gen. B. M. Skinner Colln.) (p. 265.)

FIG. 8. *Kamptokephalites* aff. *dimerus* (Waagen). Side-view of a transitional example from the Lower Callovian, *dimerus* zone, of Habye. (J. H. Smith Colln. No. 102.) (p. 197.)

FIGS. 9*a*, *b*. *Kamptokephalites lamellosus* (J. de C. Sowerby). Side-view and external suture-lines of an immature example from the Lower Callovian, *dimerus* zone ? of Habye. (J. H. Smith Colln.) (p. 198.)

FIGS. 10*a*, *b*. *Collotia* aff. *angustilobata* (Brasil). Side-view and outline whorl-section of a fragment from the Divesian, lower '*athleta* beds,' of Ler (J. H. Smith Colln. No. 54). (p. 272.)

FIG. 11. *Macrocephalites chariensis* (Waagen). Side-view of inner whorls (to last septum) of an example from the Lower Callovian, *diadematus* zone ?, probably from Habye. For peripheral view see pl. XXXIV, fig. 2. (J. H. Smith Colln.) (p. 179.)

FIG. 12. *Nothocephalites semilævis* (Waagen). Peripheral view of inner whorls of Waagen's holotype. (See pl. XXX, fig. 1.) Lower (?) Callovian, near Soorka. (G. S. I. No. $\frac{1}{996}$.) (p. 207.)

Surv. of India

Plate XXXIII.

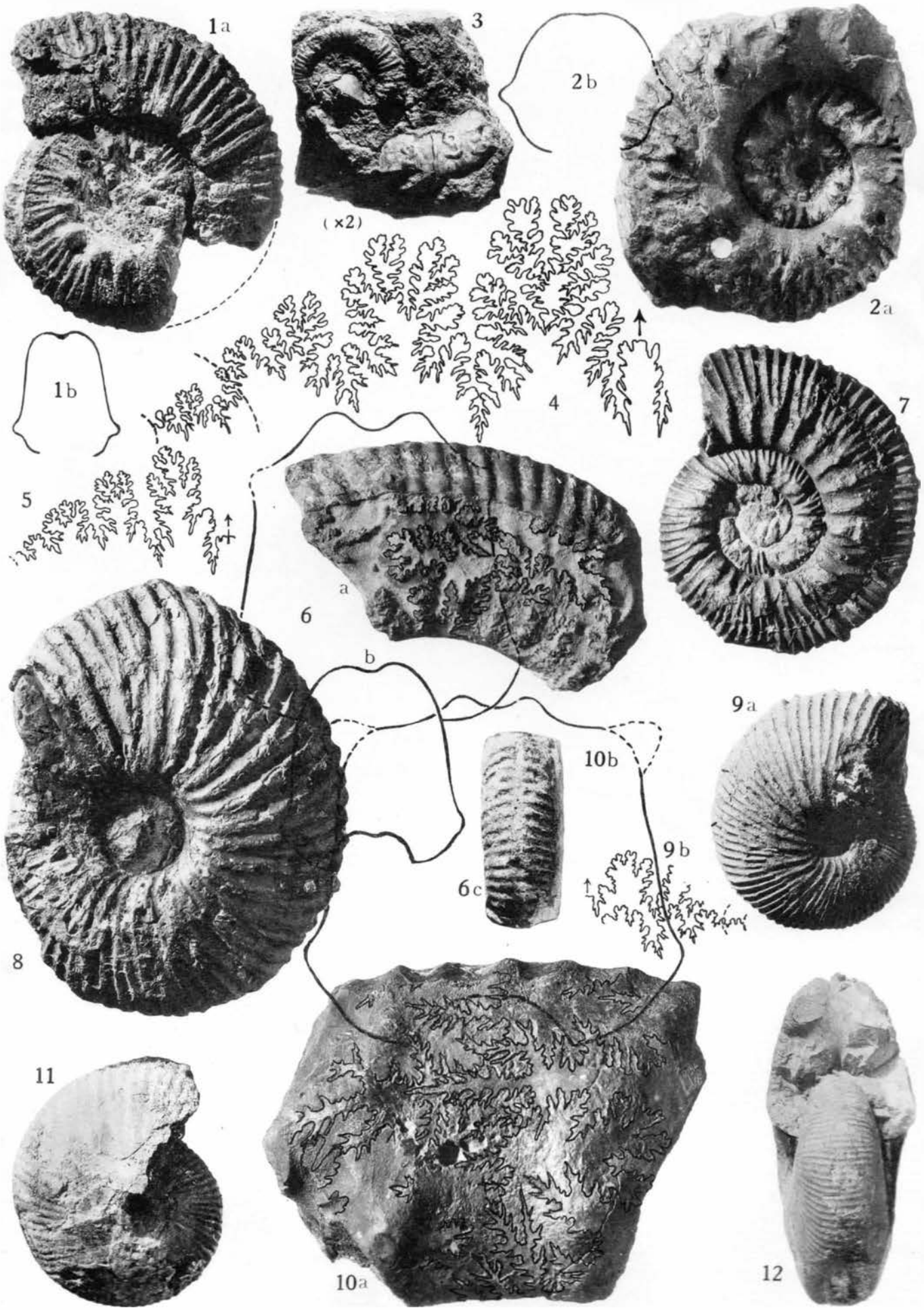

PLATE XXXIV.

FIG. 1. *Epimayaites lemoini* (Spath). Side-view of septate inner whorls from Argovian Kantcote Sandstone, River Bed, west of Kantcote. (J. F. Blake Colln. No. 305.) (p. 234.)

FIG. 2. *Macrocephalites choriensis* (Waagen). Peripheral view of the Habye (?) example figured in pl. XXXIII, fig. 11. Lower Callovian. (J. H. Smith Colln.) (p. 179.)

FIGS. 3*a*, *b*. *Epimayaites* aff. *azonoides*, sp. nov. Side-, and peripheral views of an example transitional to *E. lemoini* (Spath). From the Argovian, Kantcote Sandstone, River Bed, west of Kantcote. (J. F. Blake Colln. No. 301.) (p. 235.)

FIGS. 4*a*, *b*. *Collotia?* (*Reineckeia*) *octagona*, sp. nov. Side-view and sectional outline of a fragment from the Callovian ["*anceps* mound"=Lower *athleta* beds ?] of Fakirwadi. (J. H. Smith Colln. No. 26.) (p. 276.)

FIG. 5. *Reineckeia* aff. *tyranniformis*, sp. nov. Peripheral view of a small, fragmentary example (unlocalised) from the Callovian, *rehmanni* zone. (J. H. Smith Colln.) (p. 260).

FIG. 6. *Reineckeites* aff. *stuebeli* (Steinmann). Lower Oxford Clay of Tytherton, Wilts. (Wm. Smith, 1817, p. 60=*Amm.* sp. 7, associated with *Amm.* sp. 5=a coarse form of *Kosmoceras gulielmi*, J. Sowerby sp.) (B. M.) Callovian, *anceps* zone. (p. 270.)

FIG. 7. *Mayaites obesus*, sp. nov. External suture-line of a large fragment (at about 200mm. diameter) from the Divesian? (Lower Dhosa Oolite) of Walakhavas. (J. H. Smith Colln. No. 1.) (p. 228.)

FIGS. 8*a*, *b*. *Reineckeia*, sp. nov. ? aff. *brancoi* Steinmann. Side-, and peripheral views. Callovian, *anceps* beds, of Khera (bed No. 7). (J. H. Smith Colln. No. 12.) (p. 259.)

FIG. 9. *Reineckeites*, aff. *waageni* (Till). Peripheral view of a pathological example (with irregular ribbing on upper half) from the Callovian, *anceps* zone, of Fakirwadi. (J. H. Smith Colln.) (p. 268.)

FIGS. 10*a*, *b*. *Collotia draupadi*, sp. nov. Suture-lines, external (*a*) and internal (*b*) of the example figured in pl. XXXIII, fig. 6*a*. Divesian of Walakhavas. (J. H. Smith Colln. No. 34.) (p. 273.)

Geol. Surv. of India

Plate XXXIV.

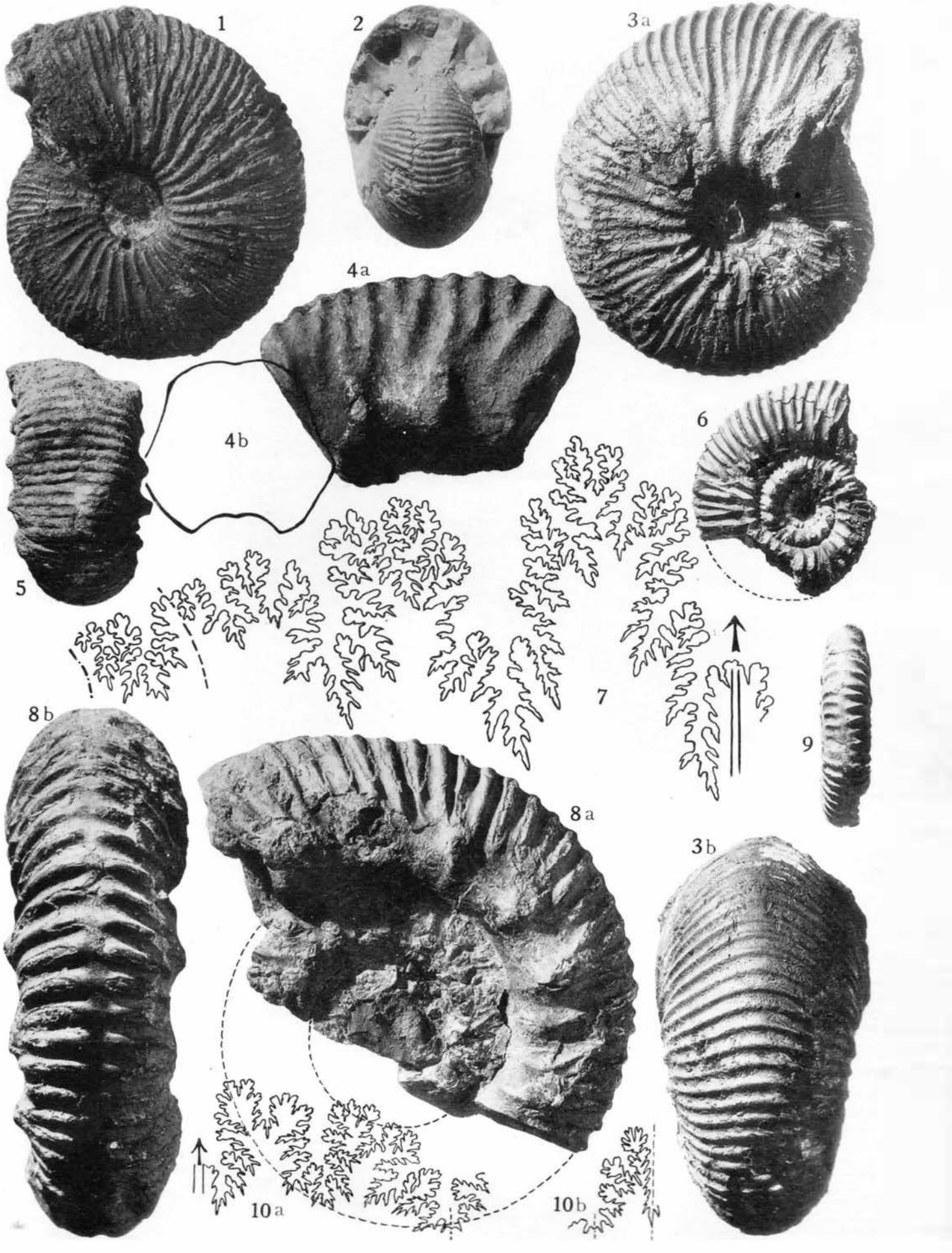

PLATE XXXV.

Figs. 1a-c. *Kamptokephalites* aff. *magnumbilicatus* (Waagen). Side-view, outline whorl-section and parts of external suture-lines (last three) of a transitional example. Lower Callovian, *dimerus* zone, of Jumara, bed No. 11. (J. F. Blake Colln. No. 232.) (p. 195).

Figs. 2a, b. *Kamptokephalites lamellosus*, var. *aureus*, nov. Side-view and outline whorl-section of an almost complete example from Khera, bed No. 5. Lower Callovian, *diadematus* zone. (G. S. I. No. K. $\frac{2\,9}{1\,7\,5}$.) (p. 198.)

Fig. 3. *Reineckeites* aff. *waageni* (Till). Side- view of an immature example from the Callovian, *anceps* beds. 'Bowl,' Fakirwadi. (J. H. Smith Colln.) (p. 268.)

Fig. 4. *Cadoceras sublæve* (J. Sowerby). Complete suture-line of a large fragment (from the Kellaways Rock of Wiltshire ?) for comparison with that of *Indocephalites diadematus*, etc. (B. M. No. C. 30501.) (p. 171.)

Figs. 5a, b. *Reineckeites waageni* (Till) var. *regalis*, nov. Side-view and outline whorl-section. Callovian, *anceps* zone, of Khera. (For peripheral view see pl. XXXIX, fig. 9.) (G. S. I. No. K. $\frac{2\,2}{2\,5\,5}$.) (p. 268.)

Fig. 6. *Idiocycloceras*, sp. ind. Peripheral view of a body-chamber fragment. Callovian, 'sub-*anceps*,' beds. Ler-Hamundra-Ellipse. (J. H. Smith Colln. No. 74.) (p. 218.)

Fig. 7. *Subkossmatia coggin-browni*, sp. nov. Side-view of a fragmentary example from the Callovian, sub-*anceps* beds, of Habye. (J. H. Smith Colln. No. 63.) (p. 212.)

Fig. 8. *Macrocephalites chariensis* (Waagen). Side-view of a typical fragment showing suture-line (figured separately in pl. XXV, fig. 2). Lower Callovian, Habye. (J. H. Smith Colln. No. 45.) (p. 179.)

Fig. 9. *Paryphoceras badiense*, sp. nov. Side-view of paratype (unlocalised) from the Argovian, Dhosa Oolite. (B. M. No. C. 30539, *ex* Pottinger-Smee Colln.) (p. 248.)

Geol. Surv. of India

Plate XXXV.

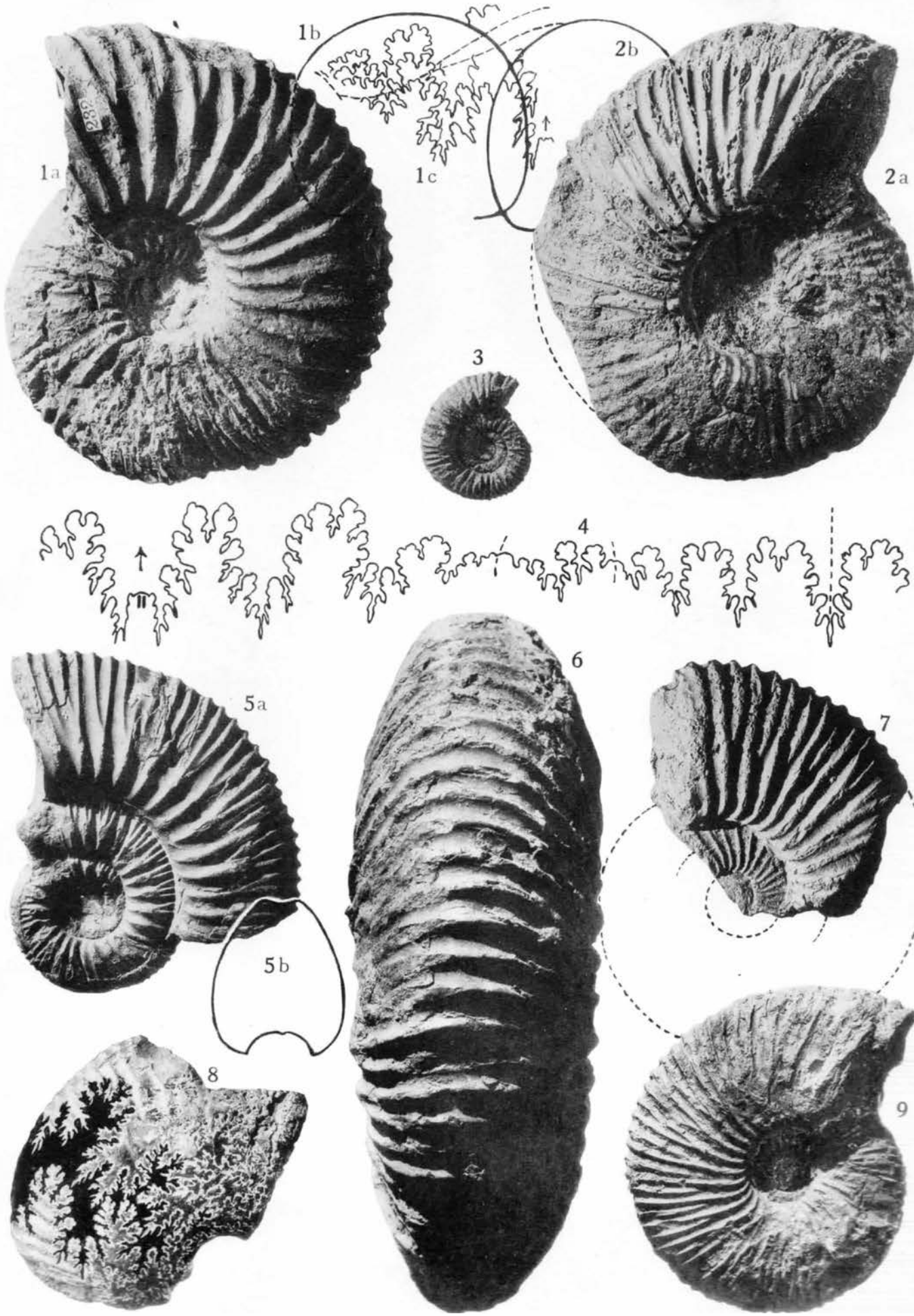

PLATE XXXVI.

FIGS. 1*a*, *b*. *Subkossmatia*, sp. ind. Side-, view and sectional outline of a completely septate fragment. Callovian, *rehmanni* zone ?, of Ler-Hamundra-Ellipse. (J. H. Smith Colln. No. 92A.) (p. 215.)

FIG. 2. *Subkossmatia opis* (J. de C. Sowerby). Last few suture-lines of holotype (pl. XXXIX, figs. 2*a*, *b*). Callovian, lower *anceps* beds ?, of Khera. (B. M. No. R. 9980, Geol. Soc. Colln.) (p. 210.)

FIG. 3. *Idiocycloceras perisphinctoides*, sp. nov. Suture-line of holotype (pl. XXXVIII, figs. 3*a-c*). Slightly corroded and wrongly drawn with the tops of the saddles on a descending instead of an ascending line. Callovian, 'sub-*anceps*' beds, of Habye. (J. H. Smith Colln.) (p. 215.)

FIG. 4. *Pleurocephalites* aff. *platystomus* (Reinecke). Side-view of an immature example from the Callovian, *rehmanni* zone ? (='*jason*-beds') of Uetzing, Bavaria. For peripheral view see pl. XXXVII, fig. 10. (B. M. No. C. 29332.) (p. 171.)

FIG. 5. *Pleurocephalites*, sp. juv. ind. Side-view of a doubtful nucleus from the Callovian, (*rehmanni* zone ?) of Jessulmir, Sinde. (B. M. No. C. 23548.) (p. 171.)

FIGS. 6*a*, *b*. *Pleurocephalites folliformis* S. Buckman, Side-, and peripheral views of inner whorls of a typical Chippenham example. Callovian [Kellaways Clay], *rehmanni* zone. (B. M. No. 51361.) (p. 171.)

FIGS. 7*a-e*. *Reineckeites* aff. *waageni* (Till). Side-, and peripheral views (*a*, *b*) and the same enlarged ×2, with outline whorl-section (*c-e*) of an immature example from the Callovian, *anceps* beds, of Fakirwadi. (J. H. Smith Colln.) (p. 268.)

FIG. 8. *Mayaites* aff. *obesus*, sp. nov. Peripheral view of inner whorls of a less inflated example, transitional to *M. subkobyi*. Argovian, Dhosa Oolite, probably of Fakirwadi. (J. H. Smith Colln. No. 13.) (p. 228.)

FIG. 9. *Nothocephalites semilævis* (Waagen). Part of internal suture-line (enlarged ×2·5) of holotype, at diameter of about 90mm. Lower (?) Callovian, near Soorka. (G. S. I. No. $\frac{1}{998}$.) (p. 207.)

FIGS. 10*a*, *b*. *Dhosaites primus*, sp. nov. Side-view of a fragment, with suture-line. Argovian (Dhosa Oolite), Fakirwadi. (J. H. Smith Colln.) (p. 245.)

FIG. 11. *Epimayaites transiens* (Waagen). Side-view of an immature example from the River Bed, west of Kantcote. Argovian, Kantcote Sandstone. (J. F. Blake Colln. No. 311.) (p. 240.)

FIG. 12. *Indocephalites* ?, sp. juv. ind. Side-view of the Madagascar nucleus of which the suture-line was figured in Spath, 1925*b*, pl. i, fig. 3 (as *Catacephalites* sp. ind.) Lower Callovian, (J. Stansfeld Colln.) (p. 173.)

FIGS. 13, 14. *Epimayaites* aff. *evolutus*, sp. nov. Side-views of an immature and of a deformed example. Argovian, Kantcote Sandstone. River Bed, west of Kantcote (No. 308) and "zone I." (No. 297) (J. F. Blake Colln.) (p. 238.)

FIG. 15. *Epimayaites patella*, sp. nov. Side-view of holotype (see also pl. XLIX, fig. 12). Same bed and locality (zone I). (J. F. Blake Colln. No. 296.) (p. 243.)

FIGS. 16*a*, *b*. *Nothocephalites mondegoensis*, sp. nov. Side-, and peripheral views of holotype, from the Lower Callovian, '*macrocephalus* zone' of Cape Mondego, Portugal. (Compare *Pseudinvoluticeras somalicum*, Spath., 1925*a*, pl. XV, fig. 7.) (B. M. No. C. 29272. ex D. Sharpe Colln.) (p. 206.)

Geol. Surv. of India

Plate XXXV

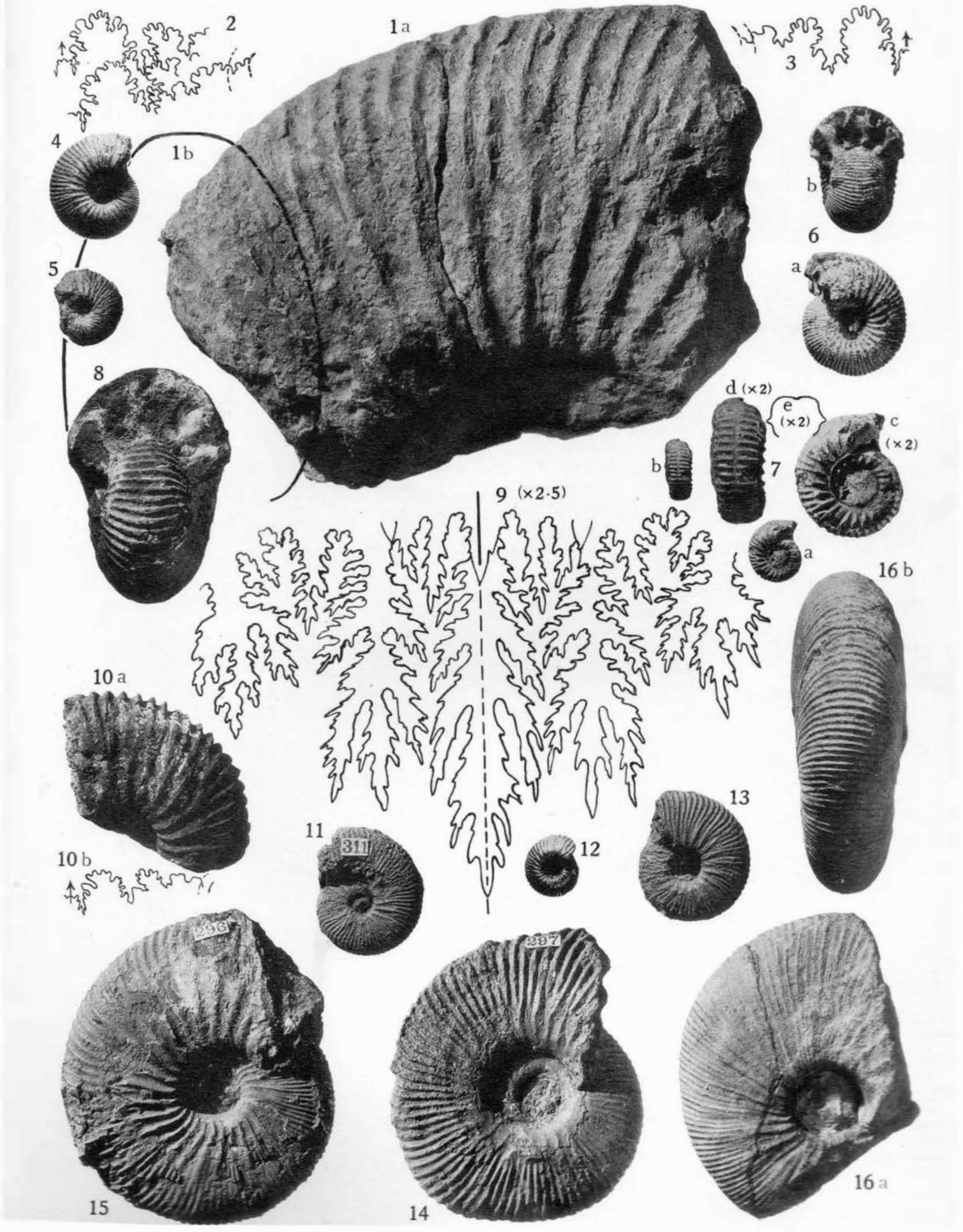

PLATE XXXVII.

FIGS. 1*a*, *b*. *Dhosaites primus*, sp. nov. Side-view and outline whorl-section of holotype from the Argovian (Dhosa Oolite) of Samatra. (J. H. Smith Colln. No. 84.) (p. 245.)

FIG. 2. *Nothocephalites asaphus*, sp. nov. Suture-line of the holotype figured in pl. XXVIII, figs. 2*a*, *b*. Callovian (bed No. 10) Khera. (J. F. Blake Colln. No. 265.) (p. 208.)

FIGS. 3, 4. *Reineckeites* aff. *waageni* (Till). Side-, and peripheral views of two immature examples from the Callovian, *anceps* beds, of Khera (bed No. 3) and of Fakirwadi. (J. F. Blake Colln. No. 365 and J. H. Smith Colln.) (p. 268.)

FIGS. 5*a-c*. *Epimayaites evolutus*, sp. nov. Side-view, outline whorl-section, and suture-line (with umbilical portion wrongly restored) of holotype from Kantcote (?), Argovian, Kantcote Sandstone. (J. F. Blake Colln. No. 290.) (p. 238.)

FIG. 6. *Mayaites* sp. juv. aff. *smeei*, sp. nov. Immature example from the Argovian, Dhosa Oolite ("upper zone") East of Badi. (J. F. Blake Colln. No. 280.) (p. 230.)

FIG. 7. *Mayaites ?* (*Paryphoceras ?*) aff. *arenosus* (Waagen). Suture-line, as in pl. XXVIII, fig. 4 (erroneously redrawn and reversed.) (p. 232.)

FIG. 8. *Epimayaites* cf. *excentricus*, sp. nov. Peripheral view of the Gangta Bét example figured in pl. XXXII, fig. 2. Argovian ('upper Beds'). (J. F. Blake Colln. No. 274.) (p. 239.)

FIG. 9. *Reineckeites* aff. *waageni* (Till). Peripheral view of an example slightly more involute than holotype. *Anceps* beds (Callovian) of Fakirwadi. (J. H. Smith Colln. No. 17.) (p. 268.)

FIG. 10. *Pleurocephalites* aff. *platystomus* (Reinecke). Peripheral view of the Uetzing example figured in pl. XXXVI, fig. 4. Callovian. (B. M. No. C. 29332.) (p. 171.)

FIGS. 11*a*, *b*. *Mayaites* aff. *maya* (J. de C. Sowerby). Side-view and sectional outline of an immature example from the Argovian, Dhosa Oolite, of Fakirwadi. (See pl. XXVIII, fig. 5.) (G. S. I. No. K.$\frac{22}{183}$*b*.) (p. 225.)

FIG. 12. *Mayaites* aff. *maya* (J. de C. Sowerby). Peripheral view of the more biplicate example figured in pl. XLIX, fig. 6. Argovian, Dhosa Oolite, Samatra (G. S. I. No. K. $\frac{22}{186}$, pars.) (p. 225.)

FIG. 13. *Mayaites* aff. *subkobyi*, sp. nov. Portions of external suture-lines of a doubtful, large, fragment. Argovian, Dhosa Oolite. Fakirwadi. (G. S. I. No. K. $\frac{22}{184}$.) (p. 229.)

Geol. Surv. of India

Plate XXXVII.

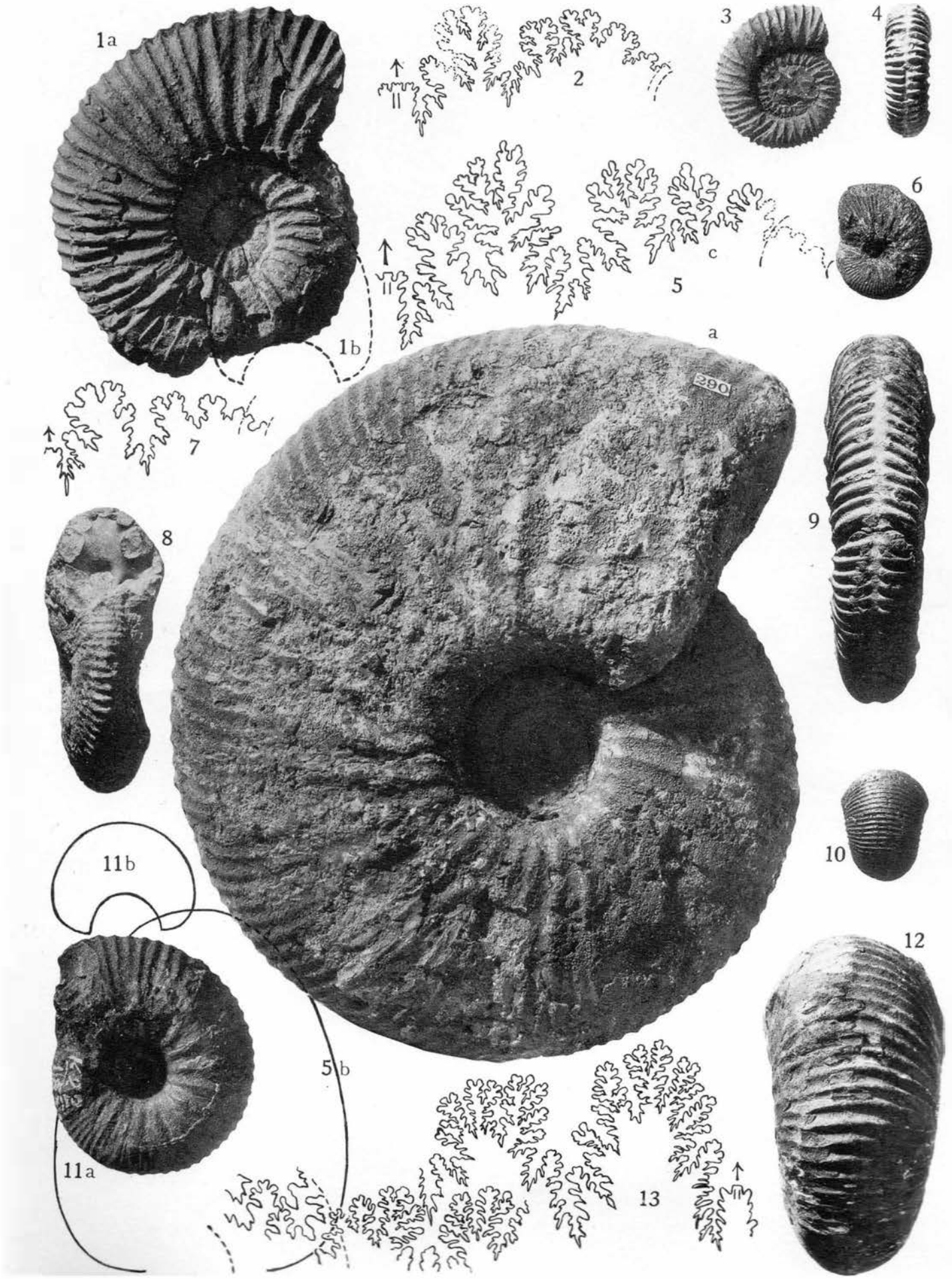

PLATE XXXVIII.

FIGS. 1*a-c*. *Subkossmatia flemingi*, sp. nov. Side-view, outline whorl-section (of body-chamber), and part of external suture-line, (of inner whorls, enlarged $\times\frac{3}{5}$) of holotype from Kalibagh, Salt Range. Callovian ? (B. M. No. C. 25435, ex Dr. Fleming Colln.) (p. 4(1927) and p. 205.)

FIG. 2. *Subkossmatia coggin-browni*, sp. nov. Side-view of a fragmentary example from the Callovian (' sub-*anceps* ' beds) of the Ler-Hamundra-Ellipse. (J. H. Smith Colln. No. 54.) (p. 212.)

FIGS. 3*a-c*. *Idiocycloceras perisphinctoides*, sp. nov. Right and left side and peripheral views of holotype. Callovian (' sub-*anceps*' beds) of Habyé. See pl. XXXVI, fig. 3. (J. H. Smith Colln.) (p. 215.)

FIG. 4. *Nothocephalites* aff. *semilævis* (Waagen). Parts of suture-lines of a doubtful example from Khera, beds 7-10, Callovian. (J. F. Blake Colln. No. 259.) (p. 207.)

FIG. 5. *Subkossmatia obscura*, nom. nov. Suture-line of holotype (=*Stephanoceras opis*, Waagen pars, non Sowerby). Callovian. Khera. (G. S. I. No. $\frac{2}{2\,8}$.) (p. 211.)

FIG. 6. *Epimayaites falcoides*, sp. nov. Side-view of paratype from the Argovian, Kantoote Sandstone. River Bed, west of Kantcote. (J. F. Blake Colln. No. 306.) (p. 242.)

FIG. 7. *Pachyceras distinctum*, sp. nov. Suture-line of holotype (pl. XX, figs. 1*a*, *b*). Divesian. Jikadi. (J. F. Blake Colln. No. 281.) (p. 222.)

FIGS. 8*a*, *b*. *Dhosaites elephantoides*, nom. nov. Side-, and peripheral views of an immature example from the Argovian, Dhosa Oolite, of Fakirwadi. (G. S. I. No. K. $\frac{2\,2}{1\,6\,1}$.) (p. 244.)

Geol. Surv. of India

Plate XXXVIII.

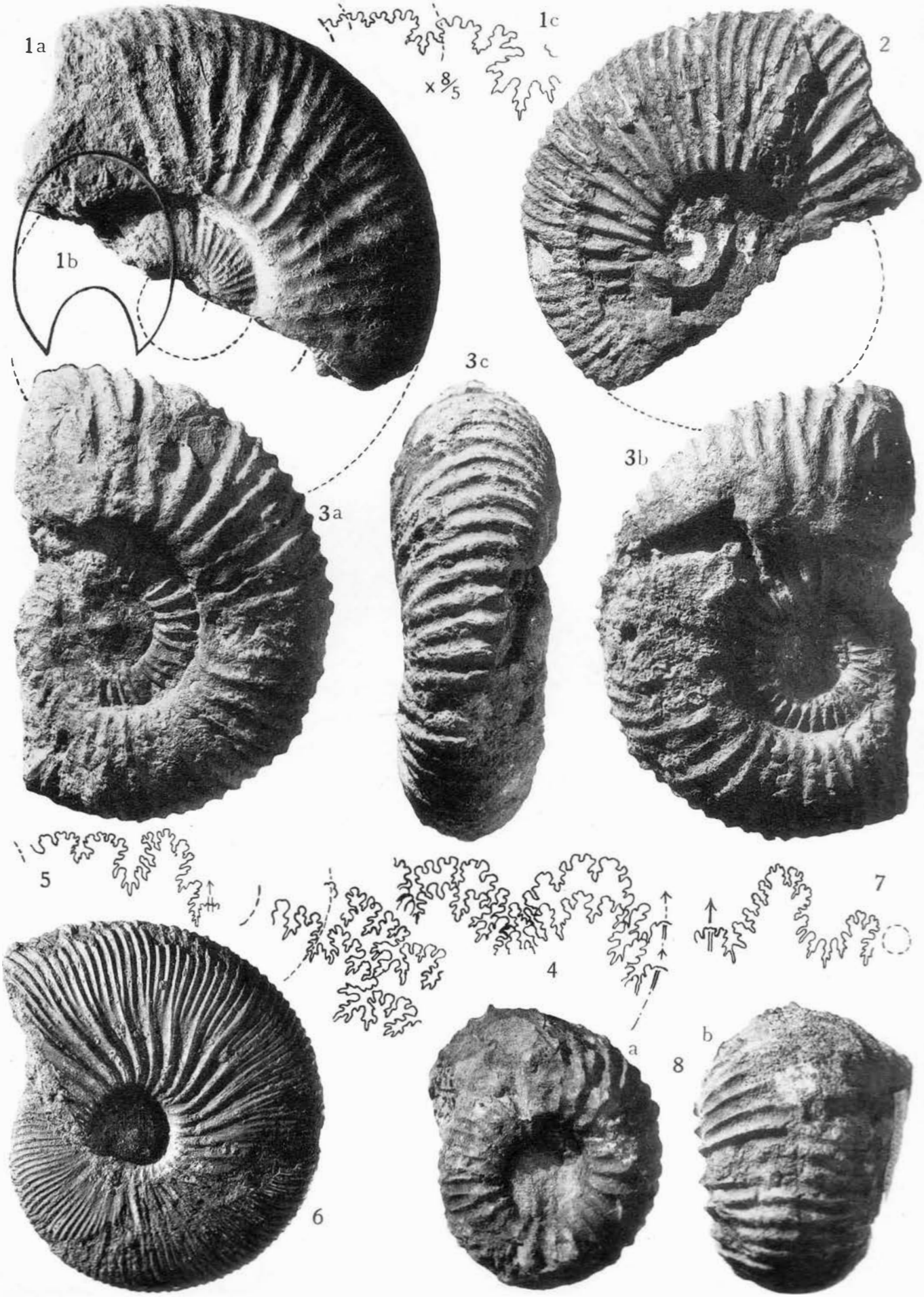

PLATE XXXIX.

Fig. 1. *Subkossmatia ramosa*, sp. nov. Peripheral view of paratype from Callovian (' sub-*anceps* ' beds) of the Ler-Hamundra-Ellipse. (J. H. Smith Colln. No. 34.) (p. 214.)

Figs. 2*a*, *b*. *Subkossmatia opis* (J. de C. Sowerby). Side-, and peripheral views of holotype. (Last suture-line at x.) Callovian. Khera. See pl. XXXVI, fig. 2. (B. M. ex Geol. Soc. Colln. No. R. 9980.) (p. 210.)

Fig. 3. *Dhosaites primus*, sp. nov. Side-view of a typical young example. Argovian, Dhosa Oolite, Wanda (' zone I '.) (J. F. Blake Colln. No. 211.) (p. 245.)

Fig. 4. *Dhosaites*, sp. juv. ind. Side-view of an immature example, resembling Waagen's young ' *Stephanoceras elephantinum* ' (pl. XXXII, fig. 4). Argovian, Dhosa Oolite, West Jooria (' upper zone '). (J. F. Blake Colln. No. 210.) (p. 245.)

Fig. 5. *Mayaites ?* (*Paryphoceras ?*) *arenosus* (Waagen). Umbilical portion of suture-line of Waagen's holotype, redrawn (×4). Dhosa Oolite, Lodai, (G. S. I. No. $\frac{2}{27}$.) (p. 232.)

Figs. 6*a*, *b*. *Idiocycloceras dubium*, sp. nov. Part of holotype (slightly reduced) with outline whorl-section. Callovian (' sub-*anceps* ' beds) Ler-Hamundra-Ellipse. (J. H. Smith Colln. No. 97.) (p. 217.)

Fig. 7. *Subkossmatia opis* (J. de C. Sowerby). Side-view of a typical example (with beginning of body-chamber at [x].) Callovian, Hamundra. (G. S. I. No. K.$\frac{22}{172}$.) (p. 210.)

Fig. 8. *Nothocephalites paradoxus*, sp. nov. Side-view and outline whorl-section (=*Stephanoceras calloviense* in Newton, 1889, Quart. Journ. Geol. Soc. p. **334**). Callovian. South of Ankaramy, Madagascar. The inner whorls, on side not figured, are indistinguishable from those of the less evolute *Dolikephalites typicus* (Blake). (B. M. No. C. 3591.) (p. 207.)

Fig. 9. *Reineckeites waageni* (Till) var *regalis*, nov. Peripheral view of the example figured in pl. XXXV, fig. 5. Callovian, Khera. (G. S. I. No. K. $\frac{22}{2\,55}$.) (p. 268.)

Geol. Surv. of India

Plate XXXIX.

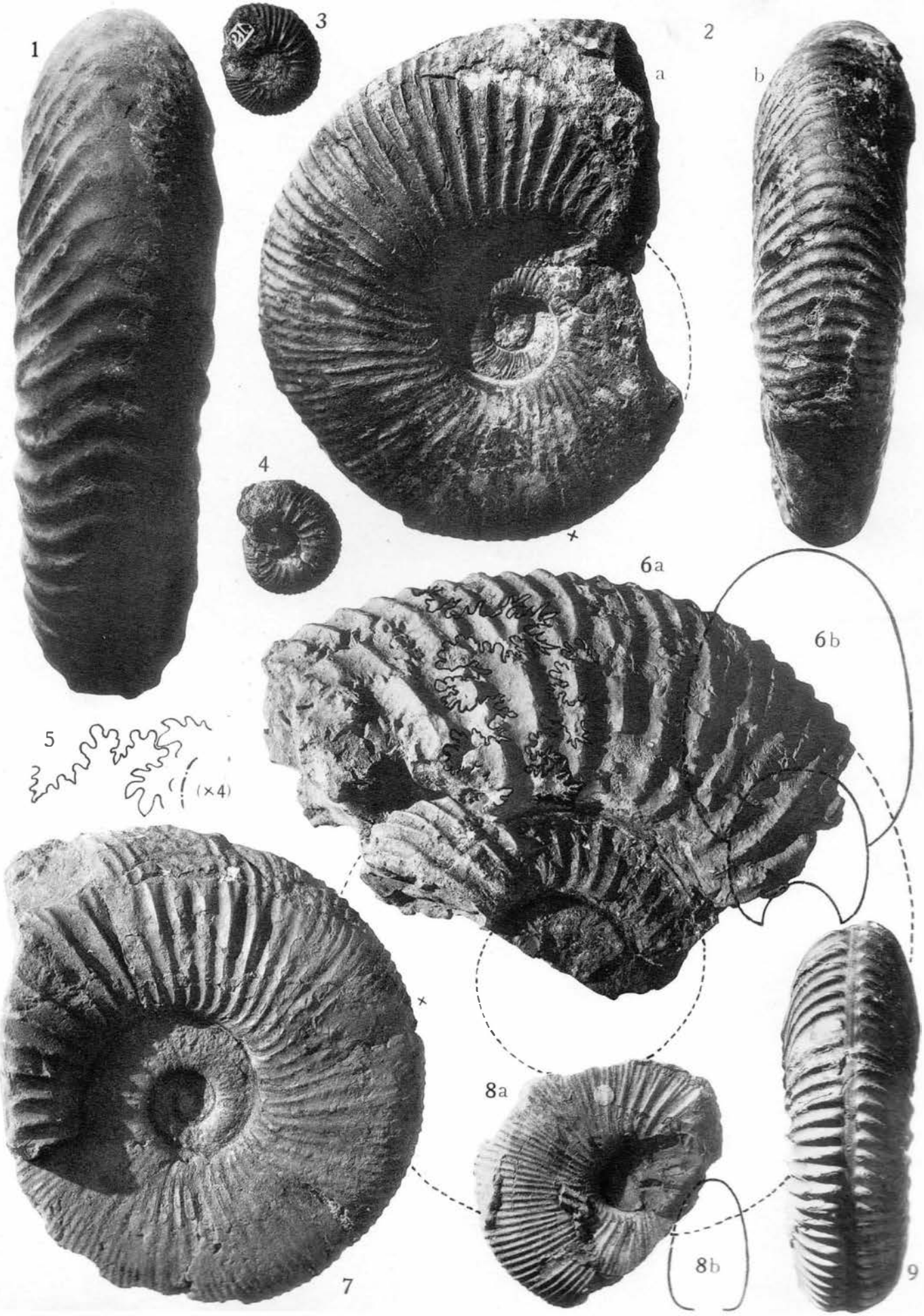

PLATE XL.

FIGS. 1*a*, *b*. *Kamptokephalites ?*, sp. ind. (*dimerus* group ?). Side-, and peripheral views of the doubtful Madagascar specimen previously (1924, p. 10) recorded as possibly a globose '*Dhosaites*.' (The bluntness of the ribs may be due to defective preservation.) North of Andranosamonta. Callovian ? (B. M. No. C. 3586.) (p. 223.)

FIG. 2. *Mayaites maya* (J. de C. Sowerby). Young example from the Argovian, Dhosa Oolite, of Fakirwadi. (J. H. Smith Colln.) (p. 225.)

FIG. 3. *Dhosaites primus*, sp. nov. Side-view of an immature example from the Argovian, Dhosa Oolite, of Fakirwadi. (G. S. I. No. K.$\frac{22}{193}$.) (p. 245.)

FIGS. 4*a*, *b*. *Parapatoceras crioconus* (S. Buckman). Suture-lines, enlarged ×4, of two Chippenham (Kellaways Rock) specimens. Callovian, *anceps* zone. (B. M. No. 48787*a* and *b*.) (p. 277.)

FIG. 5. *Idiocycloceras* aff. *singulare*, nom. nov. Side-view of a fragmentary specimen from the Callovian ("sub-*anceps* beds II"). Ler-Hamundra-Ellipse. Suture-line figured separately in pl. XXVIII, fig. 8. (J. H. Smith Colln.) (p. 216.)

FIG. 6. *Epimayaites falcoides*, sp. nov. Side-view of holotype from Kantcote ("zone I"), Argovian. (J. F. Blake Colln. No. 298.) (p. 242.)

FIGS. 7*a*, *b*. *Paryphoceras badiense*, sp. nov. Side-, and peripheral views of holotype from the Argovian, Dhosa Oolite, of Badi ("upper zone"). (J. F. Blake Colln. No. 279.) (p. 248.)

Geol. Surv. of India

Plate XL.

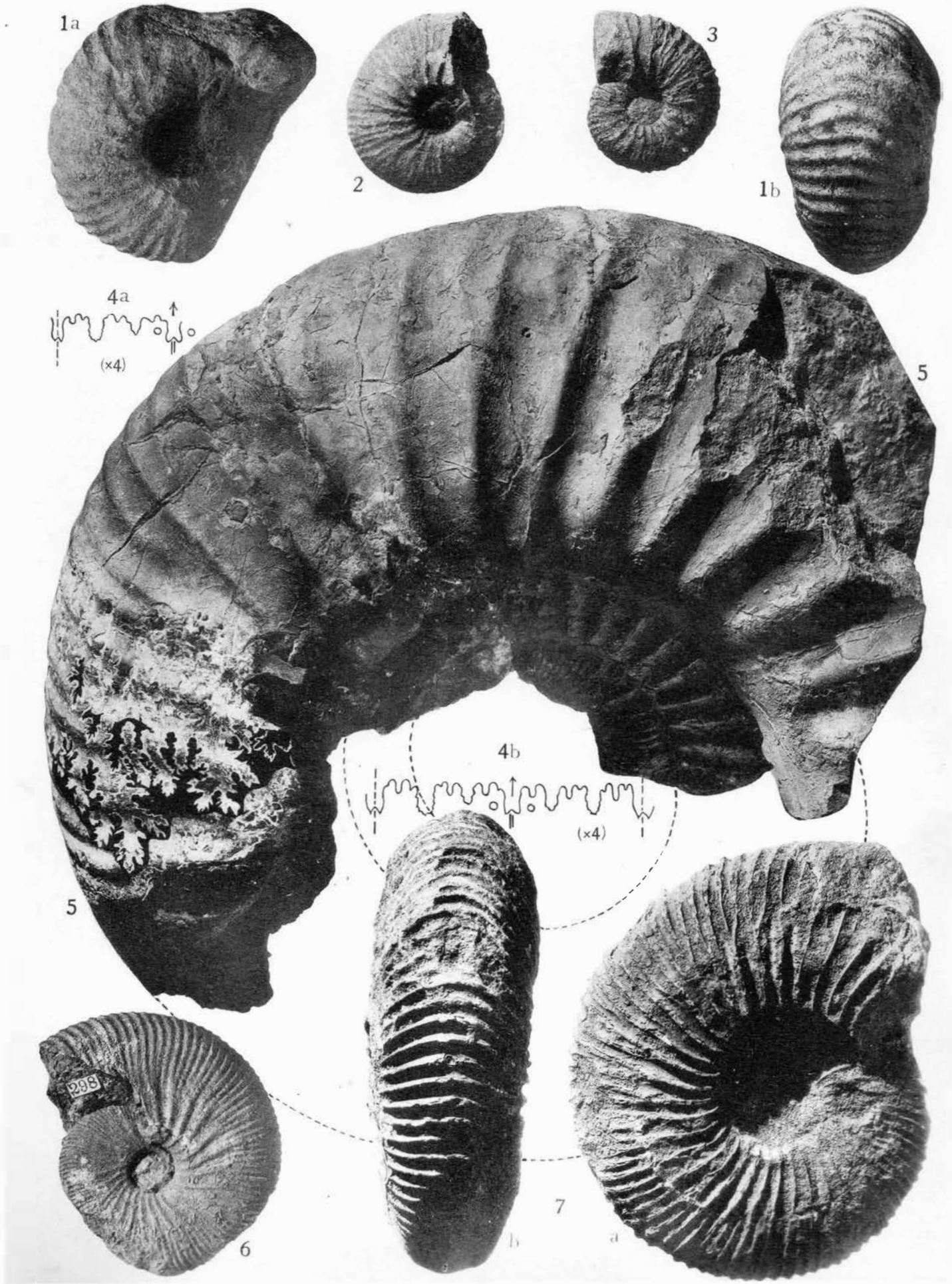

PLATE XLI.

FIGS. 1*a*, *b*. *Subkossmatia ramosa*, sp. nov. Side-view and outline whorl-section of holotype-fragment. Callovian, " sub-*anceps* " beds of Khera Hill. (J. H. Smith Colln.) (p. 214.)

FIG. 2. *Idiocycloceras singulare*, nom. nov. Portions of last five suture-lines of Waagen's type (*Stephanoceras fissum*, *pars*, non Sowerby). Callovian, *anceps* zone, Khera. (G. S. I. No. $\frac{2}{2\,9}$.) (p. 216.)

FIG. 3. *Idiocycloceras*, sp. ind. Part of external suture-line of a fragment from the Callovian, ' sub-*anceps* ' beds, of the Ler-Hamundra-Ellipse. (J. H. Smith Colln. No. 122.) (p. 218.)

FIGS. 4*a-c*. *Subkossmatia coggin-browni*, sp. nov. Side-view of holotype (*a*), with peripheral view (*b*) of smaller half (along line from x to x in fig. 4*a*), and two suture-lines (*c*). Callovian, ' sub-*anceps* ' beds, probably from Habye. (J. H. Smith Colln.) (p. 212.)

FIGS. 5*a*, *b*. *Kellawaysites oxyptychoides*, sp. nov. Side-view and outline whorl-section of holotype from the Callovian, *anceps* beds, of Samatra. (J. H. Smith Colln.) (p. 266.)

Geol. Surv. of India

Plate XLI.

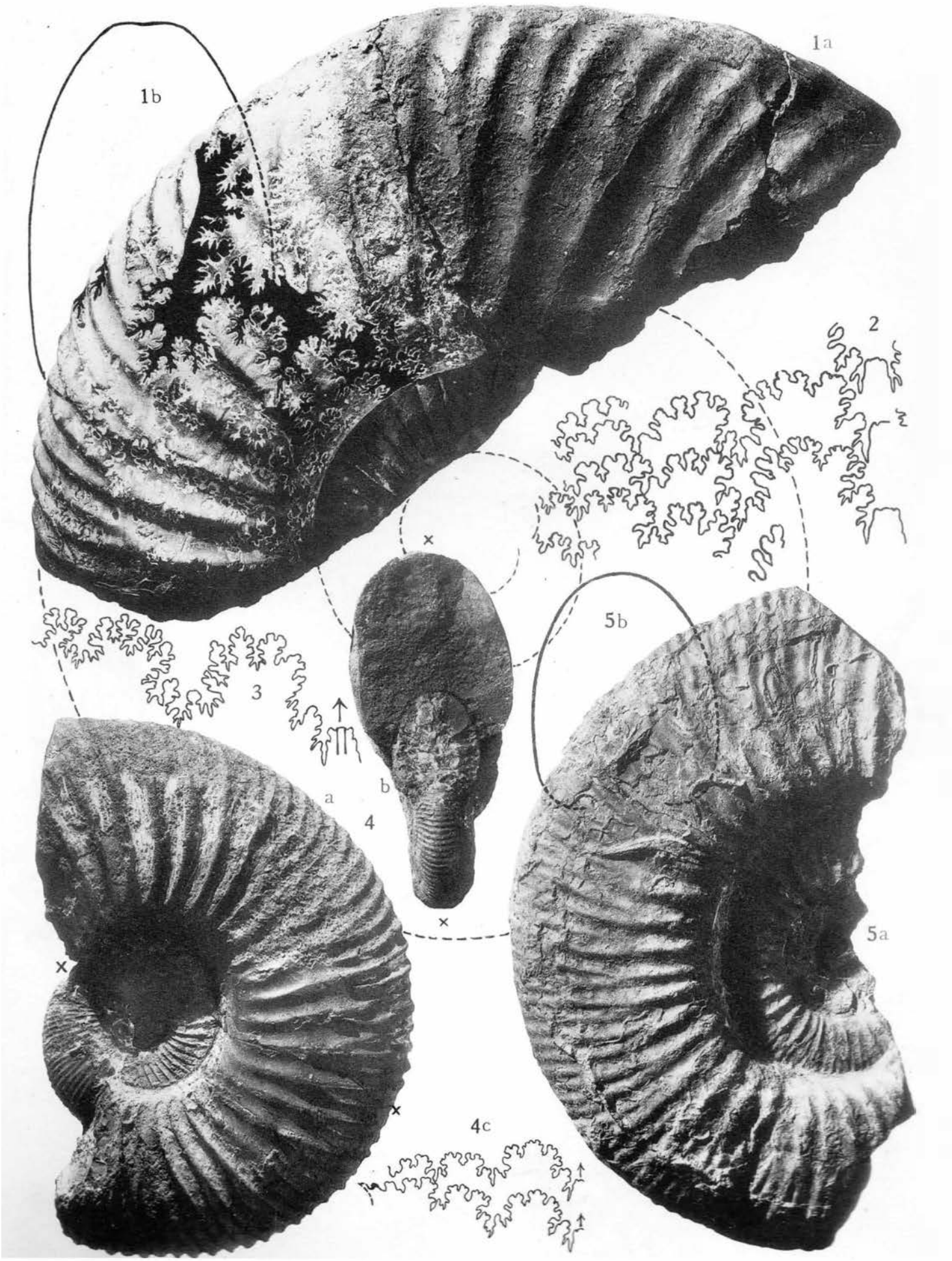

PLATE XLII.

FIGS. 1*a*, *b*. *Mayaites obesus*, sp. nov. Side-, and peripheral views of Sowerby's original '*Amm. harveyii*' (1840, p. 719, woodcut). Argovian ? or Upper Divesian (Dhosa Oolite). Exact locality unrecorded (B. M. ex Geol. Soc. Colln. No. R. 10067.) (p. 228.)

FIGS. 2*a*, *b*. *Collotia kachhensis*, sp. nov. Side-view and outline whorl-section of holotype-fragment. Callovian, lower '*athleta* beds', Samatra. (G. S. I. No. K. $\frac{22}{159}$.) (p. 274.)

FIGS. 3*a*, *b*. *Collotia*, sp. juv. aff. *fraasi* (Oppel). Side-and peripheral views. Divesian, '*athleta* beds' (No. 8), Ler. (J. F. Blake Colln. No. 493.) (p. 275.)

FIGS. 4*a*, *b*. *Prososphinctoides manialensis*, sp. nov. Side-and peripheral views of holotype. Divesian, *athleta* beds. South Manjal (bed No. 2). (J. F. Blake Colln. No. 447.) (See pl. LXIV, fig. 2.)

FIGS. 5*a*, *b*. *Subgrossouvria gudjinsirensis* (Waagen). Side-and peripheral views of a well-preserved example. Divesian, *athleta* beds, probably Fakirwadi. (J. H. Smith Colln.)

Geol. Surv. of India

Plate XLII.

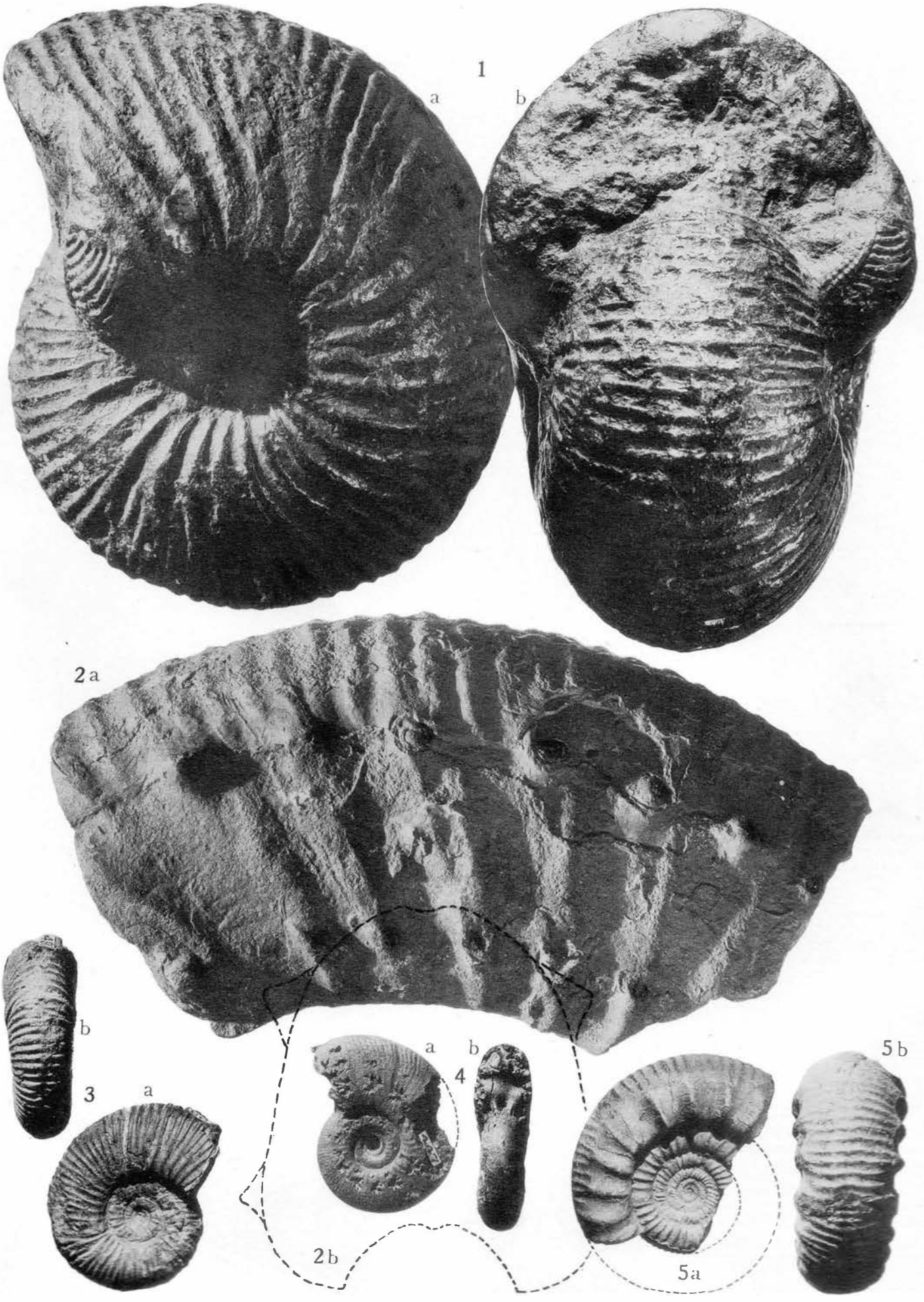

PLATE XLIII.

FIGS. 1*a*, *b*. *Mayaites jumarensis*, sp. nov. Side-, and peripheral views of holotype. Argovian Dhosa Oolite, Jumara (bed No. 1). (J. F. Blake Colln. No. 284.) (p. 228.)

FIGS. 2*a*, *b*. *Kamptokephalites herveyi* (J. Sowerby). Parts of external suture-lines of opposite sides, at about 75mm. diameter, near end of septate portion of lectotype (Sowerby's larger example, 1818, pl. CXCV, upper figure). ('Cornbrash', Callovian) Lincolnshire. (B. M. No. 46485.) (p. 195.)

Geol. Surv. of India

Plate XLIII.

PLATE XLIV.

FIGS. 1*a*, *b*. *Dhosaites otoitoides*, sp. nov. Side-view and outline whorl-section of holotype. Argovian, Dhosa Oolite, Fakirwadi. (J. H. Smith Colln. No. 24.) (p. 245.)

FIGS. 2*a*, *b*. *Paryphoceras rugosum*, sp. nov. Side-view and sectional outline of a fragmentary paratype. Argovian, Dhosa Oolite, East of Ler. (J. F. Blake Colln. No. 283.) (p. 247.)

FIGS. 3*a-e*. *Grossouvria*, spp. juv. (*sulcifera* group). [*a-c*] Side-view, sectional outline and suture-line (all enlarged x2) of a fragmentary Wanda example (bed No. 2, J. F. Blake Colln. No. 462) and [*d*, *e*] side and peripheral views of an immature Fakirwadi specimen, Callovian or Divesian, '*athleta* beds.' (J. H. Smith Colln.)

FIGS. 4*a*, *b*. *Epimayaites excentricus*, sp. nov. Side-view (reduced to about $\frac{4}{5}$ linear) and sectional outline (at x) of holotype. Argovian, Kantcote Sandstone ("zone I"), Kantcote. (J. F. Blake Colln. No. 288.) (p. 239.)

FIGS. 5*a*, *b*. *Dhosaites* aff. *primus* sp. nov. Side-, and peripheral views of a fragment showing resemblance to *Paryphoceras stephanoides*. Argovian, Dhosa Oolite, Fakirwadi (?) (J. H. Smith Colln.) (p. 245.)

FIGS. 6*a-c*. *Reineckeia anceps* (Reinecke). Side-, and peripheral views (*a*, *b*) of a septate nucleus, with (*c*) front view enlarged x2. Callovian ("*jason* zone"), Neidlingen, Wurtemberg (B. M. No. C. 29713.) (p. 255.)

FIGS. 7*a*, *b*. *Mayaites rotundus*, sp. nov. Suture-lines, external and internal, of holotype, figured in pl. XXX, figs. 3*a-c*. Dhosa Oolite, Fakirwadi. (J. H. Smith Colln.) (p. 227.)

Geol. Surv. of India

Plate XLIV.

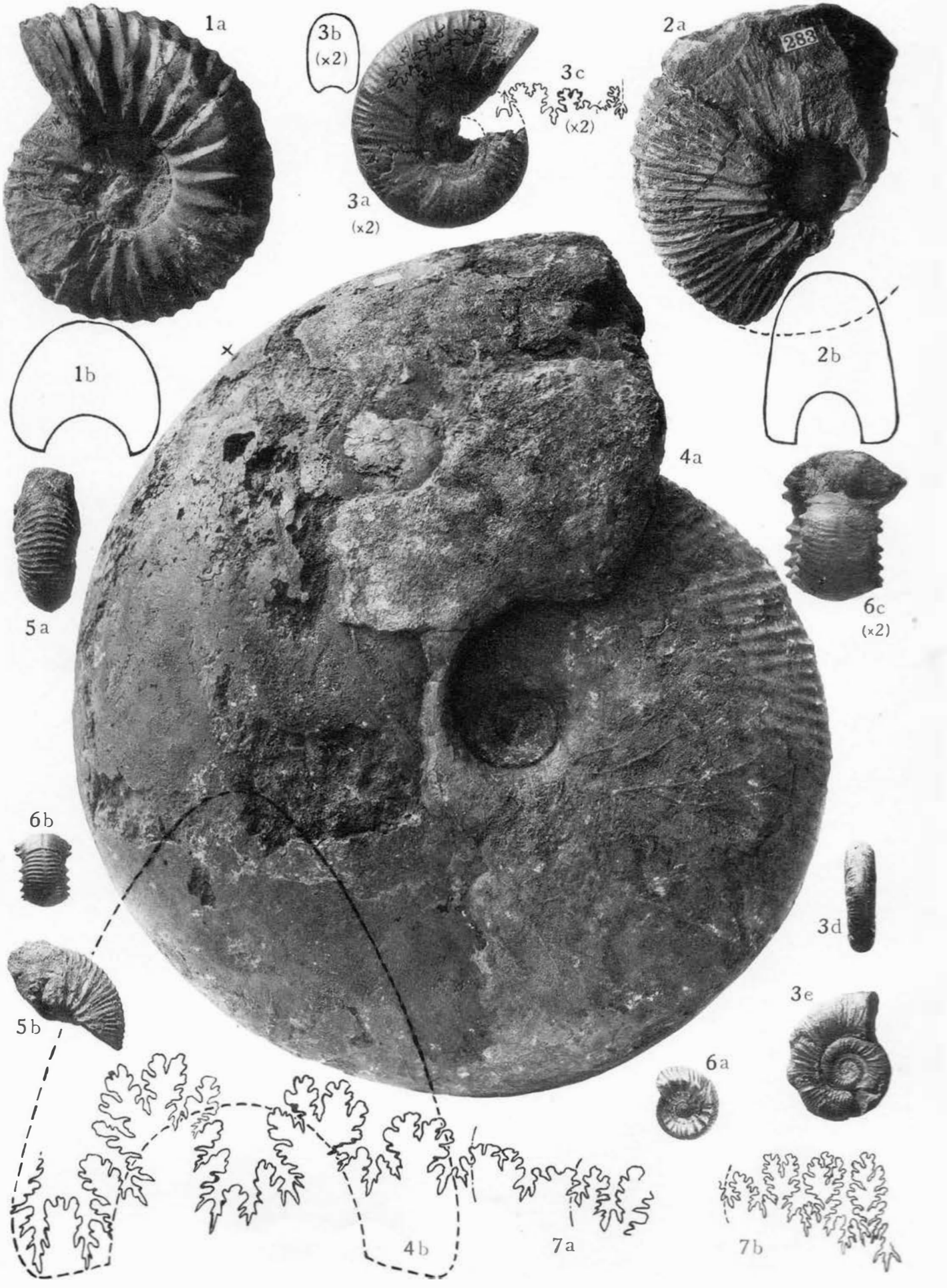

PLATE XLV.

FIGS. 1*a*, *b*. *Mayaites subkobyi*, sp. nov. Side-view and sectional outline of inner whorls of holotype. Argovian, Dhosa Oolite, Fakirwadi. (J. H. Smith Colln. No. 75.) (p. 229.)

FIGS. 2*a*, *b*. *Dhosaites primus*, sp. nov. Side-view and sectional outline of a small example. Argovian, Dhosa Oolite, Samatra. (G. S. I. No. K. $\frac{22}{257}$.) (p. 245.)

FIGS. 3*a*, *b*. *Epimayaites lautus*, sp. nov. Side-and peripheral views of holotype. Argovian, Dhosa Oolite, Jumara (bed not marked). (J. F. Blake Colln. No. 223.) (p. 242.)

FIGS. 4*a-c*. *Mayaites radiatus*, sp. nov. Side-view, outline whorl-section, and suture-line of inner whorls of holotype. Argovian, Dhosa Oolite, Habye. (J. H. Smith Colln. No. 66.) (p. 231.)

FIGS. 5. *Obtusicostites*, sp. juv. Side-view of septate nucleus. Callovian or Divesian. '*athleta* beds,' Fakirwadi. (G. S. I. No. K. $\frac{22}{266}a$.)

FIG. 6*a*, *b*. *Subgrossouvria morley-daviesi* Spath. Side-view and sectional outline of a small example from the Divesian, *athleta* beds of Fakirwadi. (J. H. Smith Colln. No. 100*a*.)

FIGS. 7*a*, *b*. *Mayaites smeei*, sp. nov. Side-view and outline whorl-section of holotype, probably from Ler or Fakirwadi. Argovian, Dhosa Oolite. (J. H. Smith Colln. No. 9.) (p. 230.)

FIGS. 8*a*, *b*. *Paryphoceras rugosum*, sp. nov. Side-view and sectional outline of holotype. Argovian, Dhosa Oolite ("upper zone"), East Badi. (J. F. Blake Colln. No. 278.) (p. 247.)

Geol. Surv. of India

Plate XLV.

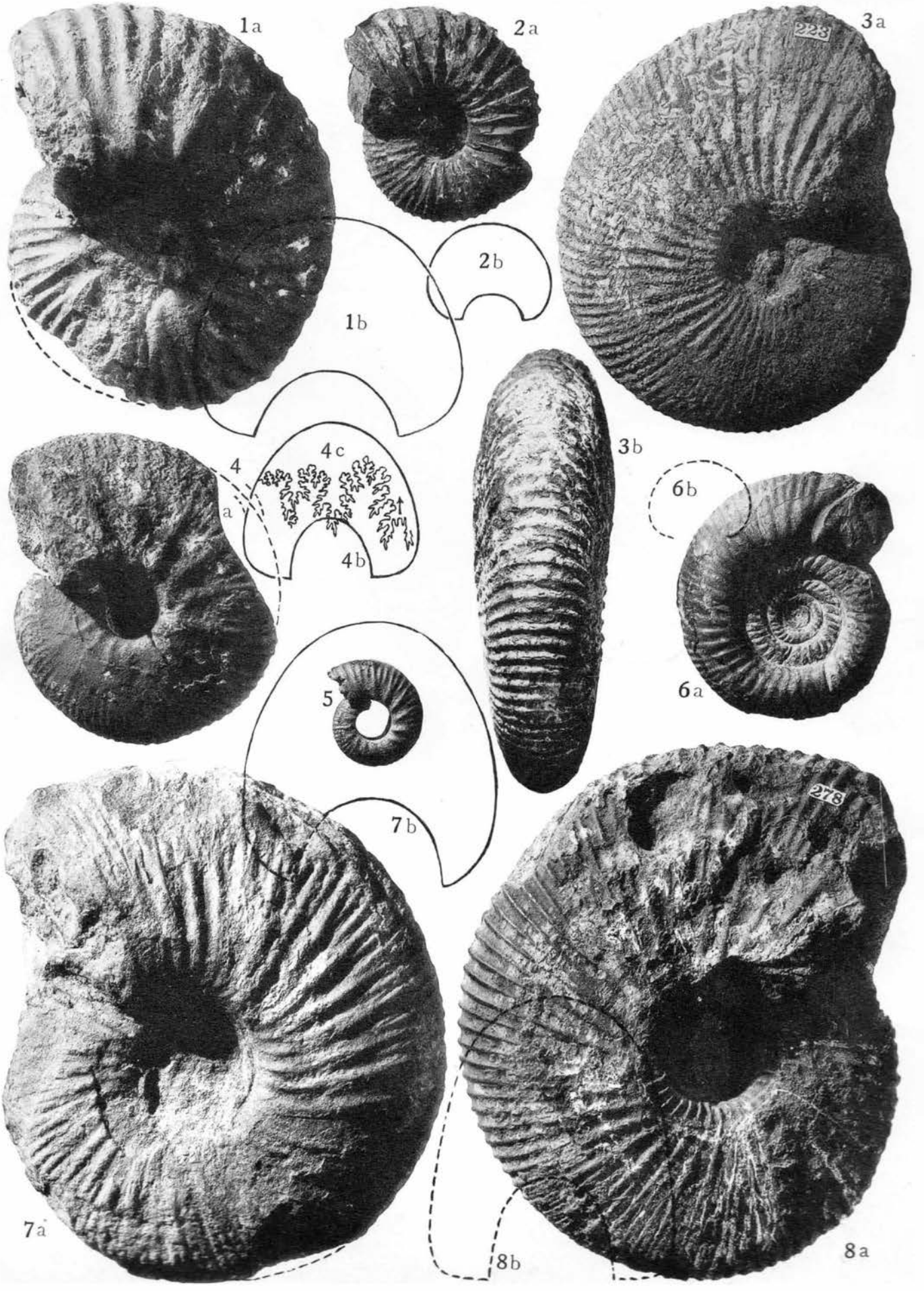

PLATE XLVI.

FIG. 1. *Reineckeia tyranniformis*, sp. nov. Side-view of holotype (reduced to $\frac{4}{5}$ linear). Callovian, *rehmanni* zone. Khera (bed No. 6) (For suture-line see pl. XLVII, fig. 7). (J. H. Smith Colln.) (p. 260.)

FIG. 2. *Neuqueniceras steinmanni* Stehn. Suture-line, at diameter of 100mm., of a San Pedro (Chili) example. Callovian, *rehmanni* zone ? (B. M. No. C. 15108.) (p. 254.)

FIG. 3. *Kinkeliniceras* aff. *angygaster* (Waagen). Suture-line (second from end, at diameter of 55mm.) of an example with wider umbilicus than type. Callovian, *anceps* beds, Fakirwadi. (G. S. I. No. K. $\frac{22}{282}$ pars.)

Geol. Surv. of India

Plate XLVI.

PLATE XLVII.

FIGS. 1*a-c*. *Obtusicostites*, sp. juv. Side-view (enlarged x2), peripheral view, and suture-line (x2), of a septate limonitic nucleus. (Callovian ?) Divesian, '*athleta* beds.' Fakirwadi. (G. S. I. No. K. $\frac{2}{2}\frac{2}{6}\frac{2}{6}b$.)

FIG. 2. *Epimayaites axonoides*, sp. nov. Side-view of holotype. Argovian, Kantcote Sandstone. River Bed, west of Kantcote. (J. F. Blake Colln. No. 285.) For peripheral view see Pl. XLVIII, fig. 4. (p. 235.)

FIGS. 3*a*, *b*. *Klematosphinctes præcursor* (Waagen). Side-and peripheral views of a typical example from the Argovian, Dhosa Oolite, of Samatra. (G. S. I. No. K. $\frac{2}{2}\frac{2}{1}\frac{2}{1}$.)

FIGS. 4*a*, *b*. *Grossouvria*, sp. juv. (*evexa* group). Side-and peripheral views of a South Manjal (bed No. 2) example previously (1924, p. 24) recorded as *G. curvicosta*, var. Divesian, *athleta* beds. (J. F. Blake Colln. No. 382.)

FIGS. 5*a*, *b*. *Grossouvria*, sp. ind. juv. Side-, and peripheral views of an East Jooria ('middle zone') example, previously (1924, p. 25) recorded as *G.* cf. *graciosa*, Siemiradzki. Divesian ?, *athleta* beds. (J. F. Blake Colln. No. 418.)

FIG. 6. *Kheraiceras cosmopolita* (Parona and Bonarelli). Last two suture-lines of holotype (Waagen's '*Stephanoceras bullatum*' *non* d'Orbigny, pl. XXXII, figs. 1*a*, *b*). Callovian *macrocephalus* beds ?, Khera. (G. S. I. No. $\frac{2}{9}$.) (p. 202.)

FIG. 7. *Reineckeia tyranniformis*, sp. nov. Suture-line, external and internal, of holotype (pl. XLVI, fig. 1), near end, at diameter of about 340mm. Callovian, Khera. (J. H. Smith Colln.) (p. 260.)

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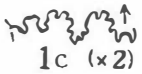
Geol. Surv. of India

Plate XLVI



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