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REVISION OF THE JURASSIC CEPHALOPOD FAUNA OF KACHH:

PART II.

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REVISION OF THE JURASSIC CEPHALOPOD FAUNA OF KACHH :

Part II.

By

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

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# REVISION OF THE JURASSIC CEPHALOPOD FAUNA OF KACHH.

BY

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

## PART II.\*

Family: *OPPELIDÆ*, Haug emend.

IN the present state of our knowledge it is considered advisable still to include in a single family Oppelidæ the fifty or more genera hitherto proposed, although they cannot be traced back to one group of *Phylloceras*. They must rather be taken to represent a heterophyletic assemblage of stocks, or successive offshoots of Phylloceratids, united merely because they all specialise more or less in similar directions. Such 'long-lived' smooth groups as '*Lissoceras*' and '*Haploceras*' are the connecting links; and a study of the Mediterranean faunas demonstrates that the rounded venters and absence of ornamentation in these persistent forms are primitive. The modification of the phylloid suture-line of e.g., *Haploceras*, with the high lateral saddle of *Sowerbyceras*, corresponds to that found again in e.g., certain *Uhligella*, Jacob, *Phyllodesmoceras*, Spath, and *Schlüteria*, Grossouvre, and it is significant that opinions are still divided as to whether some of these forms should be included in Phylloceratids or in Desmoceratids.

The original smoothness of Lissoceratids must not be confused with the secondary loss of keel or ornament in certain Oppelids. For example, body-chambers of the form described by Waagen as *Oppelia glabella* (= *Paralcidia khengari* nov.) could not be distinguished from those of *Alcidia nurrhaensis* (Waagen) or of *Subbonarellia decipiens* sp. nov. Like the crowding and reduction of the few terminal septal edges, observed in other ammonites, it is merely a phenomenon of individual growth, and cannot be applied to phylogeny. Mr. Buckman's (1924, p. 7) linking of the Bajocian *Strigoceras* (*truelleri* group) with the Middle Liassic *Paltopleuroceras* seems as far-fetched as Steinmann's (1909) derivation of *Oxycerites* from the Anisian *Pinacoceras aspidoides*, Diener, now that the spontaneous appearance of new characters in the young of many ammonites is becoming more generally realised. The Oppelids unfortunately, are not well represented in England; they are scarce already in the Corallian and altogether absent in the Kimmeridgian. In Mediterranean countries, however, they flourish even into the Cretaceous, and like most of the fundamental Phylloceratids, the transitional Haploceratids never left the warmer waters of the Tethys.

The Oppelids in the restricted sense are almost certainly derived from various members of *Lissoceras* and *Lissoceratoides* just as the Taramelliceratinæ and Streblitinae

\* Part I has been issued as the first fasciculus of this volume.

probably include descendants of different Haploceratids. I even considered it probable that *via* *Bradfordia*-like ammonites, Lissoceratids replenished other 'keeled' families, *e.g.*, Ludwigellidæ (1925, p. 113) and it may here be recalled that Douvillé (1885, p. 36) referred even his genus *Zurcheria* to the Lissoceratids, a connection still accepted by Rollier (1923, pl. I). The resemblance of *Diplesioceras* and of young *Strigoceras* to members of Sonninidæ indicates that the latter family is probably as polyphyletic as are the Ooppelids. Sonninidæ are also often confused with certain Ludwigids (*Bredya*) and even offshoots of Lytoceratids (*Erycitidæ*). Whilst some authors connected the old, comprehensive, '*Hammatoceras*' with Harpoceratids, Mr. Buckman (1888, p. 129) once considered both the true *Hammatoceras* (*insignis* group) and *Erycites* (*fallax* group) to be descended from some form allied to *Deroceras* or *Microderoceras* and therefore more closely allied to Stephanoceras. Prinz (1904, p. 84) also put *Erycites* into a sub-family Stephanoceratinæ. Since Harpoceratids are probably partly the descendants of *Harpophylloceras*, *i.e.*, the keeled Rhacophyllitids of the *eximius* type, convergence of its members towards the descendants of other groups of Phylloceratids such as the Ooppelids may be expected. The older authors again were doubtful whether to look upon Harpoceratids as derivatives of the Arietids or as keeled descendants of Aegoceratids. Mr. Buckman (1887, p. 40) also once connected *Oppelia* with the Toarcian Harpoceratid genus *Polyplectus*, but retracted this view two years later (1890, p. 216). The gravity of his later suggestion (1918, p. XIII) that Cadoceratidæ may "possibly be connected with Ooppelidæ" may well discourage systematists, but it is significant that what Mr. Buckman described as a *Phlycticeras* (*P. hyperbolicum*, Simpson sp.) is to the writer a Cadoceratid (*Chamoussetia*) *i.e.*, a descendant of Stephanoceratids.

Numerous additional examples of conflicting interpretations could be given, from the origin of Triassic Phylloceratids to the uncoiling of Lytoceratids in the Cretaceous. The sudden appearance of ornamentation in these smooth stocks has generally misled authors; but what little value can be attached to *e.g.*, tuberculation, often merely a strengthening device, first appearing in the young *i.e.*, cœnogenetic, I have discussed elsewhere (*Naturalist*, 1926, p. 140). The difficulty to which I formerly (*Geol. Mag.* 1919, p. 221) referred, of distinguishing the lytoceratid Macroscaphitinæ from the Crioceratids which "enter into the great family of Perisphinctidæ" (Sarsin and Schöndelmeyer) disappeared as soon as it was recognised that the recapitulatorial 'evidence' of the inner whorls was a hindrance instead of a help and that the tuberculate forms or those with trifid lobes could be derived from Lytoceratids or through '*Desmoceras*' from Phylloceratids as well as the smooth ones. The more he ponders why 'everything fluctuates in ammonites' (Wepfer, 1913, p. 435) the more it seems to the writer that only the common origin of all the apparently widely distinct trachyostaceous ammonite stocks in (and their repeated replenishment from) the persistent fundamental Liostraca (Phylloceratids and Lytoceratids) can explain not only the numerous puzzling cases of convergence to which we have directed attention, but also the fact that true mutations in the manner desired by Waagen are as yet unknown.

Opinions may still differ as to whether the connection is as direct as the writer holds, *i.e.*, whether there was frequent replenishing of the various ammonite tribes from the two root-stocks. Such transitional genera as *Prodactylioceras*, *Amphiceras*, the Ectocentritids, etc., have not yet received much attention, but the numerous Cretaceous *Lytoceras*-developments (note *e.g.*, *Cicatriles*), further such *Phylloceras* offshoots as *Schlüteria* and especially the Desmoceratids, strongly support the view here adopted. To trace back certain cryptogenous Ochetoceratids to the (Bathonian-Argovian) *Lissoceratoides* seems more reasonable than to go back to the base of the Lias for a connection with Phylloceratids, with the assumption of various phylogenetic ups and downs. It is also to be noted that like *Harpophylloceras* or the Desmoceratids, the transitional *Lissoceras*, *Lissoceratoides*, and *Haploceras* have unusually long ranges for ammonites. Steinmann's (1909, p. 641) view of the direct connexion of *Oppelia* with the Triassic *Pinacoceras*, and of *e.g.*, *Taramelliceras* with yet a different Triassic ancestor, cannot be accepted, but the occurrence of such close homœomorphs shows the difficulties we have to contend with in the splitting up of such a homogeneous group as the old genus "*Ammonites*."

Hard and fast definitions of genera and families within strict morphological limits fortunately are now disappearing. They made possible the connection with *e.g.*, *Kosmoceras*, of the Lower Liassic *Phricodoceras* on the one hand and of the Gault *Hoplites* on the other. But the recapitulational hypothesis is still applied equally mechanically, when, for instance the [probably coenogenetic] '*bispinosus*' stage in young *Strigoceras* is said to bring this genus into relation with *Paltopleuroceras*. Certain Bonarellids may simulate Kosmoceratids, and *Sindeites* may converge towards Peltoceratids, but few authors would now hesitate to refer them to Oppelids in spite of the presence of an external groove instead of a keel. We are as yet far, however, from realising the extent to which stocks may converge if *Amattheus* and *Paltopleuroceras*, hitherto united in one family and apparently connected by transitions, are derived from two such distinct sources as *Phylloceras* (*via Tragophylloceras* and Rhacophyllitids, also provided with 'epidermids,') and *Lytoceras* (*via Aegoceratids*). We may well exclaim with Prof. Hawkins: Alas! for systematics.

In this connection we may refer to some points raised by Wepfer in an excellent paper on the "Purpose of a Narrow Delimitation of Species in Ammonites" (1913). This author, the year before, dealt in detail with the "Genus *Oppelia*"; but palæontologists have not been able to adopt either his reintroduction of Quenstedt's trinomial nomenclature, nor his comprehensive use of the term *Oppelia*. Unfortunately it is true that, as Wepfer states, since Oppel's time "pleased by the progress of comparative stratigraphy" workers on ammonites have become accustomed to attaching too much rather than too little value to individual differences in ammonites, however slight. This led to the naming of great numbers of individuals in *e.g.*, the gentes of *Pro-lanulites königi* or of *Platylenticeras heteropleurum*. Their succession in time being unknown or imaginary and not observed in the field, there is no justification whatever for this splitting up into so many "species." It is clear that we cannot have it both ways:—give new names because our secondhand material is assumed to have come from

deposits of different dates and then because we have assigned different horizons to slightly different individuals of possibly the same species, or identical individuals with different matrixes, to put them into different genera on account of a supposed difference in age.

Again, as Wepfer says, the conception of Waagen's 'Formenreihen' necessitated strict differentiation of the most minute modifications and to be quite sure of meeting its demands authors made rather too many than too few species. It has already been mentioned that this second purpose has not been attained, simply because the various forms connected into so-called lineages were at the best independent developments of the same stock adapted to a similar mode of life but showing progressively 'advanced' features. Yet the only true successions so far known are such series within the Phylloceratids and Lytoceratids as that described above, from *Ptychophylloceras tatricum* to *P. tithonicum* and *P. semisulcatum*. In such a true lineage the change is very slight during an enormous period of time.

As for the advantage to comparative stratigraphy, palæontological science would not have continued to follow Oppel's lead of seventy years ago unless some good results had been obtained. Mr. Buckman (1924, p. 10) mentions that a reviewer of his 'Type Ammonites' had "no good word for the palæontological part of the volume (IV) but praised the chronological portion." We must consider his chronological claims to be greatly exaggerated and are not surprised that "they have received the strongest condemnation" from those who did not recognise Mr. Buckman's merit in driving home by this very exaggeration the lesson of dissimilar faunas. But Wepfer no doubt was right in objecting against the tyranny under which we are still suffering and the self-deception caused by splitting up a variable species into new genera. The pseudo-scientific justification of this manufacture of new species by means of the exaggeration of graphs and measurements of unimportant differences may not deceive anybody, but it helps to give the impression that ammonites are an exceedingly large and varied, instead of an extremely homogeneous, group.

It may not be a serious misfortune that ammonites now-a-days cannot be determined "off hand," for Neumayr pointed out many years ago that palæontological 'species' were impossible to uphold so soon as the available material was at all complete. Unfortunately it is still necessary, in order to group the apparent chaos of forms, to "advance former species to genera," and genera again to families, and this also gives the impression that ammonites are far more diverse than they really are. We may repeat in this connection that compared with the persistent liostracous Phylloceratids and Lytoceratids, the ephemeral trachyostracous offshoots are important merely from the stratigraphical point of view. There are many of these and it is only a matter of systematic detail whether we group them into genera or families—'species' obviously being out of the question in view of the time-element. The use of small families seems preferable to the writer for reasons of systematic convenience and a better general view of a multitude of units; but it is matter for regret that so far as the Oppelids are concerned, on account of the incompleteness of the geological record and our scanty knowledge of Mediterranean successions, we cannot yet restrict these smaller families to the

descendants of definite species groups within the Phylloceratidæ and Haploceratidæ. This alone would justify us to simplify the present nomenclature.

Oppelids are thus classed in the following sub-families :—

- Oppelinæ, Haug emend.
- Phlycticeratinæ, Spath.
- Bonarellinæ, Spath.
- Hecticoceratinæ, Spath.
- Ochetoceratinæ, Spath.
- Taramelliceratinæ, Spath.
- Streblitinæ, Spath.

The family Haploceratidæ, Zittel emend., with transitional forms to all the above, from the Bathonian *Lissoceratoides ferrifex* (Zittel) upwards, is preferably kept apart.

The stratigrapher does not generally favour Oppelids for the exact dating of beds. Fischer (1915, pp. 242 and 268) complained that there was an "infinite variability" which produced very similar forms in quite different areas and at entirely different times; also that only the most characteristic species could be used as zonal indexes, but that the great majority of forms were unsuitable for this purpose on account of their far too great and too uncertain variability. 'The difficulty, however, seems to be at least equally great in the case of the Perisphinctids of the Upper Jurassic when only fragmentary material is available.

#### Sub-family : OPPELINÆ, Haug emend.

The genus *Oppelia*, Waagen, s. s. (*subradiata* group only) was dominant during the deposition of the *Procerites* and *Zigzagiceras* beds at the top of the Bajocian and during the still earlier Parkinsonian age. It persisted into the Siemiradzkian age, including the upper (Bathonian) half of Mr. Buckman's *Zigzagiceratan* and his 'Gracilisphinctean' ages, which correspond with the Fuller's Earth and Stonesfield Slate deposits of England. In the latter age it is accompanied by the peculiar genus *Micromphalites* Buckman 1923 (= '*Neactinoceras*' Spath 1924) which includes '*Stringoceras*' *pustuliferum*, H. Douvillé (1916, p. 41, pl. VI, figs. 2—3), referred to below, occurring apparently with *Clydoniceras orientale* H. Douvillé in the *Eudesia cardium* beds. These were described by the same author as Lower Callovian in 1926 (p. 304).

*Oxyerites* Rollier (genotype :—*Ammonites aspidoides*, Oppel, 1862, p. 146, pl. XLVII, figs. 4a, b, non *Amm. discus complanatus* Quenstedt, 1849, pl. VIII, fig. 12= *Oxyerites calloviensis*, Parona and Bonarelli) differs from *Oppelia* merely in having crescent-shaped ribs of only one kind, feeble often even in the young. It also occurs already in the Siemiradzkian, but is more abundant in a later age, the Oxyeritan, notably its upper part in which J. Roemer (1911, p. 3) could recognise a zone with '*Sphæroceras*' and coarsely-ribbed Oppelids underlying the main horizon of *Oxyerites aspidoides*. The genus *Clydoniceras*, Blake 1905 (*Harpoceratidarum*, Pompeckj 1906), a specialised and highly variable offshoot, seems to occur throughout the Bathonian (Stonesfield Slate to Cornbrash) but need not here be considered since it appears to be absent from Kachh; but as this genus is referable to a separate family *Clydoniceratinæ*

it is advisable to separate from *Oppelinæ* s. s. the genus *Micromphalites*. It will be referred provisionally to the family *Phlycticeratinæ*, discussed below.

The earliest Indian Oppelids are the poorly-preserved impressions from the Patcham Beds, described by Waagen as '*Oecotraustes serrigerus*.' They may be as close to the true *Oecotraustes* of the Zigzagiceratan age as to the group of forms of *Oxyceritan* age to which Waagen's original (1869, non 1875) *Oecotraustes serrigerus* belongs. This stock is more closely allied to *Alcidia*, Rollier (genotype:—*Ammonites subdiscus*, d'Orbigny) than to *Oxycerites* itself. The new genus ***Paræcotraustes***, gen. nov. is now proposed for this group (genotype:—*Oecotraustes serrigerus*, Waagen, 1869, p. 230, pl. XX, fig. 8) since it is distinguished from the earlier true *Oecotraustes* by its wider umbilicus and less lissoceratid suture-line (J. Roemer, 1911, pl. VII, figs. 13, 14; pl. XI, figs. 6, 7) and by its highly developed 'ears' (Lissajous, 1923, pl. XXVI, fig. 1). This group thus stands in the same relationship to *Alcidia*, to be discussed immediately, as *Oecotraustes* (genotype:—*Oe. genicularis*, Waagen, 1869, p. 227, pl. XX, fig. 4) does to the true *Oppelia*. The tendency to flattening of the ribs in *Paræcotraustes* is reminiscent of another stock (of the *sauzei* zone), namely ***Protæcotraustes***, nov. (genotype:—*P. dundriensis* [Woodward MS] nov., pl. IX, fig. 8, with coarser ornamentation than *P. spiniger*, S. Buckman sp., 1910, p. 95, pl. XI, fig. 7); but in this genus, an unrelated offshoot of Lissoceratidæ, Grossouvre, the ribbing is merely sigmoidal, not angulirur-siradiate. *Oecotraustid* forms, of course, have often been produced and are known to recur so late as the Kimmeridgian period. Thus it is probable that a form like *Paræcotraustes subfuscus* Waagen (see Grossouvre, 1918, pl. XIV, fig. 4) with pronounced inner ribs could be attached to *Prohecticoceras* (to be dealt with below) as much as to *Alcidia*, and it occurs with both at Ste. Pézenne. On the other hand '*Oecotraustes salvadorii*', Parona and Bonarelli (1897, p. 130, pl. III, fig. 2) is apparently a later Hecticoceratid (*Lunuloceras*), whilst other stocks of this family and even some Bonarellid forms, here described, similarly produced oecotraustid offshoots.

The genus *Alcidia*, Rollier, was created for a group of forms with blunt keel and ribs that become nodate peripherally, so that we might well separate it from *Oppelinæ* s. s. It is, however, here retained in this sub-family on account of the close affinity of its genotype (*Ammonites subdiscus*, d'Orbigny, 1846, p. 421, pl. CXLVI, figs. 1—2) with *Oxycerites aspidoides*; but via the group of '*Oppelia*' *marioræ*, Popovici-Hatzeg, (1905, p. 17, pl. IV, figs. 2, 6, 7) and via '*Petitclercia*' *redlichi*, Popovici-Hatzeg (1905, p. 18, pl. V, figs. 1a, b) *Alcidia* could be connected with Bonarellinæ and Phlycticeratinæ, just as *Alcidia haugi* (Popovici-Hatzeg) and *A. costata* (J. Roemer) are transitional to *Prohecticoceras* discussed below. Costate forms of *Oxycerites*, such as *O. fuscus* (Quenstedt) or *O. biscalptus* (Oppel=*Ammonites henrici*, Kudernatsch non d'Orbigny) with *Alcidia*-like inner whorls, are often impossible to distinguish from that genus before the whorls become compressed and involute, but in Hecticoceratids there is no return to an '*Oppelia*' shape in the adult.

*Oxycerites tilli* (Loczy, 1915, p. 342, pl. IV, figs. 3 and 4, non 2 ?) to judge by a Villány example before me (B. M. No. C 13467) is probably a descendant of the true Bathorian *Oxycerites*, but contrary to Rollier, Loczy considers this to be merely a sub-

genus of *Oppelia*. Later forms, however, included in *Oxycerites* by Rollier, are merely homœomorphous developments of Ochetoceratinæ (e.g., *Ammonites hersilia*, d'Orbigny; Rollier, 1913, p. 168, text-fig. 2) discussed below.

Whereas the typical forms of *Alcidia* (*subcostaria* group) remain true '*Oppelia*' and have been considered to be closely related to so late a form as *Neochetoceras paternoi*, Di Stefani sp. (1884, p. 31, pl. II, fig. 12) of the Kimmeridgian, others show a tendency of the ribs to flatten or bifurcate as in Bonarellids; but in this family carination is modified or lost and the periphery may become even concave. In Rollier's original circumscription the genus *Alcidia* included not only *Bonarellia superba* (Waagen), but even *Metahaploceras strombecki* (Oppel) of the Kimmeridgian. Since Rollier considered Vacek's '*Oppelia*' *subaspidoides* to connect *Oxycerites* with the homœomorphous but entirely unrelated genus *Oxynotoceras*, and since he (1911, p. 308) thought that this reappeared in the Neocomian, we may well feel doubt concerning the value of his lineages; moreover he neglected even the suture-line because, according to him, the lobes of e.g., the Gault *Anahoplites splendens* or the Neocomian *Leopoldia* showed great resemblance to those of Oppelids. This is, of course, quite natural; for the former two genera are derived through Desmoceratids from Phylloceratids, as the Oppelids come from the same source through Lissoceratids and Haploceratids. *Hecticoceras blondeti* Roman and Lemoine (1924, p. 104, pl. III, figs. 6, 6a) and the (more doubtful) *Oppelia* (?) *pleurocyma*, Parona and Bonarelli (1897, p. 129, pl. III, fig. 1) are also referred to the genus *Alcidia* since they are 'transitional between *Hecticoceras* and *Oppelia*'; but it is uncertain whether they are cogeneric with *Alcidia subdiscus*. The tendency to show a return in the adult to a typical '*Oppelia*' whorl-shape, with closing of the umbilicus, has generally been the cause of confusion of various later stocks with earlier *Oppelia* and *Oxycerites*. The outer whorls of the two *Alcidia* offshoots, *Paralcidia* and *Subbonarellia*, discussed below, especially, are often indistinguishable from those of the parent stock.

It is to be noted that Waagen already, more than fifty years ago, put two forms of these offshoots, namely '*Oppelia*' *nurrhaensis* and '*Oppelia*' cf. *glabella* (non Leckenby), so similar in the adult, into two distinct groups. On comparison of their inner (neanic) whorls it is indeed found that they almost certainly belong to two different stocks. A new generic name (***Paralcidia***, gen. nov.) is therefore necessary for the latter as well as a new specific name (*P. khengari*, nom. nov.) since Waagen's Indian form is not identical with Leckenby's original *Ammonites glabella* from Yorkshire, here refigured (pl. XI, figs. 4a, b). *Paralcidia*, the latest stock of true Oppelinæ, by its rounded body-chamber and closing umbilicus, is clearly distinguished from the oxynote '*Harpoceras*' *hersilia*, d'Orbigny sp. (de Loriol, 1898, pl. I, figs. 7—13), but the inner whorls of '*Oppelia*' *villersensis*, d'Orbigny sp. (R. Douvillé, Pal. Univ. 1904, pl. LIII), also wrongly referred to *Oxycerites* by Rollier, in whorl-shape resemble the young of *Paralcidia*. It is here held that *Paralcidia* is not related to the forms of the sub-family Ochetoceratinæ that include descendants of Hecticoceratids and perhaps independent offshoots of *Lissoceratoides*, but that it is more closely allied to certain forms of *Alcidia*, with fastigate peripheries, e.g., *A. prahequensis* (R. Douvillé).

'*Oppelia nurrhaensis*' differs from typical *Alcidia* merely in its slightly simpler sutureline. This is almost hecticoceratid and the open inner whorls of the species quoted also bring it into comparison with forms like *Brightia*, with similar rursiradteia outer ribs. Waagen wrongly referred '*Oppelia nurrhaensis*' to the "group of *O. fornix*," which he considered to be transitional to Hecticoceratids and to be of "entirely Indian distribution." *Oppelia fornix* is now referred to the genus *Bonarellia* since it develops crenulate latero-ventral edges already when the whorls are still evolute and smooth. The simplification of the suture-line in *Alcidia nurrhaensis* again is conspicuous chiefly on the last few septa, whereas in Bonarellids and Hecticoceratids it is probably connected with cœnogenetic development of ornamentation in the young.

The genera *Oppelia* (in the restricted sense), and *Oxyerites* have not yet been found in the Kachh Jurassic. The forms which are here referred to the sub-family Oppelinae are the following:—

Genus: PARÆCOTRAUSTES, nov.

*P. (Oecotraustes ?)* sp. nov. ?

Genus: ALCIDIA, Rollier.

*A. dubia*, nom. nov.

*A. aff. obsoleta* (Rollier).

*A.* sp. ind.

*A. inflata* sp. nov.

*A. mimetica*, nom. nov.

*A. nurrhaensis* (Waagen).

*A.* sp. juv.

Genus: PARALCIDIA, nov.

*P. khengari* nom. nov.

*P. khengari* var. *aperta*. nov.

These forms comprise about thirty specimens, a feeble representation in comparison with the later sub-families of the Oppelida.

Genus: PARÆCOTRAUSTES, nov.

PARÆCOTRAUSTES (*OECOTRAUSTES* ?) sp. nov. ? (Pl. IX, fig. 3).

1875. *Oppelia (Oecotraustes)* cf. *serrigera*, Waagen, p. 57, pl. x, fig. 3.

1893. *Ammonites (Oppelia) serriger* (Waagen) Oldham, p. 219.

1910. *Oppelia serrigera* (Waagen) Dacqué, p. 156.

1924. *Oecotraustes* sp. Spath, p. 19, table I.

The example here figured (from a plaster cast of the original impression, diagrammatically represented by Waagen) and two indistinctly preserved smaller impressions on the same slab of rock, are still the only examples available. Waagen considered the present form to show "mixed characters of three species, *Opp. subfusca*, *serrigera* and *conjungens*", but in general form to be most nearly allied to the [first] two Bathonian species. Opinions may differ on this point, for the tuberculate termination of the flattened ribs certainly suggests comparison of the Patcham specimens with *Paræcotraustes conjungens* (K. Mayer, 1865, pl. VIII, fig. 6), but the inner whorls are unfortunately

unrecognisable in the three Indian impressions. The angulirursiradiate character of the ribs resembles that found in *Paræcotraustes subfuscus* (Waagen). Since Waagen's original fig. 8 (1869, pl. XX) has now been taken as type of *Paræcotraustes serrigerus* and fig. 7 was stated by Mr. Buckman (1910, p. 95) to belong apparently to quite another species, it seems advisable to separate the Kachh form from Waagen's species, but until better specimens become available no new name can be given. *Oecotraustes rugosus* S. Buckman (1889, pl. XXI, figs. 1—2) shows coarse ornamentation like the form here described but appears to be more prominently keeled. Since the matrix in which the specimens are preserved (a bluish-grey, hard shale, but not calcareous as Waagen stated) is quite different from that of any other specimen in the collection, it might be held that the forms here described could even be of Bajocian (Zigzagiceratan) age. From general geological considerations an immediately pre-Callovian, e.g., Oxyeritan age is, perhaps, more likely, but even such *aspidoides* faunas as those of the Nièvre and the Sarthe, of Lechstedt near Hildesheim, or of Mt. Strunga in Rumania seem to include nothing like the present form. *Paræcotraustes paradoxus* (J. Roemer, 1911, p. 41, pl. VII, figs 13—14) from the third locality, though closely allied to *Alcidia costata* (J. Roemer), resembles the Kachh species in the thickening of the peripheral terminations of the ribs. Such Callovian species, however, as *Hecticoceras hecticum* (non Reinecke) Loczy (1915, p. 319, pl. III, figs. 19—20) which may be as close to *Hecticoceras perlatum* (Quenstedt) as to the true *Paræcotraustes conjungens*, resemble the present form as much as do the Bathonian *P. serrigerus* and *P. paradoxus*.

*Horizon*.—Bathonian (?).

*Locality*.—South of Nurrha. On p.110, Waagen wrongly stated that '*Oppelia*' *serrigera* was associated with '*Stephanoceras*' *macrocephalum* in the coral beds of the uppermost Patcham Group. It is to be noted that the matrix is entirely different from the compact limestone of these Coral beds (=like that of my Jumara beds from below No. 12 to No. 14a, 1924, p. 22=*trigonalis* zone of the table\*) and that Waagen

\*Most of the material was not collected zonally, and until the stratigraphical results of the present study can be summarised in a final chapter, the following provisional classification may be adopted :—

Stages.	Ages.	Zones.	Kachh Equivalents.
Tithonian . . . .	Aulacosphinctan . . . .	{ privasensis. pronus. transitorius . . . .	Umia Beds ? (pars).
Portlandian . . . .	Gigantitan . . . .	{ giganteus. zitteli. nikitini. rotundum.	
Kimmeridgian . . . .	Up. { Virgatitan . . . .	{ palmatus . . . .	{ [Upper Katrol Group ?].
	M. { Lithacoceratan . . . .	{ steraspis . . . .	{
	L. { Katroliceratan . . . .	{ beckeri . . . .	{ Lower Katrol Amm. Bed.
	{ Idoceratan . . . .	{ eudoxus . . . .	{
Argovian . . . .	{ Perisphinctan . . . .	{ tenuilobatus . . . .	{ Belemnite Marls and Kant-
	{ Cardioceratan . . . .	{ platynota . . . .	{ cote Sdst.
Divesian . . . .	{	{ bimammatum . . . .	{
	{	{ transversarium . . . .	{
	{	{ cordatus [=polyphomus]	{ Dhosa Oolite.
Callovian . . . .	{ Quenstedtoceratan . . . .	{ renggeri . . . .	{
	{ Kosmococeratan . . . .	{ lamberti . . . .	{
	{ Reineckeian . . . .	{ duncani . . . .	{ Upper Chari Group (=
Bathonian . . . .	{	{ fraasi . . . .	{ 'athleta beds').
	{	{ anceps . . . .	{ Middle Chari Group.
	{ Macrocephalitan . . . .	{ rehmanni . . . .	{
		{ diadematus . . . .	{ Lower Chari Group.
		{ dimerus . . . .	{
		{ tri'onalis . . . .	{ Patcham Group.
		{ bullatus . . . .	{

does not record '*macrocephalus*' from near Nurrha. The matrix attached to certain examples from the higher '*macrocephalus* shales' with the fauna of what Waagen (p. 138) called the 'Brachiopod Bed' of the Patcham group, characterised by '*Macrocephalites*' *dimerus* and *M. subtrapezinus* (my *macrocephalus* beta) is also calcareous and of a different (purplish to yellow) colour. On the whole it seems therefore probable that the species now described is the only one that can properly be referred to the Patcham Group of Waagen's introductory table, of Bathonian ? age and in any case resting directly on gneiss. The two *macrocephalus* zones just referred to of undoubtedly Callovian age are so intimately connected with the succeeding *chrysolithicus-diadematus* and the (next higher ?) *rehmanni* beds (=formerly "königi zone") that they cannot be separated from the Lower Chari Group.

Genus : ALCIDIA, Rollier.

ALCIDIA DUBIA nom. nov. (Pl. x, figs. 5a, b).

1875. *Oppelia subcostaria* (non Oppel) Waagen pars, p. 48, pl. x, fig. 1 only.  
 non 1862. *Ammonites subcostarius*, Oppel, p. 149, pl. xlvii, figs. 2a, b.  
 non 1869. *Oppelia subcostaria* (Oppel) Waagen, p. 219, pl. iv, figs. 2—5.  
 non 1910 „ „ „ Till, p. 264.  
 non 1911. *Oppelia obsoleta*, Rollier ; p. 307.  
 non 1915. *Oppelia* (*Oxyerites*) *neumayri* (Gemmellaro) Loczy, p. 344.

The specimen figured by Waagen (and restored by the artist) is poorly preserved. The ventral area of the first quarter of the last whorl is worn away. Above the figure "1" in Waagen's illustration there are apparently traces of a few ribs ; but it is possible that even this appearance of costation is, at least partly, due to weathering. The peripheral view (Waagen's fig. 1a, pl. X) is also incorrect ; and the example is therefore now refigured (pl. X, figs. 5a, b), the lateral view showing that the umbilicus is considerably larger than it was drawn by Waagen's artist. This author may have been right in stating that the ammonite represented " exactly the variety he had figured in pl. XIX, fig. 3 of his former paper". Since only a drawing of the suture-line was given, and since his Kachh example does not show suture-lines at all in its present state, comparison is impossible ; and to the writer the example is altogether doubtful. It is not probable, however, that this be merely a badly preserved example of the species here described as *Alcidia mimetica*, nov., and it certainly is not referable to Oppel's original *Amm. subcostarius* of Reineckeian age.

There is a small specimen in the Blake Collection (No. 114) which probably represents the young of the present species. The change in whorl-shape at the two diameters is instructive :—

Waagen's type	.	.	.	.	60	·50	·25	·20?
Blake Colln. No. 114	.	.	.	.	30	·47	·30	·27

Since e.g., Till's '*Oppelia* cf. *subcostaria*' shows a contraction of the umbilicus from 6 to 3 per cent. of the diameter, it is clear that this author, like others, had been misled by Waagen's incorrect drawing. It can also be seen at once that *Alcidia obsoleta*

(Rollier), based on Waagen's original (1869) *Oppelia subcostaria* (non Oppel), differs from the present species in its smaller umbilicus, whereas *Oppelia neumayri*, Gemmellaro (1872, pl. I, fig. 4), wrongly identified by Loczy (1915, p. 344) with Waagen's 1869 form (not Oppel's of 1862), is distinguished by its trigonal whorl-shape and high keel. This last may be an *Oxycerites*.

The suture-lines of the smaller example are well shown and agree with those of *A. inflata* (pl. X, figs. 3a, c), whereas the fragment of *A. aff. obsoleta* (Rollier) figured on pl. X, fig. 2a, shows a slightly less deep lateral lobe and altogether eight saddles, not 6 as in the present form and in *A. inflata*.

*Alcidia mazetieri* (Petitclerc, 1921, p. 7, pl. XXI, figs. 4, 5) shows different ornamentation on the outer whorl, whilst the true *Alcidia subcostaria* (Oppel) is more compressed and more involute, and resembles *Oppelia subradiata* (Sowerby) to such an extent that Favre (1912, p. 33) suggested its attachment to the Bajocian species as a mere variety. *Oppelia virgata* Loczy (1915, p. 335, pl. III, figs. 6—7), *O. mamertensis* Waagen (1869, p. 223, pl. XIX, fig. 1), and *O. guebhardi*, Petitclerc (1915, p. 48, pl. III, fig. 2), have fine secondary ribbing, as in the *subradiata* group, and show some resemblance even to *Lorioloceras*. Since these forms seem connected with the true *Alcidia subcostaria* by such forms as the present species and *A. exotica* (Steinmann, 1881, p. 266, pl. XI, figs. 5, 6) they are here considered to be merely homœomorphs of the earlier *Oppelia* of the *subradiata* type.

*Horizon*.—Lower Callovian, upper *macrocephalus* (= *diadematus*) zone.

*Localities*.—The present species is known from the Golden Oolite of Khera (Waagen's type) and the corresponding Bed No. 10 of Jumara (Blake Collection, No. 114), and the age is definitely established. Loczy (1915, p. 440) considered *Oppelia subcostaria*, stated to be known from the "Oxfordian," to be a descendant of the closely allied *O. virgata*, ascribing the latter tentatively to the Upper Callovian. This is probably incorrect; for two other forms of *Alcidia*, described below, in addition to Waagen's two examples of '*Oppelia subcostaria*,' came from the same Lower Callovian beds.

ALCIDIA aff. OBSOLETA (Rollier). (Pl. X, figs. 2a, b).

1869. *Oppelia subcostaria* (Oppel) Waagen, p. 219, pl. xix, figs. 2 (and 5 ?).

1911. *Oxycerites obsoletus*, Rollier, p. 307.

1924. *Alcidia cf. subdiscus* (d'Orbigny) Spath, pp. 5 and 22.

The large example represented on pl. X, fig. 2b, and previously recorded as *Alcidia cf. subdiscus* (d'Orbigny), is more compressed near the periphery and also has a slightly larger umbilicus than the example described below as *Alcidia* sp. ind. Its inner whorls, so far as can be observed, are identical with the smaller fragment reproduced in pl. X, fig. 2a (enlarged  $\times 2$ ) which shows the suture-line. This form seems to have more resemblance to Waagen's *Oppelia subcostaria* of 1869, on which Rollier's species is based, than any of the other forms here discussed. *A. dubia* differs chiefly in its larger umbilicus; the true *A. subcostaria* (Oppel) on the other hand has more delicate ribbing of the *subradiata* type and a more compressed whorl-section.

Favre (1912, p. 30) considered Waagen's form to correspond exactly with *A. subdiscus* (d'Orbigny), but this cannot be admitted; for even if, with Lissajous, Favre, and Petitclerc, we take d'Orbigny's species to be Callovian rather than Bathonian, its whorl-section and suture-line are different. The lobes especially were characterised already by Waagen (1869, p. 220) as being coarser and less indented than those of *Amm. subcostarius*; but Favre not only misquoted Waagen in this respect, but united with *Alcidia subdiscus* quite a number of different forms.

Loczy (1915, p. 92) included *Alcidia obsoleta* as well as Waagen's remaining *Amm. subcostarius* (non Oppel, pl. XIX, figs. 4a—b) in Gemmellaro's '*Oppelia* [*Oxyerites* ?] *neumayri* (1872, p. 16, pl. I, fig. 4a), but the Sicilian species differs from all the forms of *Alcidia* here discussed in its sharpened venter (with a high keel) and in its suture-line with a low *aspidoides*-like external lobe. The Villány form figured by Loczy (1915, pl. IV, fig. 1) moreover, is distinguished from the species here discussed by its open umbilicus and by its whorl-section.

*Oppelia greppini*, Petitclerc (1915, p. 54, pl. X, fig. 5) with unknown suture-line, seems to be indistinguishable from the form here discussed, but its measurements, as given by Petitclerc (65—51—20—14), indicate a more compressed and more evolute shell than the typical *A. obsoleta*. The dimensions of Waagen's two Gutmadingen types (Nos. IV and VI) of this species were given as 46—59—28—11 and 75—57—25—09. The latter has to be selected as the holotype. *Hecticoceras blondeti*, Roman and Lemoine (1924, p. 104, pl. III, figs. 6, 6a), with slightly different dimensions (44—52—25—16), is also probably a closely allied form.

Whether *Oppelia tsytovitchi*, Petitclerc (1915, p. 56, pl. IV, fig. 3) is based on a large form of *Alcidia* of the present group, or whether it is an *Oxyerites*, as seems less likely, cannot be decided without examination of its inner whorls.

*Horizon*.—Lower Callovian, upper *macrocephalus* (= *diadematus*) zone.

*Locality*.—Jumara (Bed No. 10), Blake Colln. Nos. 111, 112.

ALCIDIA sp. ind. (Pl. X, figs. 1a, b).

1913. *Oppelia* (flat, with median ridge); Smith, p. 210.

This species is represented only by the fragmentary specimen here figured (pl. X, figs. 1a, b), septate to the end. The replacement of the inner whorls by crystalline calcite unfortunately prevented their preparation, but they are seen in section (pl. X, fig. 1b) and show a comparatively broad venter, so that the species cannot belong to *Oxyerites*. At a probable diameter of 105 mm. its dimensions are :—57—30—10; and it is thus more inflated than *A. mimetica* or the forms described above as *Alcidia dubia* and *A. aff. obsoleta*. Moreover, the greatest whorl-thickness is not near the umbilical edge as in *A. mimetica*, but more towards the middle of the side, which is marked by a fairly prominent spiral ridge; whilst there are about four indistinct crescent-shaped ribs on the outer area. The venter is keeled, but rounded on the cast, as in *A. obsoleta* (Rollier); the suture-line seems to be more highly frilled.

*Oppelia* (*Oxycerites* ?) *neumayri*, Gemmellaro (1872, p. 16, pl. I, fig. 4) has a higher keel and a more trigonal whorl-section than the form here described. *Oppelia* (*Oxycerites* ?) *tilli*, Loczy, is much more compressed, especially near the periphery, and the Villány species of *Alcidia*, identified by Loczy (1915, p. 344) with Gemmellaro's Sicilian *Oppelia neumayri*, has a wider umbilicus, which also prevents its reference to Rollier's *Alcidia obsoleta*. *A. exotica* Steinmann, already referred to, also has a more acute periphery.

*A. prahequensis* (R. Douvillé, 1913b, p. 61, text-figs. 2—3) has a wider umbilicus and a fastigate periphery; the section of this species given by Petitclerc (1915, pl. XIII, No. 50) is diagrammatic but shows a much more acute venter.

*Horizon*.—Lower Callovian, upper *macrocephalus* (= *diadematus*) zone.

*Locality*.—Khera Hill (belt 4 of Mr. J. H. Smith=Golden Oolite). J. H. S. Colln. No. 6.

#### ALCIDIA INFLATA, sp. nov. (Pl. X, figs. 3a—c).

1924. *Alcidia* cf. *subcostaria* (Oppel) Waagen sp., Spath, pars, pp. 5 and 22.

This species is based on two specimens in the Blake Collection (pl. X, figs. 3a—c), previously recorded from bed No. 10 of Jumara and erroneously united with the specimen of *Alcidia obsoleta*, figured on pl. X, fig. 2a. The difference in whorl-shape is slight, but the umbilicus is larger in the present form and the anguli-rursiradiate ribbing is closer. *A. dubia* on the other hand, at a corresponding diameter (compare figs. 3b and 5b of pl. X), has not only a more compressed whorl-section but presumably delicate costation, although in the width of the umbilicus it agrees with the present form.

*A. mimetica*, nov. described below, which may include the nodate variety of his '*Oppelia subcostaria*,' figured by Waagen (1869) in his plate XIX (figs. 4a, b only), differs from *A. inflata* in its more compressed whorl-section, but it also has flattened (clavate) peripheral terminations of the ribs. In the present species the terminations are much more marked than on the inner whorls of *A. dubia* or *A. obsoleta*.

*Oppelia lamberti*, Petitclerc (1915, p. 49, pl. III, fig. 3; pl. V, fig. 5; pl. XIII, No. 47), if not a malformation, may belong to the same group as the present species, but it has more distant and coarser outer ribs. On the other hand the immature form of *Alcidia*, attributed by Roman and Lemoine (1924, p. 103, pl. III, figs. 5, 5a) to *Prohecticoceras retrocostatum* (Grossouvre), mut. C, is somewhat intermediate in ornamentation between the present species and the young of *A. dubia*.

The inner whorls of such species as *Alcidia primæva* (Grossouvre, 1918, pl. XIII, figs. 8, 10 and 11 only) may be indistinguishable from those of the form here described, but the example figured by Grossouvre in figs. 9a, b of the same plate, showing a blunt keel, may be a young *Prohecticoceras*.

*Horizon*.—Lower Callovian, upper *macrocephalus* (= *diadematus*) zone.

*Locality*.—Jumara (bed No. 10).

*ALCIDIA MIMETICA*, nom. nov. (Pl. X, fig. 6).

1875. *Oppelia subcostaria* (non Oppel) Waagen, p. 48, pl. x, figs. 2, 2a only.

1912. *Oppelia subdiscus* (d'Orbigny) Favre, (pars), p. 30.

1924. *Alcidia* cf. *subcostaria* (Oppel) Waagen sp., Spath, pars, pp. 5 and 22.

1925. *Alcidia subcostaria* (Oppel) Waagen sp., Spath [Madagascar], p. 11.

This species may be identical with the Polish example referred by Waagen (1869, pl. XIX, figs. 4a, b) to Oppel's form, but it is entirely different from the holotype of Oppel's species, as has been recognised already by various writers. What Waagen, in his later paper, had considered to be a variety (his figs. 1, 1a) is discussed above under *Alcidia dubia*, nom. nov. Waagen's type-figure does not show very clearly the v-script ornamentation of the beginning of the last whorl, with the inner half shorter than the outer, not *vice versa*, as represented by Waagen. On the other hand the walls of the umbilicus are corroded, and the illustration (Waagen's fig. 2) is misleading in so far as it suggests a large umbilicus with well-defined walls, whilst the peripheral view (2a) also shows the aperture and especially the earlier half of the outer whorls less compressed than they really are. The ventral view is therefore now given (pl. X, fig. 6) but the lateral aspect, owing to corrosion, is unsuitable for photographic reproduction.

*Alcidia inflexa*, Grossouvre (1888, p. 372, pl. III, figs. 2a, b, [holotype], fig. 6) is close to the species here described but has approximate and less rursiradiate, less v-script ribs on its earlier whorls, whilst its periphery is more fastigate. Favre (1912, p. 27) considered this form to represent the true *A. subdiscus* of d'Orbigny, but, as Lissajous (1923, p. 116) pointed out, the latter (which he ascribes to the Lower Callovian) seems distinguishable by its less neatly carinate and less fastigate periphery.

In *Alcidia haugi*, Popovici-Hatzeg sp. (1905, p. 18, pl. XIII, figs. 8a-c, lectotype, figs. 2-7, 9-10, pl. XII, fig. 3) the inner whorls remain closely costate to a larger diameter than in the present species, but the transitional form figured by that author on pl. XIII, figs. 10a, b, undoubtedly is already very close to *A. mimetica*.

The present species is distinguishable from costate forms of *Oxycerites* of the *fuscus-bisculptus* type by its broad venter and thickened ribs; but species like '*Oppelia*' *costata*, J. Roemer (1911, p. 39, pl. VII, figs. 9-12) connect the two stocks. The various forms from the Dutch East Indies, referred by G. Boehm (1912, p. 143) to '*Oppelia fusca*' are easily distinguished by their non-tuberculate ribs.

The Madagascan '*Oppelia*' *colcanapi*, Lemoine (1910, p. 7, text-figs. 3 and 4) which grows to a very large size, may be close to the present species, but, as in *Alcidia inflexa* (Grossouvre), its keel is very prominent in comparison with the rows of latero-peripheral tubercles, which are also apparently less clavate.

I mentioned on a former occasion that the holotype of *A. mimetica* was very close to *Chanasia* and thence to *Bonarellia*. Like *A. nurrhaensis*, described below, it is however included in the present genus on account of its retaining Oppelid outer whorls.

*Horizon*.—Lower Callovian, upper *macrocephalus* (= *diadematus*) zone.

*Locality*.—Khera Hill (Golden Oolite).

*ALCIDIA NURRHAENSIS* (Waagen). (Pl. XII, fig. 8).

1871. *Harpoceras nurrhaensis*, Waagen, p. 91.

1875. *Oppelia nurrhaensis*, Waagen, p. 51, pl. xi, figs. 2a, b; pl. xiv, fig. 5 only.

1924. *Alcidia nurrhaensis* (Waagen) Spath, pp. 5 and 24.

As type of this species must be taken the large example (No. III) figured and described by Waagen. This form is easily recognisable, but part of the holotype, showing clearly the characteristic simple suture-line is here refigured (pl. XII, fig. 8, enlarged by  $1\frac{1}{2}$ ). Waagen compared his form to *Oxycerites fuscus* (Quenstedt) which, however, has a more complex suture-line; also to '*Oppelia*' *fornix*, described below which differs in its tuberculate latero-ventral edges and its Bonarellid inner whorls.

The fragment figured by Waagen in pl. XIV, figs. 5, as the "aperture of a young specimen" undoubtedly belongs to the present species; but the ribs are exaggerated in the drawing, as in the slightly larger holotype, the body-chamber has been represented (drawn as) too smooth. In four other body-chambers before me, there is considerable variability in the final stage, as regards both distinctness of ribbing and disappearance of the keel. The original of Waagen's figs. 3a, b of pl. XIV is here separated as *Alcidia* sp. juv. (see below); and it differs from the present species in its more complex suture-line, already at a small diameter, and in its greater compression. In the form of *Bonarellia* figured in pl. X, fig. 4 the innermost whorls are tuberculate at the ventrolateral edges as in *B. fornix*, and the resemblance to the present species is confined to the outer whorl. It seems probable that the inner whorls of *A. nurrhaensis*, preserved in crystalline calcite and inaccessible to study, are more like the young forms associated by Waagen with this species. This author held that *Alcidia nurrhaensis* and *Bonarellia fornix* belonged to the same group; but his exclusion of the latter species from his 'group of *Oppelia superba*' was no doubt due to the fact that Waagen knew Sowerby's species only from the figure.

*Horizon*.—Upper Chari Group, *fraasi* [= *castor* and *pollux*] zone.

*Locality*.—Waagen's two examples came from North-West of Jumara and from east of Nurrha, "*anceps*" zone). Two examples in the Blake Collection (Nos. 119, 120), previously listed, are from S. Manjal (bed No. 2). A doubtful, unlocalised, body-chamber fragment sent by Mr. J. H. Smith is more inflated and more involute than the type and may conceivably belong even to *Paralcidia* or *Subbonarellia*. Waagen (1875, p. 50) mentions the occurrence of two similar body-chambers (not examined by the writer), from north-east of Gudjinsir and from south-east of Nurrha, that, from their state of preservation, suggest the present species; but they were referred to the group of '*Oppelia subcostaria*.'

*ALCIDIA* sp. juv. (Pl. XI, figs. 11a-c).

1875. *Oppelia nurrhaensis*, Waagen, pars, p. 51, pl. xiv, figs. 3, 3a, b, only.

One of the examples figured by Waagen as the young of his '*Oppelia nurrhaensis*' is scarcely recognisable from this author's restored illustration. It is therefore now

refigured (pl. XI, figs. 11a-c) with outline whorl-section and suture-line, the drawing of which in Waagen (fig. 3b) was too diagrammatic. Compared with that of the holotype of *A. nurrhaensis* (pl. XII, fig. 6) it shows the first lateral lobe more distinctly trifid and the lateral saddles slenderer at half the diameter.

The young example of *Alcidia dubia*, above referred to, is very close to the present example and differs merely in its less rursiradiate ribbing and a slightly more complex suture-line. The young of *Oxycerites latilobatus* (Waagen, 1869, p. 216, pl. XVII, figs. 1 and 6) differs in costation, but other forms of *Oxycerites* show similar rursiradiate ribbing (e.g. *O. aspidoides*, Oppel sp. in Popovici-Hatzeg, 1905, p. XII, fig. 5), or similar suture-lines (e.g. *O. lateumbilicatus* and other species, in Joh. Roemer, 1911, pls. X, and XI). The open umbilicus and *Brightia*-like inner whorls, however, as well as its faunal association, suggest reference of the present form to *Alcidia* rather than to *Oxycerites*. R. Douvillé's *Oppelia prahecuensis* (1913, p. 61, text-figs. 2, 3) may have similar inner whorls, but according to the supplementary diagnosis by Petitclerc (1915, p. 54) an 'angular umbilicus' and a more acute whorl-section.

The slightly more inflated example, figured by Waagen (pl. XIV, figs. 6, 6a) as a variety of *Oppelia nurrhaensis*, with larger umbilicus, is also merely the centre of some form of *Alcidia*. The "fragment of a very young specimen," represented by Waagen in his pl. XIV, fig. 4 is referred to below under *Subbonarellia decipiens*, nov.; it has entirely different costation.

*Horizon*.—Upper Chari Group, *fraasi* [= *castor* and *pollux*] zone.

*Locality*.—East of Nurrha (*anceps* zone in Waagen).

#### Genus: PARALCIDIA nov.

PARALCIDIA KHENGARI nom. nov. (Pl. X, figs. 7a-c, pl. XV, fig. 3).

1875. *Oppelia* cf. *glabella* (Leckenby) Waagen, p. 49, pl. x, figs. 7, 7a.

1912. *Oppelia glabella* (Leckenby) Waagen; Smith, p. 1352.

Waagen's type is poorly preserved and in the side-view illustrated by Waagen (fig. 7) the ribs are far too distinctly marked. The costation agrees with that of the Yorkshire form which also has a similarly contracted body-chamber. The sectional view was also wrongly restored by Waagen's artist and a peripheral view is therefore now given (pl. X, fig. 7c) of an example comparable to the holotype but with the inner whorls in a better state of preservation. The side-view of another specimen (pl. X, fig. 7a) and the separated inner whorls of the same example (fig. 7b) show that the costation is very indistinct at first and far less pronounced than in *Alcidia nurrhaensis* even on the body-chamber. When found isolated, however, the body-chambers of the two species and even of *Subbonarellia decipiens* (pl. IX, fig. 11) are not distinguishable.

The suture-line is well shown on the inner whorls (pl. X, fig. 7b) and, in complexity, resembles that of the early *Alcidia*. In the holotype of Leckenby's *Amm. glabellus* here refigured (pl. XI, figs. 4a, b) only the last two suture-lines are visible and although showing greater complexity at that size are remarkably similar to those of Waagen's

form. The Yorkshire species, however, of which only one or two examples are known, has a simpler auxiliary series and a smaller umbilicus.

The example figured in pl. XV, fig. 3, with the inner whorls poorly preserved, seems to be identical in all characters with the type, but has a larger umbilicus. It is impossible to separate it specifically on present evidence, and since some of the examples recorded below do not show the narrowing of the body-chamber represented in pl. X, fig. 7a we may provisionally include this widely umbilicate form in the present species as a var. *APERTA* NOV.

'*Oppelia*' *subtililobata*, Waagen (1869, p. 226, pl. XVII, figs. 7a-d) from the *athleta* zone of Wurtemberg may belong to the same group as the present species, but the inner whorls appear to have been incorrectly drawn and its keel was said to be often crenulate. The small *Oppelia calloviensis* figured by Couffon (1919, p. 173, pl. XIII, figs. 5, 5a, b) shows resemblance to the inner whorls of *P. khengari* but it comes from probably earlier beds and is apparently still closer to the earlier *Oxycerites*, although it has a definitely separated keel on a subtabulate periphery, like the inner whorls of the form here described.

Mr. Buckman (1913, pp. 153, 160) gave the horizon of *Oppelia glabella* ('*vertumnus* zone') as above *renggeri* (which is believed to be = his *vernoni* hemera) instead of below. The *lamberti* zone is probably also the horizon of the Indian forms.

Wepfer (1912, p. 14) wrongly assumed identity of Leckenby's species with *Oppel's Amm. subcostarius* and curtly demanded its abolition.

*Horizon*.—Divesian [upper '*athleta* beds'], *lamberti* zone.

*Localities*.—Waagen's example came from Khera Hill. The three specimens here figured are from Fakirwadi (pl. X, fig. 7c, pl. XV, fig. 3) and Samatra (pl. X, figs. 7a, b). There are two more examples from the latter locality; one in the Blake Collection (No. 129) is marked 'bed 2' and belongs to the var. *aperta*. Another Fakirwadi example agrees with that figured in pl. X, fig. 7c; two further fragments sent by Mr. J. H. Smith are unlocalised.

#### Sub-Family: PHLYCTICERATINÆ, Spath.

The genus *Phlycticeras* Hyatt (1900, p. 569) is apparently very rare in Kachh since there is only one additional specimen in the very large collections sent by Mr. Smith. The origin of *Phlycticeras* is as yet obscure. Loczy (1914, p. 59) considered that it was connected *viâ* *Strigoceras* Quenstedt (=group of *Ammonites truellei* d'Orbigny) with the Triassic *Amaltheids*, but to the writer it is uncertain whether even the Bathonian *Micromphalites*, S. Buckman (= *Neactinoceras*, Spath) is directly connected with *Phlycticeras*, although it is provisionally included in the present sub-family. The tuberculation of young *Oppelids* is as adaptive as that of other stocks and of little help in elucidating their ancestry. *Strigoceratids* are a (doubtful) group, including forms of various dates; Mr. Buckman even thought in 1898 (p. 460) that there was "a remarkable development of closely similar forms three times over." Since the last (of *truellei* date) was "apparently at first less developed than any of their fore-runners", it might perhaps be held that *Micromphalites* and *Phlycticeras* with their tuberculate umbilical

rima belong to the same stock. On the other hand there may not be real continuity, since *Micromphalites* is not strigate, whilst *Oppelia redlichi*, Popovici-Hatzeg (1905, p. 18, pl. V, figs. 1a, b) which shows longitudinal striation and may be a Phlycticeratid offshoot, has been referred by Loczy to *Petitclercia*.

If this form really be a Phlycticeratid and merely homœomorphous with the *Alcidia*- (or *Chanasia*-) development *Petitclercia*, its resemblance to the typical species figured by Grossouvre is indeed, striking; and, of course, strigation has appeared too frequently in geological history in unrelated stocks to be relied on as indicating affinity. Moreover, Grossouvre's three species referred to *Petitclercia* may not themselves be closely related, i.e., they may represent similar offshoots of different stocks of Oppelids, so that the inclusion of *Petitclercia* in Bonarellinæ is as provisional as the reference of *Micromphalites* to Phlycticeratinæ.

The genus *Lorioloceras* nov. (= *Taramelliceras*, Rollier non del Campana) which is somewhat transitional and shows resemblance to Bonarellinæ (e.g. *Petitclercia multiformis* Grossouvre sp.) seemed related also to Phlycticeratids, viâ the genera *Acanthæcites* and *Proscaphites*, Rollier, discussed below, in which strigation occurs. Its inclusion now in Taramelliceratinæ is, in a way, a return to Quenstedt's view of a continuous succession of 'flexuosi'; but whilst we may be convinced that Taramelliceratids have been repeatedly replenished from Haploceratidæ, we are as yet unable to replace a morphological by an ideal genetic classification. The presence in the Callovian already, and contemporary with *Acanthæcites*, of forms like '*Oppelia* (*Neumayriceras*)' *kormosi*, Loczy (1914, p. 345, pl. I, fig. 6, pl. III, figs. 16-17) suggested derivation from a common ancestor with e.g. *Phlycticeras parkinsoni* (Quenstedt, 1887, pl. LXXXVI, fig. 7). Callovian *Phlycticeras*, however, are keeled in the early stages and the lines of elliptical bases of the septituberculate ventral ridge, so characteristic of later stages, result from the breaking up of the early continuous keel. This clearly indicates that *Ammonites hyperbolicus* (Simpson) Leckenby sp. (in Buckman, 1914, pl. XCVIII), already referred to as probably a *Chamoussetia*, cannot belong to the genus *Phlycticeras*. The connexion with *Sonninia*, suggested by Scheurlen (1926, p. 96) and accepted by Pompeckj (*ib.*, p. 97) seems extremely unlikely.

### Genus: PHLYCTICERAS, Hyatt.

PHLYCTICERAS WAAGENI S. Buckman. (Pl. XIII, fig. 14).

1875. *Amaltheus pustulatus* (Reinecke) Waagen, p. 40, pl. ix, figs. 2a-c.

1897. *Lophoceras* n. f. (*pustulatus*, Waagen) Parona and Bonarelli, p. 123.

1914. *Phlycticeras waageni*, S. Buckman, p. 98c.

1915. *Srigoceras pustulatum* (Reinecke) Loczy, pars, p. 314.

This form was considered to be new by Parona and Bonarelli, who figured a similar species as '*Lophoceras*' *lachati*; and it was renamed by Mr. Buckman, who even referred to the same genus what the writer takes to be a *Chamoussetia*. These authors were misled by Waagen's erroneous restoration of the whorl-section, indicating greatest whorl-thickness at the outer instead of the inner tubercle. As will be seen from the

front-view here reproduced (pl. XIII, fig. 14) the left half is missing and the oblique fracture of the other side running across two ribs caused a deceptive, quadrate, appearance of the septal surface. Waagen, however, was correct in stating that the outer row of tubercles is the more prominent, "in consequence of which the transverse section of the whorl [at the end] had an appearance somewhat different from that of *A. pustulatus*." The suture-line is shown on the side not figured by Waagen, but is too corroded for delineation. It is apparently comparable to that of *P. pustulatum*, recently figured by Couffon (1919, p. 191, text-fig. 22).

The inner whorls are unfortunately not well enough preserved for comparison with typical Franconian examples of Reinecke's *P. pustulatum* (B. M. No. 37737a-d) with which the Indian example had been identified by Waagen. Like other highly ornamented ammonites, Reinecke's species is very variable, and it is as impossible to state that d'Orbigny's large *Ammonites pustulatus* (1845, pl. CLIV, figs. 1-2) or Loczy's *Stringoceras pustulatum* represent the adult of Reinecke's form (allowing for the idealised figure in d'Orbigny and the state of preservation of the Villány example), as that *P. waageni* is really a separate 'species.'

The large form of *Phlycticeras* figured by Couffon (1919, p. 169, pl. XIII, figs. 12, 12a, b) as '*Stringoceras*' *polygonium* is more bluntly and less distinctly ribbed than the Kachh species. Zieten's type of *P. polygonium* (B. M. No. 39699), discussed by Crick (1900), has much more delicate ornamentation and belongs to the *anceps* zone.

*Horizon*.—Upper Chari Group, *fraasi* (= *castor* and *pollux*) zone.

*Locality*.—A considerable distance north-east of Gudjinsir (Waagen). The holotype was said to have been found in a black shale together with some fragments of '*Peltoceras athleta*.' Its preservation is identical with that of *Obtusicoelites buckmani*, Spath, figured by Waagen in pl. XXXVIII, fig. 3, from the same beds, and this form was listed by the writer from S. Manjal (1924, p. 24) together with *Peltoceras athleta* (Waagen non Phillips). The true *P. athleta* belongs to the next higher '*ornatum*' zone (= *athleta* zone s.s.). The '*jason*-zone' in Wurtemberg, that yielded '*P. pustulatum*' to Zakrzewski, (1887, p. 102) is obviously later than the same 'zone' in Northern Franconia (Reuter, 1908, p. 127) which probably corresponds to our *anceps* to *rehmanni* zones.

#### PHLYCTICERAS SCHAUMBURGI (Waagen). (Pl. XIII, fig. 15).

1875. *Amaltheus schauburgi*, Waagen, p. 41, pl. ix, figs. 1a-c.

1897. *Lophoceras schauburgi* (Waagen), Parona and Bonarelli, p. 123.

1912. *Amaltheus schauburgi* (Waagen), Smith, p. 1351.

1914. *Phlycticeras schauburgi* (Waagen), S. Buckman, p. 98c.

The Samatra example here figured fortunately shows the impression of the inner whorls which in Waagen's holotype are not well enough preserved for comparison with the smaller European forms. The early whorls are tuberculate to a later stage than in Zieten's type of *P. polygonium* (= *Ammonites pustulatus suevicus*, Quenstedt, 1847, pl. IX, figs. 23a, b). The umbilicus is also larger in the Indian form, though equally coronate, whereas in the probably later *P. pustulatum*, which also shows more

prominent tuberculation of the inner whorls, the umbilicus is not only smaller but its sides are **peculiarly high** and steep. At a diameter of 30mm. the tubercles disappear, but the ribbing is coarser and more distant than in *P. polygonium* or *P. laevigatum* (Quenstedt), although considerably closer and finer than in the poorly preserved Villány example compared by Till (1910, pl. XVII, figs. 11-12, 1911, p. 23) to the present species. This author mentioned that the difference in ornamentation might be due to its state of preservation, but his example clearly has fewer ribs. It is however, the only non-Indian example of *Phlycticeras* that belongs to the same group as Waagen's holotype; and nothing like it seems to occur in Savoy (Chanaz) or in the Swiss, Suabian and Franconian Jura.

*Horizon*.—Upper Chari Group, *fraasi* zone.

*Locality*.—Couffon (1919) recorded a large *Phlycticeras* together with a Macrocephalitid (wrongly identified with *Mayaites subtumidus*, Waagen sp.) that may be an immature example of a form of the *tumidus* group (see Couffon's pl. XV, figs. 7, 7a, b). These persist even into the *anceps* zone. At Samatra, the 'crimson-black beds' of Mr. Smith (1912b, p. 1351), below the golden "*athleta* beds," apparently yielded *Reineckeia* of the lower and upper *anceps* zones as well as the bispinous forms of the *fraasi* zone, so that the exact horizon of the Samatra example, preserved in red ironstone, cannot be given. Waagen's type of a similar preservation, came from the 'lower *athleta* beds' (*fraasi* zone) of Gudjinsir.

#### Sub-Family: BONARELLINAE, Spath.

This family might well have been restricted to the two genera *Bonarellia*, Cossmann (= *Distichoceras*, Munier-Chalmas) and *Horioceras*, Munier-Chalmas, which are very closely allied and are both characterised by loss of keel. Rollier (1913, p. 271), like H. Douvillé and Munier-Chalmas before him, even held that they were merely the female and male of the same species, but there is little concrete evidence in favour of this view. R. Douvillé (1913) has shown that they are contemporaries at Dives (in his beds H 1-3) and that *Bonarellia* is two or three times more abundant than *Horioceras*.

If *Bonarellia* were as close to *Hecticoceras* as is suggested by the reference to "*Hecticoceras bipartitum* (Quenstedt)" of a Chézery example (in Tsyrovitch, 1911, p. 34, pl. II, fig. 1), i.e., if Bonarellids represented a monophyletic offshoot of Hecticoceratids, this restriction of the family might have been preferable. But Rollier (1913, p. 270) who compared Mlle. Tsyrovitch's example to "*Ludwigia*" (= *Campylites* + *Trimarginites*) already pointed out that it did not correspond too well with *Bonarellia bipartita*, although it might be a polyphyletic passage form from *Hecticoceras* to *Bonarellia*, referred by him (p. 287) to two separate families (Harpoceratidae and Oppelidae). Bonarellinae are thus now taken to be polyphyletic developments of the Bathonian *Alcidia* and its later Hecticoceratid offshoots, having angular costation with often a spiral groove, peripheral clavi and a keel that is generally weak or lost entirely.

The early *Bonarellia superba* (Waagen) is thus clearly allied to *Alcidia mariora* Popovici-Hatzeg (1905, p. 17, pl. IV, figs. 2a-c), and *Bonarellia fornix* (J. de C. Sowerby)

has been grouped by Waagen with *Alcidia nurrhaensis*. Both *Bonarellia* and *Chanasia* Rollier, previously included in the present family, show great resemblance to *Loriloceras*, discussed below, which is also connected with *Alcidia* by many transitions yet *Chanasia* and its ally *Sindeites* are perhaps equally close to the true *Hecticoceras parallelum* (Reinecke). They are all more or less parallel offshoots, apparently of the same stock that produced *Alcidia*, with the Bonarellids somewhat intermediate between Oppelinæ and Hecticoceratids. *Chanasia* differs from *Bonarellia* chiefly in its retaining the keel and *Petitclercia* may represent an involute development of *Chanasia*, for it has already been mentioned that the incompletely known *Oppelia redlichi*, Popovici-Hatzeg, with strigation and crenulate umbilical edge, may be a Phlycticeratid. *Sindeites* loses the keel and the spiral groove and may even acquire recticostation, but it is connected by transitions both with *Chanasia* and with *Lunuloceras* of the type of *L. brighti* (Reuter, non Pratt, 1908, text-fig. on p. 124). Among many Franconian examples before me there is one, (B. M. No. C 27684), in which the periphery, after an injury, becomes Kosmoceratid, as in *Sindeites sindensis*. F. Roman (1924, pl. II) has lately figured a number of transitional but immature forms.

The Indian *Bonarellia fornix* was previously considered to be transitional from *Alcidia* to *Petitclercia*. The genotype of Rollier's genus is *Petitclercia mirabilis*, Grosouvre sp. (1891, p. 258, pl. IX, fig. 4) characterised by its recti-radiate ribbing, a steep umbilical edge, and a highly compressed whorl-shape. Since *B. fornix* with its typical Bonarellid inner whorls, like later species of the same genus, acquires a rounded outer whorl and is scarcely keeled at intermediate stages, it is not likely to be the direct ancestor of *Petitclercia*. Similarly *Oppelia* (*Petitclercia*?) *hungarica*, Loczy (1915, p. 341, pl. III, fig. 18) is probably more closely allied to the same author's *Oppelia virgata*, belonging to the group of *Alcidia subcostaria* (Oppel); but Simionescu's *Oecotraustes binodosus* (1905, p. 26, pl. III, figs. 5a, b) may be an early *Petitclercia*.

Another offshoot of *Alcidia* to be considered here is represented by a form, the outer whorl of which can scarcely be distinguished from that of earlier Oppelids on the one hand or even of *Kheraites smithi* on the other, but the inner whorls of which agree with certain interesting dwarf species formerly referred to ' *Oecotraustes conjungens* (Mayer) Loczy.' They are not, however, here attached to the group of forms (*Paræcotraustes*) to which Mayer's species (1865, p. 322, pl. VIII, fig. 6) or the form figured by Waagen (1869, p. 232, pl. XX, figs. 5a-c) as an extreme variety of *Oecotraustes conjungens* (Mayer) belong. The more or less rectiradiate, *Sindeites*-like ribbing and the inverse, simple, suture-line suggest reference of this stock to Bonarellids and it may be noted that d'Orbingy (1847, pl. CLVIII, fig. 3 only) figured a similar œcotraustid form as the young of *Bonarellia bipartita* (Zieten), whilst Loczy (1915, p. 337, pl. III, figs. 8-9) considered it possible to unite generically his Villány species of ' *Oecotraustes* ' and *Bonarellia*. The same author's *Alcidia spiniscens* (non Mayer) (*ib.* figs. 12-13) may also belong to the present stock for which we now propose the new name **Subbonarellia**, gen. nov. All the six Kachh examples available show the body-chambers, keeled in the smaller forms but with final rounding in the largest example. This is a point of resemblance to many Oppelinæ but, like the fact that Waagen included a

fragment of one of the œcotraustid forms (his pl. XIV, fig. 4) in *Alcidia nurrhaensis*; it does not justify the inclusion of *Subbonarellia* in Oppelinæ. The resemblance of Bonarellids to Hecticoceratids is to be expected in groups that are all connected with the early clavate *Alcidia* of the Bathonian and include homœomorphous offshoots; and the classification of certain transitional forms was equally unsatisfactory before the larger 'species' were raised to family rank.

{ Genus : BONARELLIA Cossmann.  
 { (=DISTICHOCERAS Munier-Chalmas).  
 { BONARELLIA NODULOSA (Quenstedt).

1875. *Oppelia bicostata* (Stahl) Waagen, p. 52, pl. xi, figs. 1a-c.

1887. *Ammonites bipartitus nodulosus*, Quenstedt, p. 735, pl. LXXXV, fig. 9.

1897. *Distichoceras* n. f. Parona and Bonarelli, p. 140.

Waagen united Zieten's *Amm. bipartitus*, with Stahl's *Ammonites bicostatus* but Parona and Bonarelli (1897, p. 140) kept the two species distinct, although Stahl's figure is evidently bad. A mechanical measuring of figures of this type naturally reveals differences that have no real existence to those familiar with the types. Rollier (1913, p. 277) again rightly included Zieten's species in the synonymy of Stahl's *Amm. bicostatus*. It is possible to find variations in, e.g., the Calvados and Yorkshire material available to the writer, and Quenstedt figured a number of forms that may be specifically separable from Stahl's species as Parona and Bonarelli held. But the Indian example of *Bonarellia*, figured by Waagen, cannot be satisfactorily distinguished from similar, adult, European specimens of *B. bicostata*, although the inner whorls seem to be more closely comparable to the form separated by Quenstedt as *Amm. bipartitus nodulosus*. According to topotypes (B. M. No. 22324, 5, b-d) already referred to by Crick (1889, p. 557) and specimens of this form from Les Blaches (Basses-Alpes, B. M. No. 73507a) before me, the beaded, spiral, line of tubercles is characteristic, whilst the whorl-section is more inflated and the umbilicus is slightly more open. With Parona and Bonarelli we may then consider this to be a separate form and to refer to it the Indian example, although it is incomplete.

Waagen's figures 1a and 1c are tolerably accurate; fig. 1b shows the periphery restored entirely by the artist. The umbilicus is well exposed on one side and shows high and steep, but rounded edges and only traces of strongly prorsiradiate lineation.

*Bonarellia subornata*, Spath (= *Distichoceras* n.f. [8] of Parona and Bonarelli, 1897, p. 141 = *Ammonites bipartitus nodulosus*, pars, Quenstedt, 1887, pl. LXXXV, fig. 11 only) is distinguished by its considerably finer costation and sharp umbilical rim and wide external saddle. *Amm. calcar*, Zieten, the type of which (B. M. No. 37670) was refigured by Crick (1899, p. 555, fig. 1), may possibly represent a malformation of this species.

*Oppelia* (*Bonarellia*) *semseyi*, Loczy (1915, p. 336, pl. III, figs. 10-11, text-fig. 61), is a *Horioceras*, with concave periphery.

*Horizon*.—Divesian (*duncani*) zone.

*Locality*.—South-west of Barasore, Charwar Hills.

According to R. Douvillé (1914, p. 18) *Bonarellia bicostata* is common in his bed H 1-3 (*lamberti* zone). In Yorkshire *Bonarellia subornata* is preserved in the brown matrix of the earlier *duncani* (=“upper *athleta*”) zone, but *B. bicostata* in the grey matrix of the later *lamberti* zone.

BONARELLIA BICOSTATA (Stahl). (Pl. XV, figs. 4a-c).

1912. *Oppelia bicostata* (Stahl) Waagen ; Smith (a), p. 714, (b), p. 1352.

1914. *Oppelia* (*Distichoceras*) *bipartita* (Zieten), R. Douvillé, p. 17, pl. ii, figs. 20, 20a, text-fig. 11, p. 18.

The small fragment here figured agrees in all details with typical examples of this well-known species, as figured by d'Orbigny (1847, pl. CLVIII, figs. 1-2) and R. Douvillé, and represented in the British Museum collections from numerous localities. There are regularly two crescent-shaped ribs to each tubercle; and the inner half of the lateral area, separated from the ribbed outer half by a spiral groove and ridge, is perfectly smooth. The suture-line is very simple and agrees with that of typical French and German examples of similar size.

*B. nodulosa* has a spiral line of tubercles instead of a groove and lacks the regular bicostation of Stahl's species. *B. zieteni* (Parona and Bonarelli, 1897, p. 141, pl. IV, fig. 7) has straighter ribs, no distinct spiral groove, and a more marked umbilical edge, with small tubercles at larger diameters.

*Horizon*.—Divesian, *lamberti* zone.

*Locality*.—Fakirwadi (J. H. Smith Colln., labelled ‘*athleta* beds’).

BONARELLIA sp. ind. (Pl. XIV, figs. 2a-c).

The unique body-chamber fragment here figured (pl. XIV, figs. 2a-c) shows a slightly compressed whorl-section with rounded sides and an arched periphery. This has a faint but continuous, median, keel and two lateral rows of clavi. They are unevenly spaced and not opposite one another, but prominent and raised slightly above the keel. This does not suggest affinity with the singular, globose, form with saw-like keel (*Amm. velox*, Oppel) that has been taken as the genotype of *Acanthæcites* (Roller, 1909, p. 620); but *A. flexispinatus* (Oppel = *Amm. flexuosus globulus*, Quenstedt) has always seemed to me to be very closely allied to *A. velox*, and a superficial examination of the fragment here discussed suggested comparison with these *Acanthæcites*. The presence of a continuous, if faint keel, however, makes it probable that the example is merely the body-chamber of a small *Bonarellia*. This was unduly inflated by mineral changes, as is common in e.g., pyritic specimens of somewhat similar *Proscaphites* from the *renggeri* zone of St. Ives and Warboys, Huntingdonshire. In spite of the cracked shell there are also visible traces of the spiral grooves and very faint ribs, so that the reference to *Bonarellia* seems justified. There appears to be no described

species with which the fragment could be identified; the example figured in pl. XV, fig. 4 is strongly ribbed.

*Horizon*.—Divesian, probably *lamberti* zone.

*Locality*.—Fakirwadi ('*athleta* beds,' J. H. Smith Colln.).

**BONARELLIA FORNIX** (J. de C. Sowerby). (Pl. X, fig. 4, pl. XI, fig. 1; pl. XII, figs. 3a, b, 4a, b, 5a-c).

1840. *Ammonites fornix*, J. de C. Sowerby, in Sykes, p. 719, pl. lxi, fig. 13.

1871. *Harpoceras fornix* (J. de C. Sowerby) Waagen, p. 91.

1875. *Oppelia fornix* (J. de C. Sowerby) Waagen, p. 50, pl. xiv, figs. 7, 7a.

1902. *Ammonites fornix*, J. de C. Sowerby; Blake, p. 39.

1924. *Petitclercia* ? *fornix* (J. de C. Sowerby) Spath, p. 5.

Waagen who knew this species only from Sowerby's figure and description, reproduced these adding that it seemed to be one of the rarest ammonites in the Kachh Jurassic. He stated, however, that it showed "great analogies to *Oppelia nurrhaensis*," above described, which differs mainly in the absence of ventro-lateral rows of tubercles. In the Geological Society Collection, with Sowerby's example here refigured (pl. XI, fig. 1), there was a specimen of the same rock as the characteristic orange-coloured, sparry matrix of the holotype; this contained some thirty specimens of the present species of all sizes, in addition to other fossils and ammonites of which *Macrocephalites chariensis* (Waagen) and *Grossouvria* aff. *recuperoi* (Gemmellaro) are perhaps the most important for dating the rock.

The young show considerable variability. Some, like pl. XII, fig. 4, have the peripheral nodes coarse and distant; in others (pl. XII, fig. 5) they are very fine and close. The former again may be evolute, almost œcotraustid, the latter much more involute, but there exist numerous transitions between these extremes. The innermost (brephic) whorls (fig. 3) show already a distinct spiral groove (or ridge) and an angular (fastigate) periphery, but only traces of beginning rursiradiate ribbing near the periphery. The crenulation of the ventro-lateral edges, however, is often developed already at under 10mm. diameter. The suture-line is similar to that of young *Bonarellia* and simpler than that of *Alcidia nurrhaensis*. It is ascending towards the umbilicus, and the septa are distantly spaced. The suture-line of the œcotraustid young (pl. XII, figs. 4a, b) is particularly simplified and inverse.

*Oppelia barbieri* Petitclerc (1918, p. 8, pl. XV, fig. 2, pl. XIX, fig. 2) with ornamentation resembling that of *Fontannesiella prolithographica* (Fontannes) is somewhat similar, but may be a *Chanasia*; it is more compressed and its outer ribs are less rursiradiate. *Petitclercia multiformis* (Grossouvre, 1891, p. 260, pl. IX, fig. 1) from the '*athleta* zone' is more involute and more distinctly keeled and if it is a development of the true *Petitclercia* of the *anceps* zone (*P. mirabilis*, Grossouvre sp.) its resemblance to the species here described is purely superficial.

*Bonarellia nodulosa* (Quenstedt) and the other forms above discussed have the ventro-lateral edges more coarsely crenulate, also the earlier *B. superba* (Waagen, 1869, p. 222, pl. XIX, figs. 6a-c). The suture-line in this form is also still complicated

and if it is the direct ancestor of the *bicostata* group, the Indian form here described would represent a separate offshoot.

*Horizon*.—Lower Callovian, upper *macrocephalus* (*diadematus*) zone.

*Locality*.—"Hills 12-15 miles north of Bhuj." This might refer to the Jooria or the Habye Hills. Sowerby's "*Amm. herveyi*," a Golden Oolite species, was recorded from the same locality. The slightly worn specimen figured in pl. X, fig. 4, in Mr. Smith's Colln., is marked K6=Khera Hill, bed No. 6 (but not 6 of 1913a, p. 211?).

### Genus: SINDEITES Spath.

SINDEITES WAAGENI, nov. (Pl. X, figs. 8a-c; pl. XII, fig. 6).

1875. *Oppelia orientalis*, Waagen, pars (non Sowerby), p. 58, pl. xi, fig. 6 only, pl. xii, figs. 8, 8a, b.

1925. *Sindeites* sp.? Spath, p. 10.

The small example (twice) figured by Waagen is again illustrated to show what remains of the inner whorls, also the simple suture-line (pl. XII, fig. 6). To Waagen's description we may add that at under 8mm. diameter there are already fine prorsiradiate costæ on the outer lateral area, as in many immature *Hecticoceratids*, and the "entire smoothness," even of the inner portion of the side, as shown in fig. 8a, may have been caused by excessive cleaning and developing. Whether there is a keel at that early stage cannot be determined without breaking the holotype. At 13mm. diameter and on the larger part of the (entirely septate) outer whorl the keel is low and does not rise above the level of the lateral serrated edges (see fig. 8b). Otherwise the periphery resembles that of the doubtful '*Harpoceras*' *penninicum*, Uhlig (1878, pl. XVI, fig. 3b). Towards the end of the shell, unfortunately badly preserved, the keel seems to disappear altogether and the peripheral aspect then is like that of *Sindeites sindensis*, nov. (pl. IX, fig. 10b), which differs from the present form chiefly in having finer and closer costation at a comparable diameter and in being more compressed. The bifurcation of the ribs mentioned by Waagen and diagrammatically represented in his second drawing (pl. XII, fig. 8) also appears to the writer to be, if not altogether wanting, at least far from regular.

*S. madagascariensis*, Spath, has more distant and more rectiradiate ribs with bifurcation still less distinct than in the other forms of this genus. There is also a median tubercle reminiscent of the lateral node in *Bonarellia nodulosa* (Quenstedt) although on account of its recticostation and open umbilicus I compared the Madagascan form to the same author's *Ammonites* cf. *bipartitus* (1887, pl. LXXXV, fig. 14). The umbilical tubercles of Quenstedt's form are merely the shortened primary ribs; but it remains keeled and is therefore, if not *Hecticoceras hecticum* (Reinecke) itself, as held by Tsyrovitch (1911, p. 36), perhaps closer to *Hecticoceratids* than to *Sindeites*.

Waagen first (1871, p. 91) referred the holotype of the species here described to *Harpoceras orientale* (d'Orbigny), but later united it with what is here described as *Hecticoceratoides suborientalis*, Spath. Since the inner whorls of Waagen's larger specimen are not preserved, this association was rather speculative and the additional

material now available shows that in both *Hecticoceratoides* and *Kheraites* the inner whorls are coarsely and bluntly ribbed.

*Horizon*.—Callovian?, exact bed unknown.

*Locality*.—Chari. Waagen stated that his specimen came from a yellowish-grey, sandy oolite of unknown age; the preservation and matrix are those of the *rehmanni* or even an earlier bed, rather than the *anceps* zone. The *athleta* beds, though not altogether absent at Khera, have yielded no ammonites either to Mr. Smith or to Prof. Blake.

*SINDEITES* sp. nov. ind. (Pl. XIII, fig. 16).

This interesting new form unfortunately is represented only by the fragmentary example here figured (pl. XIII, fig. 16), showing smooth inner whorls, and falcoid costation on the body-chamber. The ribs are irregular but approximately alternately long and short, thick and thin; and they all end in a slight tubercle at the latero-ventral edge, whence a forwardly directed chevron connects those of one side first with a low keel and then with the corresponding ribs of the other side. This is the type of periphery so characteristic of young *Uptonia* (*Ammonites bronni*, auct.). In *Sindeites sindensis*, sp. nov. (pl. IX, fig. 10), with similar lateral ribbing and smooth inner whorls, the ribs are indistinctly connected across the periphery and the median line is scarcely raised; in the species described above the keel remains, but there are no chevrons. The small form of *Sindeites* figured on pl. IX, figs. 2a, b, which is close to (but not the young of) *S. sindensis*, has more pronounced umbilical (primary) ribs. It resembles in this respect the Madagascan form of *Chanasia* previously recorded (Spath, 1925b, p. 11 and now figured, pl. X, figs. 9a-d) which differs from Parona and Bonarelli's *C. chanasiensis* (1897, p. 134, pl. IV, figs. 1, 2) in its simpler suture-line, and which seems to be connected by intermediate forms with Reinecke's *Amm. hecticus parallelus* (1818, p. 67, pl. III, figs. 31-2). One of these Bavarian forms (B. M. No. C27684) with kosmoceratid periphery, i.e., transverse ribs across the venter, although perhaps merely a malformed *Hecticoceras*, shows great resemblance to the present genus.

*Horizon*.—Callovian. Exact horizon unknown.

*Locality*.—Fakirwadi, "athleta beds" (J. H. Smith Colln. No. 16). The hard matrix, resembling the Calcareous Grit of Scarborough, is different from that of any of the other Oppelids and I have not come across a similar preservation in any of the other Kachh fossils so far examined.

Genus: SUBBONARELLIA, nov.

(See supra, p. 93. Genotype: *S. decipiens*, sp. nov. pl. IX, figs. 5a-c.)

SUBBONARELLIA DECIPIENS sp. nov. (Pl. IX, figs. 5a, b, c, 11a, b).

1875. *Oppelia nurrhaensis*, Waagen, pars, p. 51, pl. xiv, fig. 4 only (?).

1924. *Oecotraustes* cf. *conjugens* Loczy (non Waagen); Spath, p. 24.

This species is represented by the holotype of 32 mm. diameter (pl. IX, figs. 5a-c) showing the very peculiar, angular, ribbing, with about half of the outer whorl

belonging to the body-chamber ; also by a similar and slightly bigger paratype of 36mm. and probably the larger fragment figured on pl. IX, fig. 11, the inner whorls of which agree with the holotype and have a similarly fastigate periphery. The species may seem to be too similar to *Alcidia mimetica* described above on the one hand, and certain (but less discoidal) *Hecticoceras* on the other to be separated from them generically ; but it has a simple suture-line and it is to be noted that Waagen already included a fragment of probably an inner whorl of either the present species or of one of the œcotraustid forms described below in his *Oppelia nurrhaensis* and not in his *O. subcostaria*. *Subbonarellia*, however, shows greater resemblance to Bonarellids, notably in the flattened ribs with clavate peripheral terminations. These ribs, in the present species, are not so strongly bent and more flattened than those of *Alcidia mimetica* which it resembles in whorl-shape ; and the suture-line is characterised by comparatively simple elements with the auxiliaries ascending towards the umbilical suture. This alone is sufficient to separate the present form from *Alcidia*, whilst the Oppelid outer whorl and discoidal shape with acute venter suggest distinctness also from similarly reduced Hecticoceratids.

*Horizon*.—Upper Chari Group, *fraasi* zone ?

*Localities*.—Fakirwadi (Bowl).

SUBBONARELLIA MANIALENSIS sp. nov. (Pl. IX, figs. 12, 13a, b).

1924. *Oecotraustes conjugens*, Loczy, non Mayer ; Spath, pp. 5 and 24.

The two examples here figured and a third specimen since sent by Mr. J. H. Smith, show such close resemblance to the form last described that their inclusion in the same genus seems justified. Since, however, *Oecotraustes* has been separated from *Oppelia*, and *Parœcotraustes* from *Alcidia*, it could be argued that these ' *Oecotraustes* ' offshoots should also be given an independent name. The Kachh forms, on the other hand, are rather incomplete and also not so definitely œcotraustid as the French and Hungarian examples with which they have been compared. As in *S. decipiens*, the ribs are angulirursiradiate, distant, and flattened, with clavate peripheral terminations. The inner or primary portion seems more pronounced in the example figured in pl. IX, fig. 13a, but this is perhaps largely a matter of preservation ; and the transitional third specimen differs from the holotype of *S. decipiens* (pl. IX, fig. 5a) merely in having a wider umbilicus and perhaps a less prominent keel. The steep backward and more gentle forward slopes of the ribs, which are characteristic of all these forms, cause the peculiar hook-shape of their outer portions.

Loczy's ' *Oppelia (Oecotraustes) conjugens* ' (non Waagen, 1915, p. 337, pl. III, figs. 8 and 9) with which I had formerly compared the example in the Blake Collection, has a similar peripheral aspect, but the suture-line, if one may judge by the execrable drawing published by Loczy, seems more complex whilst the body-chamber is definitely œcotraustid. The same author's *Oppelia (Alcidia ?) spiniscens*, which is almost certainly different from Mayer's type, has more finely crenulate peripheral edges and apparently an *Alcidia* suture-line, but its ventral aspect also is reminiscent of the present form and especially the more finely ribbed species recorded below.

Petitclerc's (1915, p. 58, pl. IV, fig. 4) *Oecotraustes conjungens* (non Mayer, nec Waagen) is also more coarsely oecotraustid, but this author significantly remarked that perhaps there should be included, with his form, three Chey examples that he had taken to be *Bonarellia* [*Distichoceras*] *bi-partita*.

*Horizon*.—Upper Chari Group, *fraasi* zone.

*Localities*.—Two examples sent by Mr. J. H. Smith are from Fakirwadi (Bowl) 'anceps beds'; the specimen in the Blake Collection, from "No. 2, South Manjal," has the hæmatite matrix of the *anceps* zone, and is not preserved in the yellowish-grey limestone (with black tests) characteristic of the *fraasi* zone (with *Peltoceras* 'athleta') to which belongs the species described below.

SUBBONARELLIA sp. ind. (Pl. IX, fig. 14).

1924. *Oecotraustes* sp. ind. Spath, p. 24 (S. Manjal, No. 2).

This species, represented only by the fragmentary example here figured and formerly referred to '*Oecotraustes*' on account of its resemblance to the form last described, is as yet incompletely known. The costation is closer and distinct only on the outer half of the sides, whilst the whorl-section is more compressed. The inner whorls are smooth, with compressed elliptical cross-section and arched venter; the (last?) suture-line indistinctly seen at the beginning of the outer whorl is very simple.

There is some resemblance to one of the examples referred by d'Orbigny (1846, pl. CLII, fig. 3 only) to "*Ammonites hecticus*, Hartmann," renamed by Bonarelli (1893, p. 84) *Hecticoceras girodi*. The ribs of this form, however, are more distinctly bent and truly nodate, whilst the peripheral aspect is probably also different.

*Horizon*.—Upper Cahari Group, *fraasi* zone.

*Locality*.—South Manjal, bed No. 2 (Blake Colln.).

#### Sub-Family : HECTICOCERATINÆ, Spath.

In a recent paper on Jurassic Ammonites from Madagascar (Spath, 1925, p. 8) I included in this family (proposed in 1924a, p. 114) the genera :—*Hecticoceras*, *Lunuloceras*, Bonarelli, *Brightia* Rollier, *Hecticoceratoides*, *Kheraites*, Spath, and *Putealicerias*, S. Buckman.

To these we must now add :—*Sublunuloceras* and *Pseudobrightia*; discussed below, further, ***Prohecticoceras***, gen. nov. (proposed for *Hecticoceras retrocostatum*, Grossouvre (1888, p. 374, pl. III, figs. 8-a, b), a specialised, early development, parallel with *Alcidia*, but well kept apart from it, since it shows no return to discoidal outer whorls and has a very distinctive peripheral aspect. Roman and Lemoine (1924, p. 104) in separating the "rèmeau de l'*Hecticoceras primaevum*" (= *Alcidia*, pars) from the *retrocostatum* group (= *Prohecticoceras*), mentioned that there were three auxiliary lobes in the former but only two in the latter. The writer would not lay stress on this difference, but the ventral costation and keel are quite different in the two stocks. These authors, moreover, confused a number of homoeomorphous developments; and their mutations *B* and *C* of their '*Hecticoceras retrocostatum*' may even belong

to different genera. As Mlle. de Tsytoitch (1911, p. 32) has already stated, such typical *Hecticoceras* as *H. sarasini* and its var. *aplanata* (of the Middle Callovian) differ from the earlier (Bathonian) *Prohecticoceras* (with blunt keel), chiefly in a different peripheral aspect and in remaining widely umbilicate. In both the adult aspect is clearly 'harpoceratid,' not 'oppelid'.

*Prohecticoceras* is not directly connected with *Hecticoceras* which has very distinctive flattened, ornamentation. In the restricted sense I take it to comprise forms like Reuter's (1908, text-fig. on p. 122) *Hecticoceras hecticum* on the one hand, and d'Orbigny's large example of pl. CLII (figs. 1, 2), on the other, the inner whorls corrected as in Couffon (1919, pl. XIV, fig. 9). The writer does not know of any British specimens of this true *Hecticoceras*, although E. Neavey (1925, p. 35) and J. Pringle (1926, p. 34) have lately again recorded *H. hecticum* from the *lamberti* and *rennggeri* zones, which are far too late. The genus *Kheraites* with blunt, coarse, and distant, ribbing, tending to straighten on the outer whorl, is very distinct from the true *Hecticoceras*. There are, however, apparent transitions to the later, discoidal, *Sublunuloceras*, as well as to the evolute and tuberculate *Putealicerias*, the resemblance being perhaps unduly accentuated by the appearance in all these forms of straight ribs on the outer whorls.

R. Douvillé (1913 b, p. 366) pointed out that the root of *Hecticoceras* might have to be looked for in the group of *Alcidia inflexa*, *A. subinflexa*, and *A. tenuistriata* (Gros-souvre), with tubercles elongated parallel to a rudimentary keel. As already mentioned, an independent origin in the *Alcidia*—*Prohecticoceras* stock that also produced *Kheraites* is more likely. The comparatively evolute, subrectiradiate, outer whorls of large *Hecticoceras* and *Kheraites* are decisive for their (systematic) separation from *Alcidia* and the Oppelinæ.

The tendency to recticostation and evolution is perhaps more characteristic of Hecticoceratids than the comparatively simple suture-line. For the latter is partly dependent on ornamentation and is found not only in Bonarellids (which are polyphyletic offshoots of Hecticoceratids), but also in some Oppelinæ. Moreover, the keel in Hecticoceratids, as a rule, is more definitely separated from the (typically wider) ventral area than it is in the forms here included in Oppelinæ. Tricarinate peripheries are found both in *Kheraites* and in *Hecticoceras*, but in *Hecticoceratoides*, which is an angulirradiate offshoot of the *Hecticoceras* stock, parallel with *Kheraites*, the keel is lost altogether. *Hecticoceras* in the restricted sense seems rare in Kachh, and *Brightia* has as yet been found only in a small fragment.

Many of the Bonarellids, like *Chanasia*, Rollier, seem to be simplified Hecticoceratids, just as '*Hecticoceras bipartitum*' Tsytoitch (non Quenstedt) 'converges' towards *Bonarellia*. *Chanasia*, however, may be connected via forms like *C. pauper* and *C. pleurospania* (Parona and Bonarelli), *C. perlata* (Quenstedt) and *C. montreuilense* (Couffon) directly with *Prohecticoceras*, and may represent a more or less parallel offshoot with *Kheraites* and *Hecticoceras*, the last distinguished by its umbilical tubercles.

*Lunuloceras*, according to Reuter (1908, p. 127) occurs above *Hecticoceras*, but below the *punctata* group of '*Hecticoceras*.' It seems also connected with certain

forms of *Alcidia* of the type of *A. sp. juv.* here figured (pl. XI, fig. ii) from the upper *anceps* zone. *Lunuloceras* must be restricted to the forms with comparatively evolute and smooth inner whorls and sickle-shaped, non-nodate ribs, common in this zone and their descendants in the 'athleta beds'. Rollier (1909, p. 621) defined this genus as losing its principal ribs towards the umbilicus. In *Brightia*, dominant in the *duncani* and *lamberti* zones, the primary ribs become tuberculate and a lateral spiral groove may be formed by the strongly bent ribs; whilst in a similar stock, here separated as **Sublunuloceras**, nov. (genotype:—*S. lairens* Waagen sp., pl. XIII, fig. 3) the ribbing is straighter, and the discoidal shells have slight tubercles. This is connected with the earlier *Kheraites* on the one hand and shows transitions to the more or less parallel development, *Putealicer*as on the other. The latter is equally rectiradiate but evolute and more tuberculate and at large diameters develops coarse costation, not smooth discoidal shells like *Sublunuloceras*. The similarity to the falciradiate *Lunuloceras*—*Brightia* stock, continued in *Pseudobrightia*, and perhaps Ochetoceratids (*Campylites*), causes difficulty only in the case of intermediate forms. It has already been mentioned that it is just the presence of these that makes probable the continual replenishment of these Oppelid families from the persisting *Lissoceratoides*.

*Lunuloceras*, found in the *anceps* and 'athleta' zones, was previously erroneously stated to be earlier than *Hecticoceras*. The older works (see e.g. Collot, 1877, p. 453, and 1880, p. 545) yield conflicting evidence and Mr. Buckman (1913, p. 153) put '*Hecticoceras ombilicatum*, Tsytovitch,' as high as his *vertumnus* zone; but *Hecticoceras* must be restricted to the early types, chiefly of the lower *anceps* (*rehmanni*) zone. The higher '*Lunuloceras*' ("untuberculate Oxfordian forms") previously (Spath, 1924, p. 6) recorded from Kachh, are partly the unidentifiable young of other Oppelid genera, resembling even *Lissoceratoides*.

*Putealicer*as, S. Buckman, is connected by transitions with the earlier *Hecticoceras* (*mathayense* group) on the one hand and via *S. pseudopunctatum*, Lahusen sp. (1883, p. 74, pl. XI, figs. 10a, b) with *Sublunuloceras* on the other. The tricarinate but still rectiradiate forms of the type of *Putealicer*as *trilineatum* (Waagen) connect this group with a stock that is transitional to the falciradiate *Campylites*, Rollier, discussed below under Ochetoceratinae, and which is now separated as **Pseudobrightia** gen. nov., genotype to be the species described here as *P. dhosaensis*, nov. (pl. XIII, figs. 10a, b). Certain forms of *Brightia* e.g. the Polish specimen figured by Bukowski (1886, p. 97, pl. XXV, figs. 13a, b) which was renamed by Mlle. de Tsytovitch (1911, p. 43, pl. III, fig. 11) '*Hecticoceras*' *rossiense*, var. *lahuseni*, are remarkably similar to the Kachh forms in sideview. Comparable Scarborough species, usually labelled as from the "Calcareous Grit", are from the lower 'cherty calcareous nodules' (see Benecke, 1909, p. 430 and S. S. Buckman, 1913, p. 154-5) i.e. the *duncani* zone. De Loriol, however, (1898-1900) recorded similar *Brightia* (*B. sueva*, Bonarelli sp.) and *Putealicer*as (*P. caelatum*, Coquand sp.) together with *Campylites rauracus* (non Mayer?) from his 'Lower Oxfordian' (*renggeri* zone=*oculatus* to *scarburgense* horizons of my previous list) so that *Pseudobrightia* cannot be considered to be the ancestor of *Campylites*. This last genus and *Eochetoceras*, discussed below, are also apparently connected by passage forms with

*Sublunuloceras*, so that Ochetoceratinae are polyphyletic derivatives of various stocks of Hecticoceratids (and Oppelinæ). Since, however, *Pseudobrightia* is now taken to include also Waagen's '*Harpoceras*' *punctatum* (non Stahl) the assignment of which to the '*anceps* beds' had misled me, it seems preferable to include it in the present family rather than in the more involute and discoidal Ochetoceratinae, in spite of its close resemblance to *Campylites*.

The Kachh Hecticoceratids are here described in the following order :—

Genus : HECTICOCERAS, Bonarelli

*H. giganteum*, nom. nov.

*H. aff. turgidum*, Loczy

*H. sp. ind.*

Genus : HECTICOCERATOIDES, Spath

*H. suborientalis*, Spath

Genus : KHERAITES, Spath

*K. crassefalcatus* (Waagen)

*K. smithi*, nom. nov.

*K. ignobilis* (J. de C. Sowerby).

*K. ? varicosus*, sp. nov.

*K. ferrugineus* sp. nov.

Genus : *Putealiceras* S. Buckman.

*P. trilineatum* (Waagen).

*P. trilineatum* var. *crassa*, nov.

*P. trilineatum* var. *compressa*, nov.

*P. vijaya* sp. nov.

*P. intermedium* sp. nov.

*P. intermedium* var. *robusta*, nov.

*P. intermedium* var. *samatrense*, nov.

*P. dynastiforme* sp. nov.

*P. bisulcatum* sp. nov.

*P. spp. juv.*

*P. ? sp. ind. nov.*

Genus : PSEUDOBRIGHTIA, gen. nov.

*P. dhosaensis* sp. nov.

*P. subpunctata* (Spath).

*P. ? sp. ind.*

Genus : Lunuloceras, Bonarelli.

*L. orientale* (d'Orbigny).

*L. nisoides*, sp. nov.

*L. sp. juv.*

Genus : BRIGHTIA, Rollier.

*B. sp. ind.*

Genus : Sublunuloceras gen. nov.

*S. prelairens* sp. nov.

*S. lairens* (Waagen).

*S. aff. nodosulcatum* (Lahusen).

*S. dynastes* (Waagen).

*S. discoides* sp. nov.

Genus: *HECTICOCERAS*, Bonarelli.*HECTICOCERAS GIGANTEUM*, nom. nov. (Pl. XVI, fig. 5).1875. *Harpoceras hecticum* (Reinecke) Waagen; 61, Pl. xii, figs. 3—5.1893. *Hecticoceras hecticum* (Reinecke) Bonarelli (pars), pp. 78; 83.

The gigantic Khera example described by Waagen, well over 200mm. in diameter, is congeneric with Reinecke's oft-quoted but much smaller and later species, and is related to d'Orbigny's form (Pl. CLII, figs. 1—2). The Kachh species differs mainly in its broad costation and in its distinctly tricarinate periphery. Since the clavate terminations of the unusually wide and flattened ribs are also considerably elongated the peripheral aspect is almost quinquecarinate and very characteristic. The whorl-section of the innermost portion (Waagen's fig. 4a) does not seem to differ from that of the true *H. hecticum* as figured by Reuter (1908, text-fig. on p. 122); but there is no umbilical tubercle preserved and owing to the rounding off, by Waagen's artist, of the two ends of the fragment, its thickness (for that size) is incorrectly represented. The terminations of the next larger whorl (fig. 3a) are equally unsuccessfully drawn; the anterior end is too rounded, the lower too tabulate. The inner portion of the lateral area is broken away and the crescentic ribs shown in Waagen's drawing (fig. 3) are quite imaginary. The cross-section of this fragment is now refigured (Pl. XVI, fig. 5). The outermost whorl, still entirely septate, was not depicted by Waagen; it shows fifteen faint ribs to a length of 183mm. Its suture-line, external and internal, was, however, reproduced by Waagen (fig. 5), apparently accurately, with the exception of the deep central branch of the neatly tripartite internal lobe, which should be straight. The first lateral lobe is indistinctly trifid, partly because it touches the external saddle of the previous suture-line. Since the suture-line is almost equally complex already on the inner whorl it is probable that this species ought to be united with *Kheraites*. In the examples of *Hecticoceras* from the later *anceps* beds the suture-lines are very simple.

In its peripheral aspect this outer whorl is very similar to the (equally entirely septate) fragment here figured (Pl. XVI, fig. 4) and doubtfully referred to *H. turgidum* (Loczy). The ribbing is less distinct, however, and closer, there being about 17 ribs to the half-whorl at a diameter of 190mm. as against only eight on the fragment here figured (or approximately twelve per half-whorl). Since no comparable large Hecticoceratids seem to have been previously illustrated in palaeontological literature, with the exception of Loczy's indifferent Villány forms, Couffon's more closely costate Chalet example referred to below, and the complete specimen figured by Petitclerc (1921, Pl. XXI, fig. 9) a new name for the Kachh species seems justified. Quenstedt's *Ammonites hecticus gigas* (1887, p. 706, Pl. LXXXII, figs. 35—37) includes two different forms of *Lunuloceras*, of which the first, as its author points out, is connected by transitions with *Amm. hecticus compressus*, and was indeed included by Mlle. de Tsyrovitch in *Lunuloceras lunuloides* (Kilian). The second is referable to *Lunuloceras pavlowi* (Tsyrovitch), and the last, to which the specific name *gigas* might be restricted, is comparable to *Sublunuloceras* or *Putealicerias*, but is unidentifiable from the obviously inaccurate figure. It cannot be confused with *Hecticoceras giganteum*.

*Horizon*.—Lower Callovian, upper *macrocephalus* (= *diadematus*) zone.

*Locality*.—Khera Hill (Golden Oolite).

HECTICOCERAS aff. TURGIDUM Loczy (Pl. XVI, fig. 4).

1847. *Ammonites hecticus* (Hartman) d'Orbigny, p. 432, Pl. clii, figs. 1—2 only.

1875. *Harpoceras hecticum* (Reinecke) Waagen, pars, p. 61.

1893. *Hecticoceras hecticum* (Reinecke) Bonarelli, p. 73.

1915. *Hecticoceras turgidum*, Loczy, p. 326, Pl. vi, figs. 8—9.

1924. (?) *Hecticoceras hecticum* (Reinecke) Stehn, p. 66, Pl. iii, fig. 1.

Waagen identified with the large example last described a small specimen found in the body-chamber of the large *Macrocephalites* figured in his Pl. XXV. This specimen was not forwarded to the writer, but a squeeze of the impression shows perfect agreement with d'Orbigny's figures, as Waagen stated. Allowance, however, must be made for the imperfect state of preservation of the Kachh example which does not show the periphery. The restoration of the figure in d'Orbigny was said by Parona and Bonarelli (1897, p. 133) and Couffon (1919, p. 178) to be accurate; and the Chalet example figured by the latter author (Pl. XIV, figs. 9, 9a, b), in any case, may be identical with the Kachh impression now discussed. Since Loczy's Hungarian form has a wider and more distinctly tricarinate periphery and coarser ribbing on the outer whorl, it is possible that it is not identical with the Chalet example and d'Orbigny's type. The determination of the fragmentary Kachh specimen must thus remain provisional.

The large fragment illustrated in Pl. XVI, fig. 4 is entirely septate, like the more closely ribbed outer whorl of *H. giganteum* above described. The suture-line resembles that of Waagen's example, but the first lateral lobe is very neatly trifid. The reference of this specimen to Loczy's species must equally be tentative.

The Argentine form, figured by Stehn, as this author remarks, has the peculiar striation between the outer nodes and the keel, already noticed by Waagen. Like d'Orbigny's example, however, it is smaller than the Kachh fragment here figured. Since it was recorded from a bed about 100 ft. below *Parapatoceras calloviense* (Morris) presumably of the *rehmanni* or *anceps* zones (Riche, 1893, p. 281) and apparently some distance above the '*macrocephalus*' beds, its exact horizon is unknown. A similar body-chamber fragment in the British Museum (No. C. 19661) is from "8 or 10 miles N. W. of Mombasa, Kenya."

Like the last species this shows affinity with *Kheraites* in the complexity of its suture-line.

*Horizon*.—Lower Callovian, middle (*dimerus*) and upper (*diadematus*) *macrocephalus* zones.

*Locality*.—Khera, bed No. 6 of Mr. J. H. Smith (upper Golden Oolite), and north-west of Jumara, Macrocephalus Shales, (Waagen).

HECTICOCERAS spp. ind. (Pl. XV, fig. 6, Pl. XVI, fig. 7).

To what the writer considers to be typical *Hecticoceras*, i.e. the group of *H. hecticum* (Reinecke), as interpreted by Reuter (1908, text-fig. on p. 122), and by Tsyrovitch

(1911, Pl. II, fig. 3), probably also belong the example here figured (Pl. XV, fig. 6) and a few still more doubtful fragments. Specific identification of the latter, however, is impossible, and if one of them did not show the suture-line (see Pl. XVI, fig. 7) they would perhaps have been included in *Kheraites*; but the dwarf-form of this genus, here described as *K.?* *varicosus*, apparently also has a simple suture-line. The ribbing of the larger fragments shows very good agreement with that of the examples figured by Reuter and Tsyrovitch, but the keel is very inconspicuous in the Indian examples, which feature again suggests reference to *Kheraites* as much as to *Hecticoceras*. On the other hand, in the very similar Khera form, previously recorded as *Hecticoecras*? cf. *punctatum* (Stahl) Waagen sp. (1924, p. 21, bed 7) although badly preserved, the long, pointed first lateral lobe of *Kheraites* is distinctly shown. The evolute, small, specimen referred to below (p. 169) as resembling *Kheraites*? *varicosus* in its lateral ornamentation, and *Subbonarellia* in its peripheral aspect, at 14mm. diameter shows already nearly half a whorl of body chamber.

The forms here described as *Kheraites ferrugineus* (Pl. IX, figs. 6-a-c.), with equally simple suture-lines, are closely connected by transitional examples with the still more highly carinate *Sublunuloceras*, but they have the peculiar type of ribbing common in *Kheraites*, and like the *Hecticoceras* fragments were labelled 'crassefalcatus.' They all come from the same bed.

The example figured in Pl. XV, fig. 6, is interesting on account of its resemblance to *Campylites secula*, described below, in which, however, the periphery is tricarinate, not rounded. Its last half-whorl belongs to the body-chamber which may account for a slight decline in the *Brightia*-like ornamentation, but the suture-line is simple. Whereas the four fragments might be referable to '*Hecticoceras hecticum* (auct.)', this last example may be closer to *H. aff. turgidum*, described above. Its peripheral aspect resembles that of *H. pleurospanium* Bonarelli (?) Roman (1923, pl. II, fig. 3a) from the *rehmanni* or even an earlier zone of Spain.

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

*Localities*.—Ler-Hamundra Ellipse (J. H. Smith Colln. 'sub-*anceps* beds'). Two unlocalised fragments are preserved in a similar hæmatite matrix, and a fourth example has the purple iron-grit matrix of the 'sub-*anceps*' beds of Fakirwadi. The doubtful example figured in Pl. XV, fig. 6 was found by Dr. També at Ler, probably in the '*athleta* beds'.

#### Genus: HECTICOCERATOIDES, Spath.

HECTICOCERATOIDES SUBORIENTALIS Spath. (Pl. XIII, fig. 11).

1875. *Oppelia orientalis*, Waagen, non d'Orbigny, p. 58, pl. xi, figs. 5a-c only.

1924. *Hecticoceratoides suborientalis*, Spath, pp. 5 and 22.

1925. *Hecticoceratoides suborientalis*, Spath, (b), p. 8.

An additional example of this rare but easily recognisable species is here figured since it is larger than Waagen's type. Like the latter, it consists largely of the body-chamber and does not show a suture-line. The anguliradiate ribs and spiral groove

show striking similarity to those of *Hecticoceras* aff. *tumidum* (Loczy), above referred to, and especially the figures given by d'Orbigny and Couffon. In peripheral aspect there is greater resemblance to the more extreme *Kheraites crassefalcatus*; and there can be no doubt that these three groups are very closely allied. The total absence of a keel in the present form, however, necessitated removal from the genus *Kheraites* (not then separated from *Hecticoceras*).

The small example associated by Waagen with the species now discussed is dealt with above under *Sindeites waageni* (p. 97).

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

*Locality*.—North-west of Jarra ("anceps beds," Waagen) and Jumara (bed No. 10, Blake Colln.).

Genus: *KHERAITES* Spath.

*KHERAITES CRASSEFALCATUS* (Waagen).

1875. *Harpoceras crassefalcatum*, Waagen, p. 70, pl. xii, figs. 6, 6a, 7.

1884. *Harpoceras crassefalcatum*, Waagen; Teisseyre, p. 547.

1885. *Ludwigia crassefalcata* (Waagen) Haug, p. 692.

1887. *Harpoceras crassefalcatum*, Waagen; Noetling, p. 22.

1913. *Harpoceras crassefalcatum*, Waagen; Smith, (c), p. 423.

1925. *Kheraites crassefalcatus*, Spath, (b) p. 8.

No additional examples of this well-defined species are available. The suture-line shows seven complex saddles as in *K. ignobilis* or in *Hecticoceras giganteum*, but there is a tendency to thicken the ribs slightly at the point of bifurcation, some distance from the umbilical suture. This tendency may have led to the tri-tuberculation found in certain *Hecticoceras*. Both the examples figured by Waagen apparently just show the beginning of the body-chamber; the smaller is faintly tricarinate to the end; the larger, at that stage, is merely obtusely fastigate.

When creating the genus *Kheraites* I associated with the present species Waagen's *Harpoceras punctatum* (non Stahl), here described as *Pseudobrightia subpunctata* (see p. 116). This was thought to be related to the young '*Harpoceras hecticum*' figured by Waagen, which has similar ribbing, no umbilical tubercles, and shows resemblance even in the tricarinate periphery. The differences of the later form, however, are important, namely a costate umbilical slope, sharply defined ribs, projected peripheral terminations that join the lateral keels, a higher median carina, a simple suture-line with wide saddles, all *Campylites*-characters and almost certainly acquired independently, perhaps via *Brightia*. The resemblance of this younger stock to *Kheraites* is thus superficial.

Noetling's comparison of his *Putealicerias schumacheri* with the earlier forms of *Kheraites* was not very apt since there is little resemblance. Similarly Teisseyre compared his *Brightia rossiensis* with the present species, but there is no direct connexion, or even superficial resemblance. The forms of the group of *Hecticoceras laubei* and *H. cracoviense* (Neumayr) also have quite different ornamentation and, when well preserved, still show the peripheral striation of *H. turgidum*.

*Horizon*.—Callovian, *rehmanni* zone ?, i.e., probably from Mr. J. H. Smith's bed 6 of Khera Hill which includes also the lower *eucyclus* and *diadematus* beds, so that the exact horizon of *K. crassefalcatus* cannot yet be determined. His '*crassefalcatus*', however, from the Ler-Hamundra Ellipse (here referred to *Hecticoceras* and *Kheraites ferrugineus*), are from higher (*anceps*) beds.

*Locality*.—Khera Hill.

KHERAITES SMITHI, nom. nov. (Pl. XVI, fig. 9.)

1875. *Harpoceras ignobile*, Waagen (non J. de C. Sowerby), pars, p. 69, pl. xii, figs. 1, 1a only.

1912. *Harpoceras ignobile* (non Sowerby ?) Smith, p. 1352.

1913. *Harpoceras ignobile*, (non Sowerby ?) Smith, (c), p. 423.

The larger of Waagen's two examples of '*Harpoceras ignobile*' differs from Sowerby's type in its more distant ribbing, loss of keel on the outer whorl, and greater whorl-thickness. The peripheral view of a body-chamber fragment here given (Pl. XVI, fig. 9) shows how considerably this form differs from the keeled holotype of *K. ignobilis*. These differences of course are more pronounced in larger examples and up to a diameter of 50 mm., as in two of the Khera examples recorded below, only the less straight and blunter ribbing suggests reference to the present species rather than to *K. ignobilis*. In its more falcoid costation, Waagen's smaller example also differs from Sowerby's type; but as it is transitional in other ways it is here grouped with *K. ignobilis* rather than with the present form.

The *Hecticoceras* ? cf. *punctatum* previously recorded from bed No. 7 of Khera (Blake Colln. 118) is an immature specimen probably of a form intermediate between *K. crassefalcatus* and the species here discussed.

*Horizon*.—Callovian, [*rehmanni* ? or] *diadematus* zone.

*Locality*.—Khera Hill (bed 6, J. H. Smith Colln., [bed 7, Blake ?]; '*anceps* bed' in Waagen).\*

KHERAITES IGNOBILIS (J. de C. Sowerby). (Pl. XV, fig. 2.)

1840. *Ammonites ignobile*, J. de C. Sowerby, in Grant, pp. 297, 329, pl. xxiii, fig. 11.

1875. *Harpoceras ignobile*, (J. de C. Sowerby), Waagen, pars, p. 69, pl. xii, figs. 2, 2a, b only.

1885. *Ludwigia ignobilis* (Waagen) Haug, p. 692.

1887. *Harpoceras ignobile* Waagen; Noetling, p. 22.

1902. *Ammonites ignobilis*, J. de C. Sowerby; Blake, p. 35.

Waagen figured two examples of which only the smaller is here grouped with Sowerby's species, although it has more sigmoidal costation. The larger, characterised by more distant ribs, greater whorl-thickness, and loss of keel, is described above as *K. smithi*. Sowerby's type is still distinctly keeled at 70 mm. diameter and its

\* This typical Kachh fossil is named after Mr. J. H. Smith of Bhuj who has rendered great services to palaeontology by his collecting in the Jurassic beds of the Peninsula. Whilst correcting the proofs of the present part (December, 1926) I have had the privilege of many a conversation with him and I gratefully acknowledge his constant help with stratigraphical information.

whorl-section resembles that of the slightly more compressed *Alcidia mimetica* rather than that of *K. smithi*. Waagen's peripheral view (fig. 2, pl. XII) also is drawn considerably too inflated, so that a ventral view of the holotype is now given (pl. XV, fig. 2). The suture-line of the latter, with seven very slender and finely divided saddles and a deep, trifold, first lateral lobe, agrees in essentials with that figured by Waagen.

*Horizon*.—Callovian, [*rehmanni* ? or] *diadematus* zone. Dorn (1918, p. 96, 1922, p. 51) records a '*Hecticoceras*' aff. *ignobile* from his upper '*macrocephalus*' zone associated with *Pleurocephalites tumidus* and *Grosscurria* spp.; Model (1914, p. 27, and 1916, pp. 10 and 45) has a '*H. aff. ignobile*' from equivalents of the '*rehmanni*' zone as well as from higher beds.

*Locality*.—Near Chari (Sowerby); Khera Hill (*anceps* bed, Waagen).

KHERAITES ? VARICOSUS, sp. nov. (Pl. XI, figs. 8a-c).

This species is represented only by the body-chamber fragment here figured, but this is so different from previously described species of the *anceps* zone that a new name is desirable. There is striking similarity in ornamentation to the Upper Albian *Hysterocheras varicosum* (J. de C. Sowerby), and the keel also is nearly completely lost towards the end of the shell. The impression of the inner whorl on the dorsal side of the fragment shows that at that stage the keel was more prominent and raised above the terminations of the ribs; on the periphery of the body-chamber, however, the ribs, alternately long and short, rise above the intervening faint keel. The longer ribs are tuberculate near the umbilical end, the bullæ representing the region of greatest whorl-thickness. The shorter, comma-shaped, and separate, intermediate ribs only reach half-way down the side. On the inner whorl, the ribs are unprojected and fade away towards the keel; on the body-chamber they are connected across the periphery (and the keel) by chevrons forming an obtuse angle forward. These chevrons are visible with oblique illumination but not distinct in the photograph. The poster or end of the specimen is formed by the last septum, but the simple suture-line is not sufficiently well preserved for description.

The ribbing superficially resembles that found in the *punctatum-bisulcatum* group of *Putealicerias*, e.g., the small example figured in pl. XVI, fig. 8d, e, although the peripheral aspect is quite different. But another, similarly small, specimen, which on account of its perfect agreement in lateral ribbing, I was at first inclined to consider the young of the present species, has the peripheral aspect of *Subbonarellia*, with which it occurred. The keel is not prominent; but the peripheral terminations of the ribs are elongated as in *Chanasia*, and since the umbilical tubercles are present already at a diameter of under 10 mm., this small evolute example must represent a true *Hecticoceras*. Both *Subbonarellia* and *Kheraites ferrugineus*, from the same bed, have smooth inner whorls to a considerable diameter; in *Putealicerias* the peripheral terminations of the ribs never rise above the keel. The reference to *Kheraites* is justified by the resemblance to the inner whorls of the genotype, *K. crassefalcatum*, an equally extreme form, and to the small example previously recorded from bed 7 of Khera Hill. It would appear to be the latest known form of the genus.

*Horizon*.—Callovian, *anceps* zone.

*Locality*.—Fakirwadi.

KHERAITES FERRUGINEUS, sp. nov. (Pl. IX, figs. 6a-c).

This species is based on the fragmentary example here figured (pl. IX, figs. 6a, b), the outer whorl of which forms the body-chamber; further on the immature specimen represented in fig. 6c, and a similar third example. To a diameter of about 12 mm. the whorls are smooth, compressed, elliptical in cross-section, with first a rounded, then fastigate periphery. Later blunt costæ appear as in the typical *Kheraites*, alternately long and short, or indistinctly bifurcating at the inner third of the lateral area, which represents the region of greatest whorl-thickness. The outer terminations of the ribs are sub-clavate; the keel becomes more prominent on the outer whorl. The suture-line of the two immature specimens is very simple and resembles that of the young *Hecticoceras* sp. and *Putealicerias* sp. juv. aff. *bisulcatum*, figured in pl. XVI, figs. 7 and 8f.

The present form differs from *K. crassefalcatus* chiefly in its acute periphery. It is connected by transitions with *Sublunuloceras prelairens*, described below and resembles even certain later forms of *Putealicerias*. The former species is more discoidal and has a more highly fastigate periphery, i.e., it seems to lead directly to the discoidal stock here separated as *Sublunuloceras*, which, however, may be considered to represent a rectiradiate offshoot of *Lunuloceras* rather than to include direct descendants of *Kheraites*. The later *Putealicerias* is less coarsely and less distantly ribbed.

*Horizon*.—Callovian, *anceps* beds.

*Localities*.—Ler-Hamundra Ellipse (holotype and figured paratype, labelled '*H. crassefalcatus*'); Fakirwadi (Bowl), third example (J. H. Smith Colln.).

Genus: PUTEALICERIAS S. Buckman.

PUTEALICERIAS TRILINEATUM (Waagen). (Pl. XII, figs. 2a-c, 10; pl. XVII, fig. 10.)

1875. *Harpoceras trilineatum* Waagen, p. 71, pl. xiii, figs. 2a, b.

1885. *Ludwigia trilineata* (Waagen) Haug, p. 692.

1887. *Harpoceras trilineatum* Waagen; Noetling, p. 22.

1924. *Hecticoceras* ? *trilineatum* (Waagen); Spath, p. 5.

1924. *Hecticoceras* ? *lairens* (Waagen); Spath, p. 24 (No. 121 only).

1925. *Putealicerias trilineatum* (Waagen); Spath, p. 9.

This species is now known in a considerable number of specimens, some of which are here figured since Waagen's apertural view (pl. XIII, fig. 2b) does not quite correctly represent either the tricarination of the periphery (with the median keel much more prominent than drawn), or the whorl-section. The last, in Waagen's Khera specimen, is the same as that of fig. 10, pl. XII, showing the posterior end of the body-chamber of a very large example with its ribs 'degenerating', as in the specimen of *Putealicerias vijaya* figured on pl. XI, fig. 7. The peripheral view of the body-chamber fragment represented in pl. xii, figs. 2a, b, shows the prominence of the median keel, but some

examples with more inflated whorl-section, due partly to a very prominent umbilical tubercle, may be separated as a var. *crassa*, nov. (pl. XII, fig. 2c).

In Waagen's two examples "the lobes were not very well preserved", and the figured specimen, which shows about a quarter of a whorl of body-chamber, in any case retains its test almost completely. The Wanda example was not sent to the writer; but the description of its suture-line by Waagen seems accurate, although it applies to most of the forms of the present group. The suture-line figured in pl. XVII, fig. 10 is from a specimen slightly less inflated than the type and transitional to *P. intermedium*, described below. It may be convenient to separate these thinner examples also, as a var. *compressa*, nov., the dimensions of the three forms being as follows:—

	Diameter.	Whorl-height.	Thickness.	Umbilicus.
Holotype (Waagen's No. I, corrected)	43	·43	·33	·33
Paratype (Waagen's No. II)	49	·45	·35	·33
Pl. xii, fig. 2a, b	82	·44	·31	·28
var. <i>compressa</i>	45 ?	·40	·30	·27
var. <i>crassa</i>	57 ?	·40	·36	·35

The reduced thickness of the largest example is due to decrease of the umbilical tubercle at the end of the body-chamber.

The early forms of the group of *P. punctatum* (Stahl) such as those figured by Simionescu (1899, p. 17, pl. II, fig. 3) and Loczy (1915, p. 320, pl. VI, figs. 2-3) are easily distinguished by their anguliradiate costation. Couffon's Chalet specimens of *P. punctatum* (1919, pl. XIV, fig. 2, pl. XVII, fig. 3), however, differ merely in a wider umbilicus. The later form figured by R. Douvillé (1914, p. 6, pl. I, fig. 1 only) has a reticostate outer whorl like the Kachh species, but is also characterised by its *Brightia*-like inner whorls. The resemblance of *Putealicerias trilineatum* to species of *Kheraites*, noticed by Waagen, is confined to the outer whorl when coarse ribbing appears, but the keel becomes almost effaced.

*Putealicerias puteale* (Leckenby) the genotype, is extremely close to Waagen's original, but less distinctly trilineate.

*Horizon*.—Callovian, 'athleta beds' (*fraasi* and especially *duncani* zones).

*Localities*.—Khera (1), Wanda (1), Samatra (2), Fakirwadi (5), South Manjal (1). Two other fragmentary examples from Samatra and Fakirwadi, with still greater compression, are transitional to the var. *robusta* of *P. intermedium* (pl. XII, fig. 9).

*PUTEALICERAS VIJAYA*, sp. nov. (Pl. XI, fig. 7; Pl. XII, figs. 1a, b; Pl. XIII, fig. 2.)

As holotype of this species is taken the large example figured on pl. XI, fig. 7, although it is slightly crushed as can be seen from the peripheral view (pl. XIII, fig. 2). The fragmentary paratype (pl. XII, fig. 1) is, however, in a better state of preservation

and shows the inner whorls which differ from those of *P. trilineatum* merely in their coarser ribbing. The two examples were originally of exactly the same size, but the holotype has nearly half a whorl of body-chamber.

The ribs are at first alternately long and short, thickened at the umbilical end and rarely distinctly bifurcating. Later the tuberculation is almost lost, the costæ become blunt and straight and there is then resemblance to the outer whorl of Petitclerc's *Hecticoceras thirriai* (1921, p. 8, pl. XXI, fig. 10). The ribs, however, are not flattened as in true *Hecticoceras*; and the loss on the outer whorl of the blunt keel is reminiscent of the large *Putealicerias punctatum* (non Stahl?) figured by R. Douvillé (1914, p. 6, pl. I, fig. 1). This species differs in its evolute inner whorls as well as in the very prominent ribs of the body-chamber; and the true *P. punctatum* (Stahl) has not only less straight ribbing than *P. vijaya*, but more compressed and highly keeled whorls.

The suture-line is visible on both the figured specimens and in its wide saddles agrees with that of *P. punctatum*, as figured by Teisseyre (1883, pl. I, figs. 3-4) rather than by Tsytoivitch (1911, p. 23, text-figs. 2). The trifold first lateral lobe is indistinct in pl. XII, fig. 1a, but the ascending auxiliaries are clearly shown.

A body-chamber fragment of a very large example has a more tabulate periphery than the specimen of *P. trilineatum* figured in pl. XII, fig. 10, and may thus be attributed to the present species rather than to *P. trilineatum*.

*Horizon*.—Divesian, 'athleta beds'.

*Localities*.—Fakirwadi (4) and S.-E. end of Hamundra Ellipse (1). An immature example in the Blake Collection (No. 654) which may belong to the present species is unlocalised.

PUTEALICERAS INTERMEDIUM sp. nov. (Pl. XI, figs. 9a, b; Pl. XII, figs. 9a, b; Pl. XIV, fig. 4.)

1875. *Harpoceras dynastes*, Waagen, pars, p. 66, pl. xiii, figs. 7-8 only.

1924. *Hecticoceras* ? *lairensis*, Waagen; Spath, p. 24 (Nos. 122, 124-25).

Waagen included in his *Harpoceras dynastes*, as holotype of which must be considered the example represented in his figs. 6a, b, two smaller specimens that belong to a form represented in the material before me by forty specimens. They differ entirely from *Sublunuloceras dynastes* in ornamentation and whorl-shape at almost all stages; and, although showing considerable variability, they may be briefly defined as being more distantly and more coarsely costate and more inflated than *S. dynastes* and more compressed and more involute than *Putealicerias trilineatum*. Waagen's smallest example (pl. XIII, figs. 8a, b) is transitional to *Sublunuloceras lairensis*, and has merely greater whorl-thickness and coarser ribbing, connecting in this respect directly with the earlier and less compressed *Kheraites ferrugineus*. On the other hand a number of examples differ from the type and the similar specimen, figured by Waagen in his pl. XIII, figs. 7a, b (with the umbilicus, owing to erroneous drawing, amounting to less than the typical 25 per cent.), in a wider periphery and more pronounced ribs and lead directly to *Putealicerias trilineatum*, in which, however, the inner whorls are of the *punctatum*, not the *ferrugineus* type.

The larger and more evolute specimen figured in pl. XII, fig. 9, is somewhat intermediate between the present species and *P. trilineatum* and may be separated as a var. **ROBUSTA**. The flexi-costate ribbing is coarse and distant and the primary or inner portions of the costæ are strongly developed, whereas in the largest example known of the typical *P. intermedium*, with half a whorl of body-chamber at 90 mm. diameter, the ribs are indistinct on the inner lateral area, as in the (completely septate) holotype (pl. XI, fig. 9) or in *Sublunuloceras dynastes*. The suture-line, as seen in the holotype and a number of other specimens, is close to that of *S. lairens* on the one hand and that of *Putealicer* *trilineatum* on the other, and resembles also that of *Lunuloceras bonarellii* (de Loriol, 1898, p. 37, text-fig. 10).

Among the more involute examples included by R. Douvillé (1915, p. 6) in his *Hecticoceras punctatum* (Stahl), that represented in pl. I, fig. 4, seems closely comparable to the present species; but the outer terminations of the ribs apparently are more tuberculate. These forms are probably closer to the Scarborough examples referred to below under *Sublunuloceras prelairens*.

The example figured in pl. XIV, fig. 4, seems to be indistinguishable from typical forms of the present species except in its wider umbilicus. On the final half-whorl it shows distant recticostation like the body-chamber of *P. vijaya* and opens out the umbilicus still further. This may be termed var. **SAMATRENSE**.

*Putealicer* *puteale* (Leckenby, 1858, p. 11, pl. II, figs. 3a-c, refigured in S. S. Buckman, 1922, pl. CCXCVII) is less involute and more inflated.

*Horizon*.—Divesian, 'athleta beds' (*duncani* to *lamberti* zones).

*Localities*.—Waagen's two figured examples came from south-east of V1 and from Khera Hill. Mr. J. H. Smith's Collection includes a specimen from Ler (in the matrix of the large *Pachyceras* figured in pl. XX, fig. 2), eight examples from Samatra and ten from Fakirwadi, whilst five more are probably from the same localities or from Ler, but are not labelled. Among a large number of immature limonitic specimens and fragments from the 'athleta beds' of Samatra and Fakirwadi there are also at least another ten that may be referred to the present species, since they resemble Waagen's smaller, 'pyritised' specimen. The three examples in the Blake Collection formerly included in *S. lairens* are from South Manjal (Bed No. 2), which may be the same spot as Waagen's 'North of Gudjinsir'.

**PUTEALICERAS PSEUDODYNASTES, sp. nov. (Pl. XIV, fig. 5.)**

The holotype of this species here figured, and a larger paratype, are unfortunately poorly preserved, but specific separation seems justifiable since they show a discoidal and comparatively closely-ribbed outer whorl such as is found in *Sublunuloceras*, combined with inner whorls that might be mistaken for those of *P. trilineatum*. The ribs at first bifurcate, as in the *punctatum* group of *Putealicer*; on the outer whorl, which is still septate, they become faint, closely-set, and single, and the body-chamber, as in *Sublunuloceras* of the *dynastes* group, probably tended to lose all ornamentation, whereas in the more typical *Putealicer* the ribbing of the outer whorl is coarse and distant. It is thus doubtful whether the species should be included in this genus; but

it is scarcely discoidal enough to be referred to *Sublunuloceras*. The keel is still fairly prominent on the outer whorl, but crushing has accentuated the compression of the periphery. The whorl-section is only slightly more inflated than that of *Sublunuloceras dynastes* (pl. XIII, fig. 1b); but, to judge by the paratype, it was probably originally more rectangular. The suture-line, in general aspect, agrees with that of other species of *Putealicerias* and *Sublunuloceras*. It has an unsymmetrical first lateral lobe and four auxiliary lobes, ascending towards the umbilical suture.

The present species is probably close to '*H.*' *pseudopunctatum* (Lahusen), race *villersense* (R. Douvillé, 1914, pl. II, figs. 1-6), with similar suture-line and whorl-shape but anguliradiate ornamentation on the inner whorls. Like the equally rectiradiate *P. trilineatum*, the form now described may be restricted to Kachh and may stand in the same relationship to that species, as Douvillé's '*H.*' *pseudopunctatum* does to his '*H.*' *punctatum*.

*Horizon*.—Divesian, '*athleta* beds'.

*Locality*.—Fakirwadi. J. H. Smith Colln.

PUTEALICERAS BISULCATUM, sp. nov. (Pl. XI, figs. 12a, b; Pl. XVI, figs. 8a-f.)

This species is based mainly on the body-chamber fragment here figured (pl. XI, figs. 12a, b), but there is another example before me, also a body-chamber, which is distinctly transitional to *Putealicerias trilineatum* (Waagen), with more pronounced tuberculation. A third and immature specimen, and probably also a number of very small examples, of which four are figured in pl. XVI, figs. 8a-f, belong to the present form and suggest its inclusion in *Putealicerias* rather than in *Pseudobrightia*. Although in the wider and tricarinate periphery and in the sub-clavate outer terminations of the ribs the examples now discussed resemble the larger fragments of *Pseudobrightia* here figured, yet they all have the tuberculate primary ribs of *Putealicerias* and could at most be considered to be transitional from *P. trilineatum* to *Pseudobrightia*.

The figured holotype has alternate long and short ribs of which the former are bullate at the top of the gentle umbilical slope. The ribs are decidedly finer, closer and more curved than in *P. trilineatum* which is also more compressed and has more coarsely ribbed inner whorls. In the var. *crassa* of this species (pl. XII, fig. 2c) especially the umbilical tubercle is very coarse and the periphery is always less wide.

Some of the immature examples may be more closely comparable to the form referred by Couffon (1919, p. 182, pl. XIV, figs. 4, 4a, b) to *Hectoceras pseudopunctatum* (non Lahusen). The suture-line figured by this author (text-fig. 26) is characterised by greater complexity, but that of Couffon's *H. punctatum* (fig. 25, p. 181) is much like fig. 8f of pl. XVI. These forms are from the *anceps* zone but similar immature *Putealicerias* still occur in the *renggeri* zone (see de Loriol 1898, p. 32, pl. III, figs. 7-9). Waagen's *Harpoceras punctatum* (non Stahl, p. 62, pl. XIII, figs. 9-10) is referred to below (p. 116) under *Pseudobrightia subpunctata*.

*Horizon*.—Divesian, 'athleta beds'.

*Locality*.—Samatra and Fakirwadi, J. H. Smith Colln. The transitional example, labelled ('*Harpoceras crassefalcatum*'), is unlocalised.

PUTEALICERAS spp. juv. (Pl. XIII, fig. 3.)

1924. *Hecticoceras* ? *lairense* (Waagen), Spath, p. 24, pars (No. 121).

There are about thirty immature and generally fragmentary examples from the 'athleta beds' that cannot be identified specifically. Some ten more have already been referred to under *P. intermedium*. When the whorl-section becomes more quadrate and the ribbing more pronounced, various transitions to the immature *Putealicerias* figured in pl. XVI, figs. 8a-f are produced. Others look as though they might be the young of costate *Sublunuloceras* (*lairense* group) and by still further loss of ribbing we get transitions to the small *Sublunuloceras* ? sp. ind. figured in pl. XIII, fig. 12, which leads to the true, smooth, *Lunuloceras*, described below.

The example represented in pl. XIII, fig. 3 is more finely costate than the immature *P. intermedium* and cannot be the young of any of the other species of *Putealicerias* here described, which all have *punctatum*-like inner whorls. *Brightia*(?) *pseudopunctata* (Lahusen, 1883, pl. XI, figs. 10-13), however, is probably closer, also some of the Dives examples figured by R. Douvillé (1914, pl. V, e.g., fig. 2), which pass into the more evolute *B.*(?) *villersense* (= *Hecticoceras suevum*, var. *villersensis*, R. Douvillé, non *Brightia sueva*, Bonarelli sp.). This may also be represented by some Kachh fragments with a larger umbilicus than the figured example.

*Horizon*.—Divesian, 'athleta beds'.

*Localities*.—Mr. J. H. Smith's examples are from Samatra and Fakirwadi. The Blake Collection includes the figured example (No. 121) from S. Manjal (bed 2), and two comparable specimens (Nos. 130 and 135) from Wanda (bed 2), the latter previously listed (1924, p. 23) as "*Lunuloceras*" sp. juv.

PUTEALICERAS ? sp. ind. nov. (Pl. XIII, fig. 5.)

The example here figured is badly preserved but it indicates the existence, in the Dhosa Oolite, of yet another keeled form, distinguished from the contemporary *Campylites* chiefly by having more prominent umbilical nodes and shorter primary ribs. These suggest that the example is a *Putealicerias* and it may perhaps be intermediate between *P. schumacheri* and *P. socini* (Noetling, 1887, pl. III, figs. 2-7); but it is more compressed than either. The fragment recorded below as *Brightia* sp. ind. has more rursi-radiate secondaries and definite, rounded tubercles rather than thickened primary ribs; on the other hand in somewhat similar young *Putealicerias intermedium*, the ribbing is altogether straighter. Unfortunately corrosion has affected the ribbing as well as the (apparently narrowly acute) periphery and there is no trace of the suture-line.

*Horizon*.—Divesian, Lower Dhosa Oolite, *renggeri* zone?

*Locality*.—Ler.

Genus : PSEUDOBRIGHTIA, nov.

PSEUDOBRIGHTIA DHOSAENSIS, sp. nov. (Pl. XIII, figs. 10a, b.)

This species is based on the completely septate, fragmentary example, figured in pl. XIII, fig. 10. The inner whorls are not preserved, and it was at first believed to represent merely a larger fragment of the form referred by Bukowski (1886, pl. XXV, figs. 13a, c) to Teisseyre's *Harpoceras rossiense*, but not of this species itself. The tricarinate periphery, however, is quite different, with its two, low, lateral keels, and the slightly clavate, projected, terminations of the strongly bent, sickle-shaped ribs, forming two more edges at a still lower level. These are all *Campylites* characters. The suture-line has a wider trifid lateral lobe and a higher lateral saddle than that of *Brightia rossiensis* (Teisseyre, 1884, pl. I, figs. 6d, 7c) but is not unlike that of the *pseudopunctatus* group in general outline (see Tsyrovitch, 1911, text-fig. 9, p. 48). This again differs from that of *Campylites rauracus* (Mayer) as drawn by de Loriol (1898, text-fig. 4, p. 10) merely in small details.

*Campylites delmontanus* (Oppel, 1863, p. 194, pl. LIV, figs. 3a, b) may be an involute, compressed, development of the present species, but the fragment of an undescribed and probably new form of *Putealicerias* here figured (pl. XVI, fig. 10) connects *Pseudobrightia dhosaensis* with such forms as *Putealicerias bisulcatum* and *P. trilineatum*. It differs from the former in its elevated keels and from the latter in the distinctly projected terminations of its ribs, whilst its chief difference from the present species consists of its straighter ribs, comparable to those of *Putealicerias bisulcatum* and the transitional form to *P. trilineatum*, previously (p. 114) referred to.

The coarsely costate form included by de Loriol (1900, pl. II, fig. 15) in *Campylites rauracus* may be thought to represent the inner whorls of a form like the present. This, however, does not seem likely, for apart from the much more robust ornamentation of the form now discussed, *Campylites* tends to discoidal outer whorls and reduction of ornamentation.

*Horizon*.—Upper Divesian or Lower Argovian (*Polyphemus* Beds) ?

*Locality*.—Fakirwadi ('Dhosa Oolite' on Label, but '*Athleta* beds' in MS. Catalogue). The matrix is that of the (Dhosa Oolite) *polyphemus* bed.

## PSEUDOBRIGHTIA SUBPUNCTATA (Spath).

1875. *Harpoceras punctatum* (Stahl) Waagen, p. 62, pl. xiii, figs. 9a, b.

1893. *Hecticoceras punctatum* (Stahl) Waagen, sp.; Bonarelli, p. 86.

1924. *Hecticoceras punctatum* (Stahl) Waagen, sp.; Spath, pp. 23 and 25.

1925. *Kheraites subpunctatum* Spath (b), p. 9.

non 1888. *Harpoceras (Ludwigia) subpunctatum* Schlippe, p. 196, pl. v, figs. 3, 3a.

Waagen stated that this species, though characteristic and not very difficult to recognise, had yet very often been mistaken. His own determination, however, seems to have been equally at fault as noticed already by Benecke (1909, p. 424), and since he attributed his Wanda example, obviously not identical with Stahl's species, to the *anceps* zone, the writer previously mistook it for one of those forms that connect the

group of *Hecticoceras sarasini* Tsytoivitch (1911, p. 31, pl. II, fig. 2) with the more typical *Kheraites*. It is now believed, however, that Waagen's specimen came from a later bed, like the Badi and Jooria examples previously recorded by the writer, and that the resemblance to *Hecticoceras* and *Kheraites* on the one hand and to the forms of the group of *Putealicerias punctatum* (identified by Parona and Bonarelli, 1895, p. 133, with *Putealicerias puteale*, Leckenby sp.) is merely superficial.

In the first place, the inner whorls of the present form, as of *Campylites sucula*, are compressed, flattened and smooth, and the anguliradiate costation is pronounced chiefly at the umbilical edge and near the periphery. It is important to note that with increase in size, as Waagen stated, the ribs are "highest in the middle of the sides", but that they are not truly tuberculate, as in *Brightia* or *Putealicerias*, and certainly much thinner than at the clavate peripheral end. The latter is abruptly projected forwards, as in certain *Paltopterooceras* or *Acanthopterooceras* of the Lias, not merely bent forwards again, as in Teisseyre's '*Harpoceras*' *rossiense* (1883, p. 544, pl. I, figs. 6-7) or entirely unprojected as in the true *Hecticoceras* or *Kheraites*. *Brightia rossiensis* also shows how the primary ribs increase towards the lateral tubercle, whereas Waagen's drawing clearly indicates the character of the ribbing in the present species, especially on the last half of the outer whorl. On the earlier half, the primary ribs are badly drawn; they correspond to those of the fragmentary *Campylites* figured on pl. XIII, fig. 7. It should be added that Waagen's example is entirely septate but just shows the beginning of the body-chamber. A doubtful and unlocalised larger fragment, however, representing a shell of about 90 mm. diameter, shows no trace of septation. In peripheral view this body-chamber fragment agrees with the holotype of *Pseudobrightia dhosaensis* figured in pl. XIII, fig. 10b and the transitional form to *Putealicerias* represented in pl. XVI, fig. 10, but it is more depressed. Like large *Putealicerias* (e.g., *Hecticoceras punctatum* [Stahl ?] R. Douvillé, 1914, pl. IV, fig. 1) this fragment has more rectiradiate ribbing, but the W. Jooria example (No. 151) of intermediate size, though perhaps representing a slightly more inflated variety, shows the beginning change in the costation. The suture-line is not preserved in any of the eight examples before me, except—in a corroded condition—near the end of Waagen's figured specimen. It is very simple and shows only three broad-stemmed saddles on the lateral area, with two intervening wide lobes.

*Pseudobrightia dhosaensis*, nov. is more compressed and more anguliradiate to a much larger diameter. *Putealicerias* sp. ind. nov. (pl. XVI, fig. 10) has more delicate costation.

The differences of this species from *Kheraites crassefalcatus*, with which it had at first been associated, are dealt with on p. 107. Schlippe's so-called 'Cornbrash' species, a true *Prohecticoceras*, can at once be distinguished from the later *Pseudobrightia* by its blunt median keel on a concave periphery.

*Horizon*.—Lower Argovian, *polyphemus* beds.

*Localities*.—Wanda and Barasore (Waagen); East of Badi ("upper zone", No. 148-50) and W. Jooria ("upper zone", No. 151), Blake Collection; Dhosa Oolite, Fakirwadi, J. H. Smith Colln. Two further, immature, and poorly preserved examples

in the same collection labelled 'Katrol Beds, Fakirwadi,' but with the letters "D. O." painted on them, may belong to this species, but also resemble young *Kheraites*.

PSEUDOBRIGHTIA ? sp. ind.

A large form of probably this genus, unfortunately too fragmentary and poorly preserved to be figured, shows inner whorls that seem to differ from the form last described chiefly in being more compressed. There is a similar tricarinate periphery and the hook-shaped, forward projections of the ribs on the periphery are distinctly marked. The outer whorl, also weathered, still shows this coarse *Campylites*-like ribbing, if faintly, and is septate to the end, at a diameter of about 150 mm. It is possible that *P. dhosaensis* may also have become more discoidal with increase in size, but in the present example the lateral compression is more conspicuous and distinct also at smaller diameters and the umbilical ribs apparently were not so tuberculate at the same size. The rounded umbilical edge and comparatively open coiling make it improbable that the fragment is allied to the large forms of *Campylites* known from the *cordatus* zone, whilst the smaller forms of the earlier *renggeri* beds such as *C. secula* described below, are much more finely ornamented.

I can find nothing comparable in geological literature, but records of '*Harpoceras*' from the *cordatus* beds of, e.g., Moravia, Poland, the Carpathians, etc. (see Neumann, 1907, pp. 60-65) may possibly include *Pseudobrightia* as well as *Campylites*.

*Horizon*.—Lower Argovian (Dhosa Oolite), *polyphemus* beds.

*Locality*.—Fakirwadi (J. H. Smith Colln., No. 41).

Genus: LUNULOCERAS, Bonarelli emend.

LUNULOCERAS ORIENTALE (d'Orbigny). (Pl. XIII, fig. 9.)

1840. *Ammonites corrugatus*, J. de C. Sowerby, in Grant, pl. xxiii, fig. 12.

1850. *Ammonites orientalis*, d'Orbigny, p. 331.

1875. *Harpoceras lunula* (Zieten) Waagen, p. 63, pl. xiii, figs. 1a, b.

1891. *Ludwigia* sp. ind. I, v. d. Borne, p. 9.

1893. *Hecticoceras* (*Lunuloceras*) *lunula* (Reinecke) Bonarelli, pars, p. 99.

1902. *Ammonites corrugatus*; J. de C. Sowerby; Blake, p. 35.

1912. (?) *Harpoceras lunula* (non Reinecke), Smith, p. 1352.

Reuter (1908, p. 123) has shown that the true *Lunuloceras lunula* (Reinecke) is rather rare even in Bavaria. The numerous forms that have been identified with Reinecke's species, from Zieten's (1830) Wurtemberg example and Pratt's English *L. lonsdalei*, down to Couffon's Chalet form (1920, p. 184, pl. XIV, figs. 1, 1a, b) are mostly, if not all, different. Thus, Waagen's Kachh example also cannot be identified with Reinecke's form. Yet in spite of the enormous number of species of this group already existing, and although there is only a single example available, this seems to require a new name. Fortunately it appears permissible to transfer to Waagen's type d'Orbigny's name, originally proposed for a small Kachh example, preserved in the red hæmatite matrix of the *anceps* zone.

Sowerby's holotype in the British Museum (ex Geol. Soc. Colln.) is here refigured, but it is badly preserved. The original drawing was inaccurate and, as Waagen stated "barely to be recognised" in view of the numerous similar forms. Waagen, indeed, incorrectly identified with this species the small example here described as *Sindeites waageni*, which is entirely different, and a larger form, now renamed *Hecticoceratoides suborientalis*, which shows as little resemblance to the smaller form as it does to Sowerby's original. The ribs so far as can be seen are divided into two branches some distance from the umbilical edge; and the primary costæ are worn so as to suggest to Sowerby the presence of inner nodes. The two rows of tubercles on the periphery, mentioned by Waagen are also very indistinct, and not more pronounced than in the original of Waagen's '*Harpoceras lunula*.'

The preservation of Sowerby's type is so bad that specific identity with Waagen's '*Harpoceras lunula*' could not be satisfactorily proved. On the other hand, the two specimens are at least as closely allied to each other as the larger is to, e.g., *Lunuloceras pawlowski* (Tsytoivitch) or *L. lonsdalei* (Pratt) and it seems preferable not to suggest specific identity with European species, since comparison with actual examples of these forms reveals differences that except perhaps in the case of *Hecticoceras navense*, Roman (1924, p. 74, pl. XII, fig. 4), may be specific. The ribbing of the inner whorls of Waagen's type, whilst strongly anguliradiate shows a distinct resemblance to that of *Campylites* (pl. XIII, fig. 13). In Polish examples of *L. taeniolatum* (Bonarelli) and *L. pawlowski* in the British Museum (No. 4992a-d), the inner whorls, although similar, are distinctly more *Brightia*-like, i.e., of '*bifrons*' aspect.

*Hecticoceras chartroni*, Petitclerc (1915, p. 22, pl. I, fig. 2) may have inner whorls identical with Waagen's type, but the adult dimensions are different, as is to be expected. The same author's *H. buckmani* (p. 37, pl. II, fig. 3) may be more inflated and shows stronger primary ribs, but like the more finely costate *Harpoceras didieri*, Petitclerc (p. 21, pl. I, fig. 1), it is a form of the same type as *Lunuloceras pawlowski*. Since Petitclerc (p. 28) listed in the synonymy of his "*Hecticoceras lunula*, Zieten", not only Reinecke's different type, but also d'Orbigny's pl. CLVII, figs. 1, 2, which he again (p. 35) included in the synonymy of '*H. pseudopunctatum*, var. *orbignyi*' Tsytoivitch, it is doubtful what his interpretation of Zieten's form was. The measurements of some of these ammonites compare as follows:—

Waagen's <i>H. lunula</i> , p. 64, No. I . . .	42	·40	·29	·30
Waagen's <i>H. lunula</i> , p. 64, No. II . . .	55	·44	·26	·27
Petitclerc's <i>H. lunula</i> , p. 29, No. I . . .	95	·44	·22	·20
Petitclerc's <i>H. lunula</i> , p. 29, No. II . . .	35	·43	·26	·23
„ <i>H. chartroni</i> , p. 22 . . .	95	·44	·18	·21
„ <i>H. buckmani</i> , p. 37 . . .	80	·52	·26	·20
„ <i>H. didieri</i> , p. 21 . . .	90	·48	·22	·27
„ <i>H. pawlowski</i> , p. 31 . . .	75	·47	[·12?]	·27

The whorl-thickness, in this last, is undoubtedly inaccurate since even in the discoidal scaphitoid variety of Tsytovitch (1911, p. 70) it is still 23—24 per cent. of the diameter. A mere comparison of measurements, however, especially those based on single individuals is generally useless if only the inner or outer whorls are known; and it will probably be years before increased knowledge of the assemblages in which these Hecticoceratids occur throughout Callovian time will enable us to simplify their nomenclature.

Less closely costate forms of *Lunuloceras* that occur at Christian Malford (*e.g.*, B. M. No. C.-2793) with the finely ribbed *L. lonsdalei*, (Pratt, 1841, pl. V, fig. 2, refigured in S. S. Buckman, 1924, pl. DII) and the smooth *L. brightii* (Pratt, 1841, pl. VI, fig. 3, refigured in S. S. Buckman, 1925, pl. DXLIX) cannot satisfactorily be distinguished from the present form on account of their usual crushed condition.

*Horizon*.—Upper Chari Group (= *fraasi* beds?). Roman (1921, p. 160, 1924, pls. II and III) has no comparable species from his Lower Callovian (*rehmanni* zone? with *Parapatoceras*), but numerous similar forms from the *anceps* and especially *fraasi* zones.

*Locality*.—Wanda ('*anceps*' beds in Waagen). Sowerby's type preserved in the hæmatite matrix of the *anceps* zone, is from Chari.

*LUNULOCERAS NISOIDES* sp. nov. (Pl. XIII, fig. 8 b; Pl. XIV, fig. 11; Pl. XV, fig. 5).

As type of this species is taken the example figured in pl. XV, fig. 5, showing the simple suture-line (pl. XIV, fig. 11) and over half a whorl of body-chamber. The septate portion is smooth with a barely angular periphery, and resembles similarly involute young of other species of *Lunuloceras*, from the early *L. lunuloides* (Kilian, 1888, p. 118, = pl. VIII, fig. 3 in Quenstedt, 1849) to *L. bonarellii* (de Loriol, 1898, p. 36, pl. III, figs. 19—21) of the *renggeri* zone. I have a number of these smooth immature examples before me of which two Charwar specimens are figured in pl. XIII, figs. 8a, ; they cannot be identified specifically, but the smaller may perhaps be included with the present species. On the outer whorl of the holotype the fine ribs are strongly sickle-shaped as in forms of *Aconeceras* of the Aptian, notably *A. nisoides* or *A. haugi* (Sarasin, 1893, pl. VI, figs. 10c, 11c); but they are not prominent and are scarcely visible in the figure. The specimen is slightly crushed, but where intact, the periphery resembles that of *L. bonarellii*, as represented in de Loriol's fig. 19c, although without the prominent ribs. There is no distinct spiral groove, but the example was labelled '*H. kobelli*' and it may be noted that Noetling (1887, p. 20) compared his '*Harpoceras kersteni*' to Oppel's species. The Syrian form, however, which is quite unlike *Hildoglochiceras*, has an oxynote periphery and straight outer ribs.

The form of *Lunuloceras* figured by Lahusen as *Harpoceras brighti* (Pratt) var. (1883, pl. XI, fig. 16) is more evolute at the same diameter and quite smooth.

*Horizon*.—Divesian ('*athleta* beds').

*Localities*.—The holotype is marked '*athleta* beds,' but not localised. A doubtful second example in Mr. J. H. Smith's Colln. is from the same beds of Fakirwadi, and the

immature example above referred to (Blake Colln. No. 138) is from 'Charwar' (Blake's Bed No. 2) which may be the same locality.

*LUNULOCERAS* spp. juv. (Pl. XIII, figs. 8a, 12?; Pl. XVIII, figs. 9 a—c).

A number of immature examples of *Lunuloceras* cannot be identified specifically. Some like that figured in pl. XVIII, figs. 9 a—c are smooth, and compressed, and the periphery is rounded or subtabulate, without keel. Between these and the similar keeled forms already referred to above, two of which are figured in pl. XIII, figs. 8a, b, there are numerous transitions. The example represented in pl. XIII, fig. 12, with more conspicuous ribbing and similar but asymmetrical suture-line may, perhaps, be an immature *Sublunuloceras*. There are numerous comparable forms in the British Museum including the Dettingen (Wurtemberg) examples (Nos. 22309a—d) of which one, a young *Brightia*, was figured by Crick (1898, pl. XX, figs. 5—7) as '*Hecticoceras hecticum*', and they show that at this small diameter it is impossible to distinguish the early *lunuloides* from the later *bonarellii* type. Even the inner whorls of *Campylites* are smooth and the three keels do not appear until a diameter of 10mm. or over is reached.

A *Lunuloceras lunuloides* (Kilian) has now been recorded from Persia (Fischer, 1915, p. 229) and other forms of the same genus were listed by v. d. Borne (1891, p. 27) from the extreme north-west of the same country.

*Horizon*.—Callovian to Divesian. *Lunuloceras* seems to have spread farthest during 'athleta times' (= *promæ* to *duncani* horizons in Pringle, 1926, p. 33=bed C of Krenkel, 1915, p. 204=*ornatum* zone of Wetzel, 1919, p. 124=*lithuanicum* zone of Brinkmann, 1924, p. 498).

*Localities*.—Nineteen small examples are from the 'athleta beds' of Samatra and Fakirwadi (J. H. Smith Colln. and G. S. I., K.  $\frac{22}{565}$ ). Examples in the Blake Collection previously referred to (1924, pp. 23, 24) come from Wanda, S. Manjal, Jikadi, and Charwar.

Genus : *BRIGHTIA* Rollier.

*BRIGHTIA* sp. ind. (Pl. XVIII, fig. 7).

A small whorl-fragment of a length of 35mm. clearly belongs to a form of *Brightia* like typical, nodose, *Brightia* before me from English, French, German, Polish and other localities. It shows strongly rursiradiate outer ribs, without peripheral projection, four or five of which correspond to one prominent inner tubercle. The compressed whorl-section (pl. XVIII, fig. 7) shows an angular periphery with a simple, hollow, projecting keel. It is more compressed than that of *Brightia 'rossiensis'* (Bukowski, non Teisseyre; 1886, pl. XXV, fig. 13) or of *B. salvadorii* Couffon sp. (non Parona and Bonarelli; 1919, pl. XIV, figs. 8, 8a, b). The suture-line can be seen on the weathered side, but its details are indistinct.

Since this is the only representative of the genus *Brightia* from Kachh, it has been considered advisable to record it. Specific identification, however, is impossible;

and it may suffice to mention that comparable forms occur in Persia (v. d. Borne, 1891, p. 6, pl. I, fig. 4), whilst *Brightia metomphala* (Bonarelli), identified by Parona and Bonarelli (1897, p. 137) with the Persian form, has even been listed by Loczy (1915, p. 439) as occurring in India.

*Horizon*.—Callovian (or? Divesian) 'athleta beds.' Forms of this type, with *Bonarellia* are particularly abundant in the Ornaten Ton or Middle Brown Jura zeta-*duncani* zone (see Stahlecker, 1926, p. 212).

*Locality*.—Ler. Mr. J. H. Smith stated that the specimen was found by Dr. També and that the bed (probably 'athleta') was not marked.

Genus: SUBLUNULOCERAS, nov.

SUBLUNULOCERAS PRELAIRENSE sp. nov. (Pl. XI, figs. 5a, b).

The body-chamber fragment now figured seems to be connected by transitions with the more inflated *Kheraites ignobilis* and *K. ferrugineus*, here described; also with the later *Sublunuloceras lairensense*. It is, however, given an independent name because the differences appear of considerable importance. The ribbing has the peculiar bend and outer flattening of that of *S. lairensense*, but the periphery is acutely fastigate, not so definitely keeled, and without the tendency to tricarination shown in Waagen's species. The suture-line is not preserved in the holotype fragment; but a slightly less acute example, transitional to *Kheraites*, shows it very clearly. At a diameter of 45—50mm. its complexity and general aspect are about those of the suture-line of *Brightia salvadorii* (Parona and Bonarelli) as figured by Tsyto vitch (1911, text-fig. 10, p. 54), but the external lobe is slightly less deep in the Indian example. In *Sublunuloceras lairensense*, the suture-line is similar; in *Putealicerias intermedium*, it is more simplified, as it is also in the more inflated *Kheraites ferrugineus*. This last, moreover, differs in its short and bullate primary ribs and a more distinctly keeled and broader ventral area, but two examples here listed from Fakirwadi and Khera, on account of greater whorl-thickness, are transitional and also show resemblance to the later *Putealicerias intermedium*.

A large and complete example, doubtfully included here, at 90mm. diameter, has almost lost keel and costation, but it is too imperfectly preserved to be figured. There is superficial resemblance to the large *Subbonarellia decipiens*, figured in pl. IX, fig. 11, but the venter is narrowly fastigate even on the outer whorl and the ribs can still be seen although they are faint. Since the inner whorls are not exposed, definite identification of this example is impossible.

Comparable specimens occur in the Divesian (*athleta* zone) of Scarborough, but the ribs of the two sides tend to unite at the keel. One example (B. M. No. C 10042), with body-chamber, is indistinguishable from the holotype here figured and was labelled (apparently in Leckenby's own handwriting) '*Am. puteolis*.' Other specimens (e.g., B. M. No. 39557a) agree with the young *Hecticoceras punctatum* (non Stahl) figured by R. Douvillé (1914, pl. I, fig. 4).

*Horizon*.—Callovian, *anceps* beds.

*Localities*.—Fakirwadi ('anceps beds' holotype and one transitional example), Khera (a more inflated form) J. H. Smith Colln. The last probably came from what Blake labelled 'Bed 3.' The doubtful large example above mentioned is from the "Stream, East of Ler" (J. F. Blake Colln. No. 157), and was attached to an example of *Kinkelinceras* of the *mutans* group.

SUBLUNULOCERAS LAIRENSE (Waagen). (Pl. XI, figs. 6a, b?, 10; Pl. XIV, fig. 1; pl. XVII, figs. 5—6; pl. XVIII, fig. 8).

1875. *Harpoceras lairense*, Waagen, p. 65, pl. xiii, figs. 3, 4.

1885. *Ludwigia lairensis* (Waagen); Haug, p. 691.

1893. (?) *Harpoceras lairense*, Waagen; Bonarelli, p. 103.

1912. *Harpoceras lairense*, Waagen; Smith, pp. 1350-52.

1913. *Harpoceras lairense*, Waagen; Smith (c), p. 422.

The complete example figured by Waagen (pl. XIII, figs. 3a, b) is taken as lectotype of the species and the fragment represented in his fig. 4 is now separated as a variety:—*var. plana* nov. This consists largely of the body-chamber; but two examples here figured in pl. XI, fig. 10, (and pl. XVII, fig. 5?), belong to this variety. It will be seen that the variety differs mainly in the absence of a lateral tubercle; *i.e.*, there is weakening or flattening of the (slightly more distant) ribs, instead of thickening, at the point of bifurcation, as in the type and examples here illustrated (pl. XI, fig. 6, pl. XIV, fig. 1, and pl. XVII, fig. 6). Waagen did not figure the suture-line although the lectotype shows it quite plainly. The lobes (pl. XVIII, fig. 8) are not very different from those of other so-called '*lunula*,' and the lateral lobes can, perhaps, be called 'very narrow' only on one side of the type, although the siphuncle is central. The immature suture-line as seen, *e.g.*, in the specimen figured in pl. XVII, fig. 6, is simpler but built on the same plan. This example is interesting on account of its striking resemblance to certain *Cardioceras*. If the wide external saddle of the latter is due to mechanical causes, correlated with a serrate keel, *Cardioceras* could, indeed, have been replenished by successive Oppelid 'waves.' It may be noted that the *Amphiceras* suture-line is also of a similar modified rhacophyllitic type as that of the Oppelids here discussed, and in its probable derivative *Amaltheus*, developed a wide external saddle.

(*Brightia*?) *pseudopunctata* (Lahusen, 1883, p. 74, pl. XI, figs. 10-12) differs from the species here described in its strongly bent ribs and their thickened primary (inner) portions. It is to be noted, however, that owing to the more rectiradiate ribbing of the outer whorls of this species and the bending of the (continuous) costae on the body-chambers of *S. lairense*, confusion is possible, especially since the suture-lines are similar. The Alsatian forms referred by Benecke (1909, p. 420, pl. XI, figs. 1—3) to Lahusen's species are, however, close to *Lunuloceras orientale*, described above.

Those examples that are transitional to *S. prelairense* and that, judging by their matrix, may come from the *fraasi* zone (=lower '*athleta* beds'), have a more fastigate periphery; the doubtful example represented in fig. 6, pl. XI, by its more distinctly

tricarinate periphery, is transitional to *Campylites* and comes from the Dhosa Oolite. Schloenbach's (1865, p. 43, pl. XXXI, figs. 2 a—c) *Amm. henrica* (non d'Orbigny) seems to differ chiefly in its anguliradiate ribs and small umbilicus.

The specimen figured in pl. XVII, fig. 7, has continuous non-tuberculate costation and seems transitional to *Lunuloceras* of the *pavlowi* type (Tsyrovitch, 1911, pl. VII, fig. 12), as the variety *plana* is connected with *L. orientale*.

*Horizon*.—Divesian, 'athleta beds.'

*Localities*.—Waagen's four examples came from Ler, from north-east of Gudjinsir, and from north-west of 'Jikli.' Seven specimens sent by Mr. J. H. Smith are from Ler, Samatra and Fakirwadi; and the four examples in the Blake Collection are from Ler (Bed No. 8), and from West Katrol (Bed No. 4).

SUBLUNULOCERAS aff. NODOSULCATUM (Lahusen). (Pl. XV, figs. 1a, b).

The example here figured is undoubtedly close to *S. dynastes* and *S. discoides* described below, but on account of the comparatively large umbilicus of its inner whorls it is brought into association with the Riasan species described by Lahusen (1883, p. 75, pl. XI, figs. 17 and 18) and the Dives example identified with it by R. Douvillé (1914, p. 10, pl. II, fig. 9). The Kachh specimen is septate to the end, but the last half whorl is weathered and thus shows no ribs and too thin a periphery. It is probable that the outer whorl was comparable to that of *S. discoides* at this size, but the inner whorls of this form and of *S. dynastes* have a small umbilicus amounting in the example figured in pl. XII, fig. 2a, to 23 per cent. of the diameter, compared with 32 per cent. in the form here discussed. Moreover, the ribbing of the inner whorls of the present example is more anguliradiate; and there is resemblance in this respect to examples of *Lunuloceras taeniolatum* (Bonarelli) and *L. pavlowi* (Tsyrovitch) from Rudniki, Poland (Prof. J. Siemiradzki Colln.), and to the fragment of *Brightia* sp. ind. recorded above. In this earlier group, however, the ribs do not show the peculiar straightening out at larger diameters, characteristic of the *dynastes* group.

The suture-line is similar to that of *S. lairensis* (pl. XVIII, fig. 8) but the first lateral saddle is slenderer and L is not so distinctly trifold. The keel is shown only at the beginning of the outer whorl and is less prominent than that of *S. discoides* (pl. XIII, fig. 1b).

*Lunuloceras orientale*, described above, is very similar at a corresponding size, but its ribbing is more prominent, especially on the inner half of the lateral area, and more sickle-shaped, whilst *Brightia*(?) *pseudopunctata* (Lahusen) Reuter sp. (1908, pl. E to p. 98, fig. 1, 1909, p. 110, fig. 12) may be even closer. The typical *S. lairensis* is characterised by its fine tubercles, but such a transitional fragment as that figured in pl. XVII, fig. 7, at a corresponding diameter, has similar if more continuous ribbing. Its ventral area, however, is wider, and more distinctly keeled.

Two large and entirely septate fragments are included here only with doubt, but they still show the comparatively wide umbilicus and close costation of the figured example at twice its diameter. *S. dynastes* at this stage acquires distant costation, whilst *S. discoides*, with much smaller umbilicus, tends to become smooth.

*Horizon*.—Divesian ('*athleta* beds'). Reuter (1908, p.127) records it from the *fraasi* (= *castor* and *pollux*) and *duncani* (= *ornatum*) zones.

*Locality*.—Ler (J. H. Smith Colln., labelled K=Katrcl Beds; the matrix is that of the '*athleta* beds' rather than that of the Dhosa Oolite). The two large fragments are labelled 'Dhosa Oolite', Fakirwadi.

SUBLUNULOCERAS DYNASTES (Waagen). (Pl. XI, figs. 2a, b, 3.)

1875. *Harpoceras dynastes*, Waagen, p. 66, pl. xiii, fig. 6 only.

1885. *Ludwigia dynastes* (Waagen); Haug, p. 91.

1893. (?) *Harpoceras dynastes*, Waagen; Bonarelli, p. 103.

1912. *Harpoceras dynastes*, Waagen; Smith (a), p. 714; (b) pp. 1350-51.

1913. *Harpoceras dynastes*, Waagen; Smith (c), p. 422.

1915. *Harpoceras dynastes*, Waagen; Smith, p. 795.

The prominently keeled inner whorl of Waagen's large example (pl. XIII, fig. 6) here figured (pl. XI, fig. 3) agrees with the specimen represented in figs. 2a, b, of the same plate. It is almost certain that this really belongs to Waagen's species, since *S. discoides* and, more so, *S. nodosulcatum* (Lahusen, 1883, pl. XI, figs. 17, 18) are already clearly distinguishable at that stage. The former can be recognised also by the loss of its (more sigmoidal) costation at larger diameters and by its sharpened periphery. The present species develops coarse sigmoidal ribs only at a late stage, also a comparatively inflated outer whorl, with bluntly fastigate periphery, i.e., the keel is lost whilst the shell is still septate. *S. nodosulcatum* on the other hand, has less flattened sides and the ribs are more marked near the periphery, whilst the Dives examples referred by R. Douvillé (1914, pl. II, fig. 9) to this species differs from all the Indian examples in the wider umbilicus.

All these forms could be looked upon as merely discoidal developments of such forms as *Brightia*(?) *pseudopunctata* in R. Douvillé's sense; and since there are not two examples absolutely identical, it might be held that many more such 'species' could be distinguished if the measurements and differences were plotted. Yet it seems certain that careful zonal collecting will prove the interrelations of the various forms to be far less simple than is generally assumed. Waagen considered the present species to be closely allied to his *Harpoceras lunula* (here identified with *Lunuloceras orientale* d'Orbigny sp.) and if we separate from *S. dynastes* the tuberculate young erroneously attributed to it by Waagen the differences between the two species become reduced to the curvature and mode of ribbing. This, however, is sufficiently striking for generic separation, if sub-division of the original *Hecticoceras* is to be upheld.

*S. lairense*, with similar rectiradiate ribbing, tends to develop small tubercles at the peripheral ends of the ribs and at the middle of the sides, and is somewhat transitional to the group of *Putealoceras intermedium*. The closely allied *S. prelairense* of the *anceps* zone similarly appears to be transitional to the recticostate *Kheraites*, but the prominent keel of at least the compressed inner whorls of *Sublunuloceras* is an important distinction.

Bukowski (1887, p. 100) compared with the present form a new '*Harpoceras*' (his pl. XXVI, fig. 18) showing the acute whorl-section of *S. discoïdes*, but more flexiradiate ribbing. If a *Sublunuloceras*, this form is probably closer to *S. prelairens* and *S. lairens* than to the *dynastes* group. R. Douvillé (1904, pl. 53) referred it to *Eochetoceras villersense* (d'Orbigny) but the thickened primary ribs are against this identification.

*Horizon*.—Divesian, 'athleta beds.'

*Localities*.—Waagen's type came from S. E. of Nurrha; he included in this species some examples here referred to *Putealicerias intermedium*, but of his other localities, at least Ler, Wanda and 'North of Gudjinsir' may well have yielded *S. dynastes*. The example figured in pl. XI, fig. 2, is from Fakirwadi; and at the same locality and Samatra, Mr. J. H. Smith also collected some limonitic, doubtful, fragments.

SUBLUNULOCERAS DISCOIDES sp. nov. (Pl. XII, figs. 7a, b; Pl. XIII, figs. 1a, b; Pl. XV, fig. 11).

1913. *Oppelia* sp. Smith (b), p. 418.

As type of this new species is taken the example figured in pl. XII, figs. 7a, b; but the specimen represented in pl. XIII, figs. 1a, b, with slightly larger umbilicus slightly more distinct and less sigmoidal costation and a less fastigate ventral area is also attached to it, as is the doubtful, large, fragment figured in pl. XV, fig. 11. The inner whorls, on being broken out, proved to be identical with the second example. It is not considered advisable to separate these, even as a variety since there are still other specimens, including some yet more definitely transitional to *S. dynastes*, and it would lead to the naming of individuals instead of species or varieties.

To a diameter of 50mm. the whorls are not easily distinguished from similarly sized *S. dynastes*, e.g., the examples figured in pl. XI, figs. 2a, b, 3. The compressed, discoidal whorls and the narrowly rounded periphery with the (hollow) keel conspicuous only when the test is preserved, are much like many other so-called '*lunula*'; but the ribbing becomes comparatively straight after the initial, smooth, stage, and in typical examples is lost again at from 70—80 mm. diameter. The more coarsely ribbed forms (pl. XIII, fig. 1) do not lose their costation till 100mm. or more, but the outer whorl of the larger example figured in pl. XV, fig. 11, though slightly weathered, is smooth while still entirely septate. The suture-line agrees with that of *S. dynastes*.

Owing to its acute periphery and very prominent keel (when preserved) the present form may be compared with *Eochetoceras*, notably *E. villersense* (d'Orbigny) and *E. divense* (Rollier, 1913, text-fig. 1, p. 267). The latter has the characteristic spiral band on the lateral area and the ribs come up to the keel; in the former species (as refigured in Pal. Univ., 1904, pl. 53) the periphery is oxynote at all stages.

A badly preserved fragment in the Blake Collection (No. 155) was, however, referred by myself to *Trimarginites* on a previous occasion.

*Horizon*.—Divesian, 'athleta beds.'

*Localities*.—Samatra (3), Fakirwadi (3), Wanda (1), Ler-Hamundra Ellipse (1). The last is the 'huge *Oppelia*' referred to by Mr. Smith and here figured (pl. XV, fig. 11). A very badly preserved Jikadi example (Blake Colln. No. 143, previously listed as '*Oppelia*' sp. ind.) has more closely costate inner whorls, but is too fragmentary for exact identification.

Sub-Family : OCHETOCERATINÆ, Spath.

The presumed sequence from '*Hecticoceras*' (i.e., Hecticoceratinae, including *Pseudobrightia*, nov.), through what is now called *Campylites*, to *Trimarginites*, in the meaning of Bukowski and Rollier is indeed convincing; and it seemed 'very reasonable' to Wepfer (1912, p. 51), who also stated that "*hecticus*" [*Hecticoceras*] and "*fuscus*" [*Oxycerites*] could not be clearly separated. The close affinity of Hecticoceratids with Oppelinae (*Alcidia* and *Oxycerites*) has already been noticed; but their separation for systematic purposes, into different sub-families, tends to obscure this near relationship, and it must be remembered that, among e.g., goniatites, with smooth shells, simple suture-lines and lack of stratigraphical 'refinement,' we probably include almost as diverse but not so conspicuous an assemblage in a single 'species.' Again Rollier stated that the origin of the earliest *Ochetoceras* had to be looked for in the genus *Oxycerites* (Oppelinae), but other forms of the genus *Ochetoceras* he included in the entirely different family Harpoceratidae, so that it is clearly heterophyletic. This also indicates that a vague derivation of Ochetoceratids from "Middle Jurassic *Oppelia*" (in O'Connell 1922, p. 407) is not helpful.

It seems probable that, as in other ammonite families, the above sequence is more apparent than real; and I have previously (1925a, p. 115) stated that "it was almost certain that the genus *Ochetoceras*, Haug, as lately defined by Dr. Marjorie O'Connell (1922, table V) represented merely a series of homoeomorphs, not a genetic lineage."

*Lissoceratoides*, which persists from the Callovian to the Argovian, has, in the writer's opinion, repeatedly produced eared and tricarinate forms that may ultimately denote merely a certain environment but that, in the present state of our knowledge, may conveniently be grouped with the family Ochetoceratidae. *Ochetoceras* itself includes such early forms as *O. lautlingense*, Rollier (= *Oppelia fusca trimarginata*, Wepfer, 1912, p. 40, pl. III, figs. 1, 1a, 3) which, in point of time, may not be so widely separated from the Argovian types as Wepfer thinks. Throughout the Divesian and beyond, in deposits of Cardioceratan age, there occur smooth, compressed Oppelids that for want of a better name I previously called '*Lunuloceras*.' I stated (1924, p. 6) that some at least, e.g., the Wanda examples (whence *Campylites* is now described) may belong to "*Trimarginites*" [i.e., *Campylites*]; but the Haploceratids persisted and continued to replenish Streblitinae as well as Taramelliceratinae, discussed below. Isolated small specimens of such transitional forms of the Argovian and Divesian cannot be distinguished from immature *Lunuloceras* of the Callovian on the one hand and undoubted *Lissoceratoides* on the other. '*Trimarginites girardoti* Petitclerc (1917, p. 8, pl. I, figs. 8—10, pl. III, fig. 8 non de Loriol) of the *lamberti* zone is one of the early transitions from *Lunuloceras* to *Campylites* and other Ochetoceratids.

The genera now referred to Ochetoceratinae include *Campylites* (Mayer-Eymar MS) Rollier (1922, p. 360, genotype :—*Ammonites delmontanus*, Oppel, 1863, p. 194, pl. LIV, figs. 3a, b from the *cordatus* zone) which, as has already been stated, is close to *Pseudobrightia*, although probably not its direct descendant. *Trimarginites*, Rollier (1911, p. 309, genotype :—*Ammonites arolicus*, Oppel, 1863, p. 188, pl. LI, figs. 2a, b) and *Ochetoceras* Haug (1885, p. 698, genotype :—*Ammonites canaliculatus*, von Buch, 1831, in Oppel, 1863, pl. LI, fig. 3) also belong to the present family; but contrary to Dr. O'Connell I would not consider *Amm. hersilia*, d'Orbigny, to be the direct ancestor of *Ochetoceras*. In the *duncani* and *lamberti* zones of Peterborough there occur compressed, involute, developments of *Lunuloceras* of the type of *L. lunula* var. *lahuseni* (Tsyтовitch), with complex suture-lines, that strikingly suggest transitions to ' *Harpoceras* ' *hersilia* (d'Orbigny) as figured by de Loriol (1898, pl. I, figs. 7—13). *Campylites rauracus* (Mayer) again is distinguished from *Lunuloceras orientale* (d'Orbigny = ' *Harpoceras lunula* ' Waagen) chiefly by its more prominent keel and smaller umbilicus. If *Campylites*, *Trimarginites* and *Ochetoceras* are recognised as independent genera, it is advisable also to keep this *hersilia* group distinct (***Eochetoceras*** gen. nov.); and another offshoot that requires a new name is represented by *Oppelia girardoti*, de Loriol (1902, p. 40, pl. III, figs. 8, 9) with serrated keel. Grossouvre (1922, p. 306) thought this peculiarity insufficient to exclude that form from the genus *Trimarginites*; but a British example of de Loriol's species (B. M. No. C 27546, from the *cordatus* zone) in any case is sufficiently different from the later true *Trimarginites* to justify the creation of a new genus (***Neoprionoceras***, gen. nov.). This genus is probably closer to *Campylites* (*rauracus* group) and hence *Lunuloceras*; but *Eochetoceras* seems connected by transitions with *Sublunuloceras* of the *discoides* type if not also with *Paralcidia*, so that it appears indeed that Ochetoceratids merely continue the various Hecticoceratid (and Oppelid) genera, with tricarination and 'Ludwigid' ribbing becoming more and more pronounced in higher beds. It is impossible, however, to keep apart from these offshoots certain homoeomorphous developments of Haploceratidae with lateral groove and 'ears,' in which spontaneous tricarination may even be the result of mimicry. Thus *Oppelia subclausa* and *Trimarginites stenorhynchus* have been considered to be merely the male and female of one and the same species. It is the occurrence of such forms that prevents the reduction of Ochetoceratids to a single genus, descended from a comprehensive ' *Hecticoceras*,' and precludes the view that, e.g., *Campylites delmontanus* (Oppel) could be a 'premonitory species' (in the sense of R. Douvillé, 1911) of *Ochetoceras*, which "did not appear till later."

Of these five genera of Ochetoceratinae, only *Campylites* is represented in the Kachh Jurassic.

Genus : CAMPYLITES (Mayer-Eymar MS) Rollier.

CAMPYLITES SECLA (Bean MS) nov. (Pl. XIII, figs. 6, 7, 13).

1875. *Harpoceras rauracum* (Mayer) Waagen, p. 68, pl. xiii, fig. 5.

1887. *Harpoceras rauracum* (Mayer) Noetling, p. 23, pl. iii, figs. 11, 11a—c.

1893. *Harpoceras rauracum* (Mayer) Noetling ; Bonarelli, p. 102.

1911. *Ludwigia rauraca* (Mayer) Rollier, p. 309.

1913. *Ludwigia rauraca* (Mayer) Rollier, p. 270.

Mayer's *Amm. rauracus* (1865, pl. VII, fig. 4) has generally been too widely interpreted by different authors. On comparing the Indian examples with specimens from the Upper Oxford Clay (*renggeri* zone) of Scarborough and Warboys, Huntingdonshire, Besançon, Doubs., etc., it is found that they show very close resemblance. Noetling's Syrian form is probably also identical with these, but the true *C. rauracus* (Mayer) is much more like examples before me from the later *cordatus* beds. Although the six Kachh specimens that are now referred to the present species differ slightly in minor characters, they are all of the earlier *secula*-type. Bean's MS name is attached to one of his specimens in the British Museum (No. 39643) from the Oxford Clay of Scarborough [associated with *Proscaphites oculatus* (Phillips), *Klematosphinctes vernoni* (Bean MS) Young and Bird sp., *Cardioceras scarburgense* (Young and Bird), *Creniceras renggeri* (Oppel)]. This assemblage suggests an age corresponding to that of the Hermon fauna (zone of *Putealicerias socini*, Noetling sp.) and it seems permissible to refer Noetling's example, and the Kachh specimens here identified with it, to Bean's species.

Noetling's description is fairly accurate ; but he thought that Waagen's example showed a type of ribbing entirely different from that of Mayer's species. The Syrian form, however, differs in the same character, and shows neither the strongly angular ribs nor the vertical umbilical edge of the typical later forms. Waagen's peripheral view does not show the three keels, but he referred to these in the text. The suture-line was described by Bukowski (1887, p. 100) and is shown in the example represented in pl. XIII, fig. 13. It does not differ essentially from that of Mayer's species, but the external saddle is rather wide on both sides, though the suture-line is asymmetrical. It seems to be slenderer in Argovian forms from, e.g., Scarborough (Lower Calcareous Grit) and Vieil St. Remi, Ardennes.

The example figured in pl. XIII, fig. 7, agrees with Waagen's type ; fig. 6 has the umbilical tubercles less pronounced and may be confused with certain earlier *Lunuloceras*, except in peripheral aspect. The example figured in pl. XIII, fig. 13, has the outer whorl accidentally displaced which makes it appear rather too involute. It was previously recorded (1924, p. 23) as *Trimarginites* sp. cf. *delmontanus* (Oppel) and was wrongly brought into association with a larger and poorly preserved whorl-fragment of the form now described as *Sublunuloceras discoides*.

The example of *Hecticoceras* figured in pl. XV, fig. 6, with the ventral area almost rounded, a spiral groove on the sides, and the inner tubercles not pronounced, is interesting on account of its resemblance to *Campylites*. Its suture-line differs from that of the very similar *C. secula* chiefly in having a longer median prong in its trifold lateral lobe. The doubtful *Sublunuloceras* ? figured in pl. XI, fig. 6, and referred to above under *S. lairensis* differs from *Campylites* merely in its continuous and comparatively straight ribbing.

The fragmentary *Harpoceras* sp. recorded by Fischer (1915, p. 239) from Persia may well represent a form of *Campylites* like the Wanda example figured in pl. XIII,

fig. 13. Waagen's two examples of *Perisphinctes obliqueplicatus* apparently came from the same bed and Fischer's Persian specimen was associated with the same species.

Rollier thought Mayer's *Amm. rauracus* identical with Oppel's earlier species *Amm. delmontanus* and probably its female form, and when publishing Mayer-Eymar's MS genus *Campylites* (1922, p. 360) took the supposed male form as the genotype. When the various forms of *Campylites* existing during the *renggeri* and *cordatum* zones are better known it may be found that the two species (united also by Grossouvre, 1922, p. 306) are not even contemporaneous.

*Horizon*.—Divesian, *renggeri* zone (Dhosa Oolite).

*Localities*.—Waagen's only example came from north west of Soorka. Mr. J. H. Smith collected three specimens at Samatra, two of them (including the example figured in pl. XIII, fig. 7) in the same block of hard Dhosa Oolite matrix as an impression of a *Mayaites (polyphemus)*. The example in the Blake Colln. (No. 156) figured in pl. XIII, fig. 13, is from Wanda.

Sub-Family : TARAMELLICERATINÆ, nov.

(=NEUMAYRICERATIDÆ, Spath, 1925).

The genus *Taramelliceras*, Del Campana, was introduced in place of *Neumayria*, Bayle, 1878, which was preoccupied. Del Campana expressly stated (1905, p. 48) that it had been created for that group among the Oppelids that was characterised by *Ammonites flexuosus*, von Buch. Now it is clear that this same species cannot be chosen as genotype of a later genus *Neumayriceras* (Rollier, 1909) nor can *Taramelliceras* be restricted to forms that neither Bayle nor Del Campana had in mind when creating the new genus. I used *Taramelliceras* in this original sense in 1913 (p. 543) but it might be held that, since the genotype was not selected from the syntypes figured by Bayle, and since '*Oppelia flexuosa*' in the wider sense (*e.g.*, Wepfer's 1911) might be taken to include the group of *Ammonites flexuosus canaliculatus*, Quenstedt, the two genera in Rollier's connotation could be accepted. To avoid troublesome changes of nomenclature I adopted *Taramelliceras* (including the group of *Ammonites oculatus*, Phillips) and *Neumayriceras* in Rollier's sense in the descriptions of Jurassic faunas from Kachh, Somaliland, and Madagascar, and used the family name Neumayriceratidæ (1925a, p. 114) for certain offshoots of Haploceratidæ that were considered to be unconnected with the earlier, homœomorphous, '*Taramelliceras*,' which was attached, provisionally first to Bonarellids, and then to Phlycticeratids.

On reconsideration, however, it seems impossible to use the genus *Taramelliceras* except in the original sense for the group of '*Oppelia*' *trachynota* of Bayle and Del Campana. It is thus necessary also to change the family name. Von Buch's *Ammonites flexuosus* and Oppel's *Amm. trachinotus* are considered to be congeneric; and the genus *Taramelliceras* must therefore be used for those forms with evolute inner whorls that are characteristic especially of the Upper Argovian (*bimammatus* zone) and the Lower and Lower Middle Kimmeridgian (*tenuilobatus* to *beckeri* zones). *Taramelliceratids*, however, are not monophyletic. They seem connected with the earlier *Oppe-*

lids, but probably were replenished by developments of *Lissoceratoides*, of *Metahaploceras* (*Oppelia nodosiuscula*, Fontannes), and *Fontannesella* (=group of *Oppelia valentina*, Fontannes), whilst *Hemihaploceras* (=group of *Oppelia nobilis*, Neumayr) can sometimes scarcely be distinguished from the last *Taramelliceras* of the same [*beckeri*] zone. These were previously (1925a, p. 113) associated with *Haploceras* and *Glochiceras* but may, perhaps, be more suitably separated from the (persisting and typically smooth) Haploceratids and transferred to Taramelliceratids, similarly *Eurynotoceras*, Canavari, which is still another offshoot of *Haploceras* that develops flexuose ornamentation.

Zonal collecting will yield a good deal of information yet concerning the rarer forms of the present family, but in the Argovian there seem to be numerous indefinite Haploceratids of the type of *Oppelia bruckneri* (Oppel) de Loriol (1902, p. 41, pl. III, figs. 10, 10a, b) that probably produced Taramelliceratids on the one hand and various 'Creniceras' on the other, both with their 'æcotraustid' or secondarily 'Haploceratid' offshoots. Their reference to the present family rather than to Haploceratidæ seems advisable when lateral ornamentation becomes pronounced; thus *Oppelia dentata* (Reinecke) Fontannes (1879, p. 52, pl. VII, fig. 10) may well be left in *Glochiceras* whilst *Metahaploceras pascoei*, described below, is now included in the present family.

Other (Argovian) forms again may be descendants of *Proscaphites*, Rollier, 1909 (genotype:—*Ammonites anar*, Oppel, 1863, pl. IV, fig. 1) in which the writer would also now include the groups of *Ammonites oculatus*, Phillips (1829, pl. V, fig. 16), and of *Oppelia episcopalis*, de Loriol. *Sphærodomites*, Rollier, 1909 (created for *Ammonites calcaratus*, Coquand) represents perhaps only pathological forms of the same group, and *Popanites*, Rollier, as its author states (1909, p. 614), and as is clear from Bukowski's figures (1886, pl. XXVI), is a related genus. The comparison of *Popanites* with the Permian *Popanoceras*, of course, is as little apt as the reference, even provisional, of *Ammonites scaphitoides*, Coquand, to *Cymbites*, or the connection of *Proscaphites anar* with the true *Scaphites* of the Cretaceous.

The dwarf offshoot *Acanthæcites*, Rollier (genotype:—*Ammonites velox*, Oppel, 1862, p. 156, pl. XLIX, figs. 5a-d) which also includes such forms as *A. flexispinatus* (Oppel)=*Amm. flexuosus globulus*, Quenstedt (1887, pl. LXXXV, fig. 61), is a morphic prefiguration of certain later *Proscaphites* and *Taramelliceras*, and is probably derived from that Callovian stock which I had previously called 'Taramelliceras.' This is connected with *Alcidia* by such forms as 'Oppelia' *flector*, Waagen, which according to Wepfer (1912, p. 14) is only an inflated [*Alcidia*] 'subcostaria,' and which many authors still consider to be the rootform of all the *flexuosi*. The involute *Oppelia* ('Neumayriceras') *kormosi*, Loczy (1915, p. 345, pl. I, fig. 6, pl. III, figs. 16-17) appears to be a development of this stock, with punctate keel, for which the new name **Lorioloceras**, gen. nov. may be suggested. Rollier's original 'Taramelliceras' *canaliculatum* (Quenstedt, in Rollier, 1913, p. 275, text-fig. 5) and de Loriol's *Oppelia mayeri* (1898, p. 62, pl. IV, figs. 21-23) with the lateral groove more pronounced, are also provisionally included in *Lorioloceras*; but whether *Oppelia inconspicua* de Loriol (1898, p. 58, pl. IV, figs. 25-8), called by R. Douvillé (1911, p. 16) a 'premonitory' species of *Taramelliceras*, with thickened terminations of the ribs, is closer to this genus than to the numer-

ous forms of *Proscaphites* of the type of *P. frequens* (Grossouvre, 1922, p. 310, text-figs. 1-2), with which it is associated, is as yet doubtful. Rollier (1923, pl. XXII) considered his ' *Taramelliceras* ' and ' *Neumayriceras* ' to be offshoots of the same Oppelid stock that produced *Streblites*. This is probably correct if we put ' Haploceratid ' instead of Oppelid and it seems clear that *Taramelliceras* is not the direct (monophyletic) descendant of *Proscaphites*, as this itself is not derived directly from the earlier *Lorioloceras*. But Rollier's ' phylogenetic ' scheme that widely separates such relatively unimportant offshoots as *Acanthæcites*, *Sphærodomites*, and *Popanites* from the Taramelliceratids here discussed, cannot be too strongly condemned. Schindewolf (1923, p. 370) may well ask how an author who claims to have familiarised himself with the interrelations of ammonites for more than forty years of profound study could yet be ignorant of such genera as *Hauericeras* and *Schlusteria*, Grossouvre, 1893, to which we may add the still older *Cymatoceras*, Hyatt, 1883. If his scheme had not been styled ' phylogenetic ', but had been frankly put forward as a return to a subdivision of ammonites into keeled and unkeeled, *i.e.*, based on the most superficial resemblances, we should not venture to condemn it, for it becomes clearer every day that ammonites are so homogeneous a group and the ephemeral trachyostracous offshoots of the persistent liostracous root-stocks produce so complex a succession of homœomorphs that a natural, *i.e.*, phylogenetic classification must remain an ideal. We may note in this connection that R. Douvillé in 1914 (p. 20) still seemed attracted by the old suggestion of Munier-Chalmas, that *Creniceras* was the male of *Taramelliceras*.

The resemblance of *Acanthæcites* to *Phlycticeras* is interesting but can only be appreciated on examination of actual examples. *Proscaphites episcopalis* (de Loriol) also may show fine longitudinal striation, and it may be noted that Rollier (1923, pl. XXII) considered the allied *Oxydiscites* to be a derivative of *Phlycticeras* ( ' *Lophoceras* '). I was thus inclined to refer ' *Taramelliceras*, ' as then understood, to Phlycticeratinae (Spath, 1925*b*, p. 11) since its connection with the true *Taramelliceras*, as now restricted seemed to be too hypothetical. But in lateral ornamentation, this original ' *Taramelliceras* ' shows resemblance also to *Bonarellia*. Some forms of the latter genus, *e.g.*, *B. nodulosa* Quenstedt, 1887, pl. LXXXV, figs. 10, 11) and *B. subornata*, Spath (Naturalist, 1926, p. 323, text-fig. 15) have pairs of peripheral nodes and lateral grooves almost like *Lorioloceras*, whilst the similarity between this genus and *Petitclercia*, due to their common Oppelid origin, had also been noticed by authors, as Wepfer (1912, p. 16) commented on the affinity of *Lorioloceras canaliculatum* with *Bonarellia*.

#### Genus : LORIOLOCERAS, nov.

LORIOLOCERAS CF. INCONSPICUUM (de Loriol). (Pl. XIV, figs. 3*a-c*).

1875. *Oppelia* sp. ind. Waagen, pl. xi, figs. 7*a, b*.

1898. *Oppelia inconspicua*, de Loriol, p. 58, pl. iv, figs. 27-28.

1913. *Oppelia inconspicua*, de Loriol ; R. Douvillé, p. 67.

1914. *Oppelia inconspicua*, de Loriol ; R. Douvillé, p. 15, pl. ii, figs. 10-13.

Waagen figured an example of this apparently common form " to show the occurrence of another species of *Oppelia* in the *athleta* beds," but he did not describe it or list

it (on p. 229) among the species found in that zone. His original agrees very well with the two examples here figured, and with some costate forms included by de Loriol in his species. The suture-line, of the type of that of *L. mayeri* (de Loriol), is equally complex.

Of the Dives specimens figured by Douvillé, one (fig. 12) appears to be perhaps closer to Quenstedt's *Ammonites flexuosus inermis* (1887, p. 746, pl. LXXXV, figs. 52-54), but his fig. 11 especially cannot be distinguished from the Kachh examples. Douvillé's interpretation of this form as transitional from *Alcidia* to '*Taramelliceras*' of which latter genus he considered it to be a 'premonitory variation,' has already been referred to.

In the two figured examples the keel is scarcely noticeable. In another (Jikadi) example, however, previously (1924, p. 23) listed as '*Lunuloceras* sp. juv.', it is as conspicuous as in de Loriol's fig. 28a.

G. Müller (1900, p. 523) compared Waagen's form with his *Streblites Futtereri*, which, however, is closely allied to, if not identical with, the Kachh *S. plicodiscus*, described below.

*Horizon*.—Divesian, '*athleta* beds.'

*Localities*.—Barasore (Waagen); Fakirwadi (pl. XIV, figs. 3a-c); Jikadi (bed No. 22, Blake Colln. No. 146).

#### LORIOLOCERAS CANALICULATUM (Quenstedt). (Pl. XVII, figs. 2a-d).

1849. *Ammonites flexuosus canaliculatus*, Quenstedt p. 127, pl. ix, fig. 5.

1887. *Ammonites flexuosus canaliculatus*, Quenstedt; p. 743, pl. lxxxv, figs. 40-43.

1909. *Taramelliceras canaliculatum* (Quenstedt) Rollier, p. 623.

1912. *Oppelia flexuosa canaliculata* (Quenstedt) Wepfer, p. 62.

1913. *Taramelliceras canaliculatum* (Quenstedt) Rollier, p. 275, text-fig. 5.

Three fragmentary Kachh examples, including the one represented in pl. XVII, figs. 2a-c, are unhesitatingly identified with Quenstedt's well-known species. The suture-line of another is also figured (fig. 2d) since it shows the internal lobes. Several of Quenstedt's specimens of *Ammonites flexuosus canaliculatus* show slightly coarser costation of the inner whorls, and Rollier's figure seems to represent a coarsely costate variety, but Quenstedt's fig. 41 (pl. LXXXV), like the somewhat diagrammatic representation of the holotype in Rollier, agrees in all details.

De Loriol's smallest example of the later *Lorioloceras mayeri* (1898, p. 62, pl. IV, figs. 23, 23a, b) differs from the Kachh examples merely in the more pronounced tuberculation of the peripheral ends of the ribs.

*Horizon*.—Divesian, '*athleta* beds.'

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

## Genus : PROSCAPHITES Rollier.

PROSCAPHITES cf. HERMONIS (Noetling). (Pl. XIII, fig. 4).

1887. *Oppelia hermonis*, Noetling, p. 24, pl. iv, figs. 4, 4a-c.

1890. *Oppelia* aff. *hermonis*, Noetling; Lent and Steinmann, p. 632.

1924. *Taramelliceras* sp. (cf. *episcopalis*, de Loriol), Spath, pp. 6 and 25.

The single, small, specimen in the Blake Collection previously recorded and now figured (pl. XIII, fig. 4) is still the only example available. It is slightly worn laterally, but the fine costation and the line of small tubercles along the siphonal line make it probable that the specimen is referable to Noetling's species. Its cross-section is comparable to that of some of the examples included by de Loriol (1898, pl. IV, figs. 3-4) in his *Oppelia episcopalis*, but the ribbing shows no sign of coarsening towards the end of the Kachh shell. The similar *P. richei* (de Loriol, 1898, pl. IV, figs. 13-16) is more compressed and *P. ledonicus* (de Loriol, 1900, p. 43, pl. IV, fig. 1 and 1902, p. 38, pl. III, fig. 7) is rather more coarsely and distantly costate.

The form is referred to *Proscaphites* on account of its resemblance to *P. oculatus* (Phillips) of the *renggeri* zone, with costation continuous across the venter as in *P. anar* (Oppel). The group of *Ammonites flexuosus inflatus*, Quenstedt, however, to which Wepfer (1912, p. 62) refers de Loriol's *P. episcopalis* is also related to *Acanthæcites* Rollier, and the keeled varieties of this species figured by de Loriol (1900, pl. III, figs. 21-23) indicate that *Sphærodomites*, Rollier, is only an offshoot of the present group.

*Horizon*.—Divesian, *renggeri* zone (base of Dhosa Oolite).

*Locality*.—West Jooria, 'upper zone,' (Blake Colln. No. 183).

## Genus : TARAMELLICERAS del Campana.

TARAMELLICERAS KACHHENSE (Waagen). (Pl. VIII, figs. 2a, b, 4; pl. XIV, figs. 6, 12, 13; pl. XVII, figs. 3a, b; pl. XVIII, figs. 1a, b, 6).

1875. *Oppelia kachhensis*, Waagen, p. 55, pl. x, figs. 4, 4a, b.

1893. *Ammonites (Oppelia) kachhensis* (Waagen); Oldham, p. 222.

1903. *Oppelia (Neumayria) kachhensis* (Waagen); Uhlig, p. 41.

1903. *Oppelia kachhensis* (Waagen); Uhlig, p. 72.

1912. *Oppelia kutchensis* Waagen; Smith, (a), p. 714.

1913. *Oppelia kachhensis* (Waagen); Smith (c), p. 422.

1924. *Neumayriceras kachhense* (Waagen); Spath, p. 6.

1925. *Neumayriceras kachhense* (Waagen); Spath, p. 113.

Waagen's figures and description are tolerably accurate, but in his front-view (fig. 4a) the periphery of the outer whorl is too rounded (see fig. 2b, pl. VIII) and his suture-line is too diagrammatic. Waagen had only four specimens for study, but the species is now before me in about sixty examples and it is possible to recognise several varieties. These connect *T. kachhense* not only with the more finely ribbed *T. compsa* (Oppel) and with the coarser form, wrongly referred by Waagen to '*Oppelia trachynota*' (see e.g., pl. XVIII, fig. 6), but with a number of other species since found in Kachh.

The form figured in pl. XIV, fig. 12, thus, is distinctly more inflated and more highly ornamented, whereas the inner whorls of another example, figured in pl. XIV, fig. 6, are transitional to the species described below as *T. gibbosum*. These two varieties are represented by nine and five specimens respectively. On the other hand the form figured in pl. VIII, fig. 4 and pl. XIV, fig. 13, loses its tuberculation earlier than the type, is slightly more finely costate throughout, and tends to become smooth at an earlier stage. This variety is known in seven specimens and the example illustrated in pl. VIII, fig. 2, connects it with the typical form. But this variety is also transitional to the form described below as *T. cf. holbeini* (Oppel), with fine ornamentation, and there are various immature specimens that connect this variety with the compressed form represented in pl. XIV, figs. 7 and 8 (*T. transitorium*, nov.). The large example here referred to *T. cf. compsum* (Oppel) differs from *T. kachhense* merely in having a compressed periphery with closely set clavi, still at a considerable diameter. The gigantic specimen figured in pl. XVIII, fig. 1, also shows that, as Waagen clearly recognised, the present species is extremely closely allied to *T. compsum* and may be only its Indian equivalent; but the inclusion of both in a very comprehensive *T. gigas* (Quenstedt) could be considered only if they were all shown to be strictly contemporaneous forms.

*T. meschinellii*, del Campana (1905, p. 53, pl. I, fig. 15) has closer ribbing and peripheral tubercles, and strongly marked primary ribs. The latter also seem to be more clearly differentiated in *T. oculatiforme* (de Zigno MS, in del Campana, 1905, p. 50, pl. I, fig. 14, pl. II, fig. 11) but this 'Tithonian' species is based on execrable figures, and in any case its comparison to forms of the Divesian rather than to the *compsum* group seems inapt. Herbich's *Oppelia kochi* (1878, pls. VI, VII, figs. 1.2) is more inflated than even the most robust varieties of the present species and has a more strongly defined umbilical rim, but it probably belongs to the same (*compsum*) group.

The innermost whorls of a form of the *kachhense* group, figured in pl. XVII, figs. 3a, b, are first circular, then slightly compressed in section, but with a rounded periphery. They are smooth; but on the median line of the ventral area there are traces of transversely elongated tubercles as in *Haploceras carachtheis* (Zeuschner) figured by Zittel (1868, pl. XV, figs. 1a, 1e).

*Horizon*.—Middle Kimmeridgian, *eudoxus* (and *beckeri*?) zone.

*Localities*.—Waagen's four examples came from East of Ler. Mr. J. H. Smith's collection includes twenty examples from the same locality, sixteen from Fakirwadi, sixteen unlocalised specimens, probably from either of these two places, two from Habye, and one from Walakhavas. Two badly preserved examples in the Blake Collection (Nos. 165 and 6) from the last locality are labelled "above zone I."

TARAMELLICERAS AKHER sp. nov. (Pl. XIX, figs. 4a, b).

1875. *Oppelia trachynota*, Waagen (non Oppel), p. 54, pl. x, fig. 6.

1903. *Oppelia* (*Neumayria*) *trachynota*, Waagen; Uhlig, p. 41.

1910. *Oppelia* (*Neumayria*) *trachynota*, Waagen non Oppel; Dacqué, p. 10.

1912. *Oppelia* (*Neumayria*) *trachynota*, Waagen non Oppel ; Smith, (a), p. 714.

1913. *Oppelia* (*Neumayria*) *trachynota*, Waagen non Oppel ; Smith, (c), p. 422.

During his enquiries into the affinities of Oppel's *Ammonites trachinotus*, Prof. Dacqué discovered that this form was extremely rare and that the ammonites commonly referred to Oppel's species in geological literature belonged to similar Kimmeridgian forms. He identified, however, with *Amm. trachinotus* the East African specimens recorded by Beyrich, Futterer, and himself, and a third fragment of the same species, from Mombasa, Kenya (B. M. No. C 8136) is before me. This form is certainly not represented among over a hundred Kachh *Taramelliceras* sent to the writer (including only two examples of this early group); and even among many hundreds of specimens from the White Jura in the Häberlein and other collections in the British Museum, there is nothing like Oppel's *Amm. trachinotus*, except, perhaps, some immature specimens from Rians, Var (France). Now if species of *Taramelliceras* of the White Jura Gamma or even Delta (Middle Kimmeridgian) can be so much like *T. trachinotum* of the Upper Argovian that not only the authors quoted by Dacqué but many more have been unable to distinguish them, it is clear that, as was mentioned above, generic separation is not advisable, although I have previously (1925, p. 113) stated that the later species are probably partly independent developments of *Fontannesiella* and *Metahaploceras*.

The Kachh form, of which Waagen had only two examples, was characterised as having rather low whorls and very strong and prominent ornamentation. It is connected by numerous transitions (like pl. XVIII, fig. 6) with *T. kachhense*, and, as already stated, it might well be considered to be merely an extreme of the robust varieties of that species, with more distantly and more strongly costate inner whorls. It is, however, now distinguished by a separate name since all the species of *Taramelliceras* are really very closely allied ; and *T. akher* is at least as close to *T. gibbosum* as it is to *T. kachhense*.

Waagen identified his Indian form with Zittel's '*Oppelia trachynota*' (1870, p. 70, pl. XXIX, fig. 3) from Cesuna in the Sette Comuni, but Dacqué referred this to Neumayr's *Oppelia pugilis*. There is, perhaps, some resemblance to one of the examples figured by this author (1873, p. 167, pl. XXXII, fig. 2), but not to the holotype (fig. 1), nor to the equally evolute Sicilian form figured by Gemmellaro (1871, pl. VI, figs. 2a-c), with a more tabulate, non-tuberculate, periphery (= *T. pugiloides*, Canavari sp.). The specimens figured by Fontannes (1879, p. 45, pl. VII, figs. 1-2), even if more finely tuberculate than the type, indicate that in their evolute inner whorls, the forms of the *pugilis* group resemble those of the costate and ventrally non-crenulate *Hemihaploceras*, Spath (= group of *Oppelia nobilis*, Neumayr), which is probably a separate offshoot. There is no form of this genus and only two forms of the transitional *pugilis* group among the Kachh material so far received.

It is doubtful whether *T. akher* is identical with other so-called *Oppelia trachynota* (non Oppel) to which Prof. Dacqué has directed attention, and to which we may add del Campana's Italian form (1905, p. 52, pl. II, fig. 10). Some of these do not seem to differ essentially from Del Campana's *T. meschinellii*, and certain forms intermediate between *T. kachhense* and *T. gibbosum*. Of Choffat's four Abadia specimens, the best

(1893, p. 24, pl. XVII, figs. 1a, b) is perhaps comparable to the species described below (p. 144) as *T. sp. ind.*, whilst the ammonites figured by Favre, de Loriol, Fontannes, Herbieh, and Burckhardt, will be discussed below in connection with various other species of *Taramelliceras*. The last author's *T. crucis* (1912, p. 48, pl. X, figs. 4-6) has a much broader whorl-section than the young *T. akher*.

The immature example here figured (pl. XIX, figs. 4a, b) is exceptional, and is characterised by a more tabulate periphery and flattened side, suggestive of the *pugilis* group, in which, however, the inner whorls are apparently smooth. *T. transitorium* has a somewhat similar aspect, but is more finely ornamented.

The *Taramelliceras* sp. figured by Dietrich (1925, p. 10, pl. III, fig. 4) has nothing to do with the 'Kimmeridge *trachynota*' and its strongly projected sickle-shaped ribs are entirely different from those of *T. holbeini* or *T. kochi*, though possibly merely wrongly drawn.

*Horizon*.—Middle Kimmeridgian, *eudoxus* zone ?

*Localities*.—Waagen's types came from Kuture (Jooria Hills), and from East of Ler. Mr. J. H. Smith's collection comprised four examples from Fakirwadi, but the example figured in pl. XIX, figs. 4a, b was unlocalised.

,      *TARAMELLICERAS* sp. nov. ? (Pl. XVIII, figs. 3a, b).

The inflated young form here figured is imperfectly preserved and slightly crushed, but in the comparatively rapid change from coarse to fine costation it differs from all the other Kachh forms here described. It is still septate at 47mm. diameter and, as in a similar young specimen of *T. akher* from the same bed, the costæ are at first comparatively distant and equally tuberculate at the peripheral ends. Later one or two intermediate ribs appear and the costæ approximate, whilst the siphonal line of tubercles also becomes weakened. The thick siphuncular tube itself is exposed for a distance of about 10mm. and shows a wavy surface, indicating that it followed the contour of the tuberculate ventral area. The umbilicus is comparatively small and, owing to the inflation of the whorl-side, its walls are high, but rounded. The suture-line, so far as it can be observed, agrees with that of, e.g., *T. kachhense*.

The form figured by del Campana (1905, pl. I, figs. 12-13) as *T. pseudoflexuosum*, and referred to below, apparently has inner whorls like the example here discussed, but the smaller specimen figured by the same author (Pl. VI, figs. 2-3) is less coarsely ribbed and has a wider umbilicus. As the form is represented by a single example, no new name is proposed for it.

*Horizon*.—Middle Kimmeridgian, *eudoxus* (or *beckeri* ?) zone.

*Locality*.—Fakirwadi (Katrol Beds, J. H. Smith Colln.)

*TARAMELLICERAS* cf. *COMPSUM* (Oppel). (Pl. XVIII, fig. 10).

1863. *Ammonites compsus*, Oppel, p. 215, pl. lvii, fig. 1.

1866. *Ammonites compsus*, Oppel ; Würtenberger, table to p. 68.

1872. *Oppelia compsa* (Oppel) ; Gemmellaro, p. 37, pl. vi, fig. 3a

1878. *Oppelia compsa* (Oppel) ; Herbieh, p. 150, pl. v.  
 1879. *Oppelia compsa* (Oppel) ; Fontannes, p. 34, pl. v, fig. 1.  
 1897. *Oppelia compsa* (Oppel) ; Canavari, p. 44, pl. v, fig. 2.  
 1902. *Oppelia compsa* (Oppel) ; Haizmann, p. 523.  
 1903. *Oppelia compsa* (Oppel) ; Uhlig, p. 72.  
 1905. *Neumayria compsa* (Oppel) ; Kilian and Guébbard, p. 788.  
 1907. *Oppelia compsa* (Oppel) ; Toulou, p. 23.  
 1913. *Taramelliceras compsum* (Oppel) ; R. Douvillé p. 69.  
 1925 ?. *Oppelia compsa* (Oppel) ; Jekelius, p. 68, text-fig. 12.

A specimen of 113mm. diameter, showing a third of a whorl of body-chamber, seems to agree with this species rather than with the less compressed *T. kachhense*, but it is somewhat corroded, especially near the end. Waagen's species has not only a wider but a more rounded or flattened periphery and the ornamentation of the inner whorls is coarser in the typical forms though not in the smoother variety figured in pl. VIII, fig. 4. The Transylvanian form depicted by Herbieh is somewhat intermediate ; it differs from *T. kachhense* in the presence of a keel, but it is more inflated than Oppel's type and the Kachh example here discussed. Quenstedt's *Amm. flexuosus gigas* (1887, p. 909, pl. XCVIII, fig. 8) with which Wepfer (1911, p. 63) had identified Oppel's species, does not seem to differ in any essential from the large example of *T. kachhense* figured in pl. XVIII, fig. 1. The Baden form figured by de Loriol (1877, pl. IV, fig. 4) is more inflated than any of the Kachh forms of *Taramelliceras* before the writer.

The Persian '*Oppelia flexuosa*' recorded by Fischer (1915, p. 241) probably belongs to the same group of *Taramelliceras* as the species now discussed, but is known only in one crushed fragment. Other doubtful examples from Dalmatia and Tanganyika have lately been recorded by M. Furlani (1910, p. 83) as *Oppelia* cf. *compsa* and by Dietrich (1925, p. 10) as *Taramelliceras* cf. *compsum*.

*Horizon*.—Middle Kimmeridgian, *eudoxus* zone ? The horizon of Oppel's type is given as White Jura Delta (= *eudoxus* zone) but Lory (1904 p. 643) has it also in his higher beds with *Sowerbyceras loryi*, probably belonging to the *beckeri* s. l. (= *gigas*) zone. Kilian (1892, p. 166) had it in still later beds with *Perisphinctes geron* and *P. contiguus*, and in 1905 (pp. 788, 805) he listed this long-lived species from Lower as well as Upper Kimmeridgian beds and stated it to be known even in the Tithonian. Paquier (1892, p. 34) on the other hand recorded it from the *tenuilobatus* but not from the higher *acanthicus* zone.

*Locality*.—Unrecorded, probably Fakirwadi or Ler (J. H. Smith Colln.).

#### TARAMELLICERAS aff. HOLBEINI (Oppel). (Pl. XIV, fig. 14.)

1863. *Ammonites holbeini*, Oppel, p. 213.  
 1866. *Ammonites flexuose* sp. Benecke, p. 191, pl. x, fig. 1.  
 1877. *Oppelia holbeini* (Oppel) Gemmellaro, p. 195.  
 1879. *Oppelia holbeini* (Oppel) Fontannes, p. 37, pl. v, figs. 3a, b.  
 1881. *Ammonites (Oppelia) holbeini* (Oppel) ; de Loriol, p. 9, pl. i, figs. 7-8.

1887. *Ammonites flexuosus gigas* (pars) Quenstedt, p. 911, pl. xviii, fig. 10.  
 1889. *Oppelia holbeini* (Oppel) Kilian, p. 627.  
 1892. *Oppelia holbeini* (Oppel) Paquier, p. 34.  
 1897. *Oppelia holbeini* (Oppel) Canavari, p. 42, pl. v, fig. 1.  
 1901. *Oppelia holbeini* (Oppel) Pompeckj, p. 166.  
 1902. *Oppelia holbeini* (Oppel) Haizmann, p. 523.  
 1908. *Oppelia* cf. *holbeini* (Oppel) Haas, p. 395, pl. xiv, figs. 1a, c.  
 1911. *Oppelia holbeini* (Oppel) Wepfer, p. 27.  
 1913. *Taramelliceras holbeini* (Oppel) R. Douvillé, p. 69.  
 1921. *Taramelliceras holbeini* (Oppel) Riche and Roman, p. 185.

The example here figured (pl. XIV, fig. 14, reduced to  $\frac{3}{8}$  linear) has dimensions :— 97 — 56 — 30 — 11 and is still septate at the end. It agrees well with the figures given by de Loriol and Fontannes. Neumayr's illustration (1873, p. 166, pl. XXXIII, fig. 1) which according to Wepfer has nothing to do with the holotype of Oppel's species, shows a wider periphery of the outer whorl, and one of de Loriol's earlier examples (1877, pl. III, fig. 7 only) is also more inflated than the Kachh specimens. Favre's examples (1877, p. 31, pl. II, figs. 11, 12) are perhaps too prominently costate and seem to be transitional to the species here described as *T. transitorium*, as Gemmellaro's Sicilian specimen (1872, pl. VI, fig. 1) is transitional to *T. compsum*. The suture-line shows good agreement with that figured by Canavari (1897, text-fig. 10, p. 43).

*T. erycinum* (Gemmellaro, 1870, p. 50, pl. X, fig. 2) has no outer tubercles, *T. pseudoflexuosum* (Favre) is more finely ornamented. *T. kachhense*, especially the variation figured in pl. VIII, fig. 4, is only slightly more coarsely ornamented than the form here described. Some young examples referred to that variety might perhaps have been included with *T. cf. holbeini*, and Haas's Alpine form is another of these transitions, whilst Burckhardt's Mexican *Oppelia* (*Neumayria*) sp. ind. (1912, p. 50, pl. X, figs. 9-11) has rather strongly ribbed inner lateral areas. On the other hand there is another small and incompletely preserved example which shows that the species now described has always a smaller umbilicus than *T. kachhense*, or the form figured by Haas.

*Horizon*.—Katrol Beds, Lower or Middle Kimmeridgian. Herbieh (1878, p. 149) mentioned that it was commonest in the Red Limestone, below his bed with *Terebratula janitor* (in which was found also his '*Oppelia trachynota*') but that it again occurred in the upper beds (with *T. pugilis*, Neumayr sp. = *beckeri* zone). Pompeckj recorded it from the Lower Kimmeridgian (with *Sutneria platynota*), Riche and Roman even from the *bimammatus* zone.

*Locality*.—Habye, 'Katrol Beds' (J. H. Smith Colln.). Two smaller examples in the same collection are unlocalised, but probably came from Fakirwadi or Ler.

#### TARAMELLICERAS aff. FRANCISCANUM (Fontannes) (Pl. XV, fig. 9).

1879. *Oppelia franciscana*, Fontannes ; p. 41, pl. vi, figs. 1, 2.  
 1903. *Oppelia franciscana*, Fontannes ; Uhlig, p. 72.

1908. *Oppelia franciscana*, Fontannes ; Haas, p. 391.

1913. *Taramelliceras franciscanum* (Fontannes) R. Douvillé, p. 69.

A fairly well-preserved specimen shows very good agreement with Fontannes's type of the same size, as does a second smaller fragment. The third and largest example figured in pl. XV, fig. 9 with the inner whorls incompletely shown, might, perhaps, also be compared with *T. hemipleurum* (Fontannes, 1879, p. 47, pl. VI, figs. 6-7); but this species has a wider umbilicus and the inner whorls are more of the *pugilis*-type. Two imperfect specimens with slightly more inflated whorl-section are transitional to *T. compsum* (Oppel) as figured by Fontannes, or to *T. holbeini* (Oppel). The suture-lines of all agree with that of the Alpine example figured by Haas (1908, pl. XIV, fig. 1). This author also discussed the differences shown by the examples attributed to these species by various authors.

*Horizon*.—Lower or Middle Kimmeridgian, *tenuilobatus* zone ?

*Locality*.—Fakirwadi (four examples in Mr. J. H. Smith's Colln.). The two transitional specimens are unlocalised.

TARAMELLICERAS GIBBOSUM sp. nov. (Pl. XV, figs. 10a, b, c).

The inner whorls of the holotype of this species, figured separately in pl. XV, fig. 10c, are intermediate in costation between the more finely ribbed *T. pseudoflexuosum* (pl. XVIII, fig. 2) and the coarser varieties of *T. kachhense*, to which belongs the specimen figured in pl. XIV, fig. 6. They cannot be distinguished from the example figured by de Loriol (1877, pl. IV, figs. 2, 2a-c) as *Ammonites trachynotus*. The inflated outer whorl is characterised by its strong and curved primary ribs, perpendicular and high umbilical wall, with a rounded edge, close and prominent peripheral tubercles, and very prominent siphonal spines. The suture-line agrees with that of *T. kachhense* and, unlike that figured by de Loriol, it has a slender and high, lateral saddle. A Randen example of de Loriol's species (B. M. No. C 37741 b) does not differ in this respect from the Kachh form, and up to a small diameter they may not be distinguishable; but the costation of the Randen form remains finer and, at a diameter of 55mm., suggests that de Loriol's large fragment (pl. IV, fig. 3) may, indeed, belong to the same, unnamed, species.

The present form, on the other hand, is distinguished from *T. kachhense* and especially the similarly inflated forms of the coarser varieties, merely by retaining primary costæ and siphonal tubercles at a stage in which they have been weakened or even lost in the latter. *T. subcallicerum* (Gemmellaro, 1872, p. 39, pl. VI, fig. 4) has a similarly inflated whorl-section, but different costation; *T. schmidlini* (Moesch, 1867, p. 297, pl. III, figs. 1a, b) with wide umbilicus is closer to the forms of the group of *T. karreri* (Neumayr) and can be distinguished by the absence of the prominent siphonal tubercles. Zittel's '*Oppelia trachynota*' (non Oppel), which may be intermediate between the present species and the coarser *T. akher*, differs merely in having closer primary ribs on the outer whorl.

There is nothing among the Kachh material that resembles the gibbose form figured by Krumbeck (1922, p. 204, pl. XVIII, fig. 7) as *Oppelia* (*Neumayria*) sp. from Rotti, with gentle umbilical slope and unusual ribs and suture-line.

*Horizon*.—Middle Kimmeridgian, *eudoxus* zone.

*Localities*.—The holotype and another, smaller, example came from Ler, three specimens from Fakirwadi, and five more are probably from the same localities but not labelled (all J. H. Smith Colln.).

TARAMELLICERAS cf. SUCCEDENS (Oppel) Zittel sp. (Pl. XIV, fig. 10).

1870. *Oppelia succedens* (Oppel) Zittel ; p. 67, pl. xxix, fig. 2.

The body-chamber fragment here figured shows good agreement with Zittel's drawing of the type, but the inner whorls are preserved only as an impression (on the side not figured), and apparently do not differ from those of other forms of the *kachhense* group here discussed, notably of *T. gibbosum* (see pl. XV, fig. 10c). There is no trace of the suture-line, but in *T. succedens*, according to Zittel's somewhat diagrammatic representation, it is so closely similar to that of *T. gibbosum* that the species could not be separated on that basis. In spite of the fact that Zittel and Pervinquier (1907, p. 19) compared the present species with Oppel's *Amm. strombecki*, the comparatively coarsely costate inner whorls with trituberculate periphery suggest closer affinity with the *compsum* group.

*Horizon*.—Middle Kimmeridgian, *beckeri* zone ?

*Locality*.—Fakirwadi (J. H. Smith Colln.). Like Zittel's type, this example was associated with *Waagenia*.

TARAMELLICERAS PSEUDOFLEXUOSUM (Favre). (Pl. XVIII, figs. 2a, b).

1875. *Ammonites flexuosus* v. Buch ; Favre, p. 25, pl. i, figs. 13, 14.

1876. *Ammonites* (*Oppelia*) *flexuosus*, v. Buch ; Favre, p. 40, pl. iii, fig. 6.

1877. *Ammonites* (*Oppelia*) *pseudoflexuosus*, Favre, p. 29, pl. ii, figs. 9-10 ; pl. iii, fig. 1.

1892. *Oppelia pseudoflexuosa* (Favre) Paquier, p. 34.

1903. *Taramellia pseudoflexuosa* (Favre) del Campana, p. 385.

1905. *Neumayria pseudoflexuosa* (Favre) Kilian and Guébhard, p. 788.

1908. *Oppelia pseudoflexuosa* (Favre) Lewinski, p. 431.

The figured example seems to agree well with Favre's originals ; and his two smaller examples (of which we may regard fig. 9 of pl. II [1877] as the lectotype) indicate that the development of the costation in ontogeny is from fine to coarse, not from coarse to fine as in the examples referred by del Campana (1905, p. 49, pl. I, figs. 12, 13 ; pl. VI, figs. 2, 3) to Favre's species. Choffat's Portuguese specimens (1893, p. 23, pl. XVI, figs. 15-17) are probably closer to the true *T. pseudoflexuosum*, since he mentions that with diminishing whorl-thickness there was an approach to his '*Neumayria*' *kobyi* ; the largest example, however, (pl. XVI, fig. 15) is slightly more coarsely costate than the Kachh form.

Quenstedt's *Amm. flexuosus pinguis* (1887, p. 908, pl. XCVIII, figs. 5-7) was included in *T. pseudoflexuosum* by Choffat and del Campana, and was recorded by Wepfer (1911, p. 30) from the *tenuilobatus* zone; but Quenstedt's form, which belongs to the White Jura Beta, is more coarsely costate than the Kachh example and probably also the type.

*Horizon*.—Middle Kimmeridgian, *eudoxus* zone?

*Locality*.—Ler (Katrol Beds, J. H. Smith Colln.).

*TARAMELLICERAS TRANSITORIUM* sp. nov. (Pl. XIV, figs. 7-8).

cf. 1879. *Oppelia trachynota* (non Oppel) Fontannes, p. 36, pl. v, figs. 2a, b.

cf. 1906. *Oppelia* (*Neumayria*) cfr. *trachynota*, Fontannes non Oppel; Burckhardt, p. 72, pl. xvii, fig. 5.

cf. 1910. *Oppelia* sp. Dacqué, p. 10.

The larger of the two examples here figured shows good agreement with a Randen specimen (B. M. No. 37741a) which is close to, if not identical with, Fontannes's form. Gemmellaro's *T. subcallicerum* (1872, p. 38, pl. VI, fig. 4) is also very closely allied and differs apparently merely in retaining peripheral tubercles to all the ribs, whereas in the Kachh form now discussed, and the Crussol and Mexican examples doubtfully identified with it, there soon appear first one, later two or three, secondary ribs in between the tuberculate ones. In the typical sigmoidal '*flexuosa*' ornament, the compressed whorl-shape, and the trituberculate periphery, the present form at first is much like *T. kachhense* and some immature examples have already been referred to as transitional to the species now described. The whorl-sides, however, become smooth in larger examples of *T. kachhense*, and the inner half of the side, even in small specimens, does not show the prominent distant principal ribs that are reminiscent of the *karreri* group. The holotype, at 60 mm. diameter, has about 44 ribs and its dimensions are :—60—57—35—13.

The smaller example (pl. XIV, fig. 7) is probably nearly related to or identical with the form figured by Fontannes (1879, p. 40, pl. V, fig. 7) as *Oppelia greenackeri* (non Moesch). There are many transitional forms not only between the present species and *Taramelliceras* of the *kachhense-compsa* type, but also the coarser *T. planifrons*, described below and the *pugilis* group; and as in the case of Waagen's variable *T. kachhense*, almost every specimen shows certain individual differences. The peculiar subrecticostate and slightly reclined ribs are highly characteristic and occur again in the form figured by Herbieh (1878, pl. III, fig. 2) as *Oppelia trachynota*. In this form, however, there are numerous intermediate ribs between the tuberculate ones, if the illustration is at all reliable.

*Horizon*.—Katrol Beds, Middle Kimmeridgian, *beckeri* zone?

*Localities*.—Three out of nine specimens in Mr. J. H. Smith's Collection are labelled Ler; the others are unlocalised but appear to have come from the same bed (Smith, 1913b, p. 418).

TARAMELLICERAS PLANIFRONS sp. nov. (Pl. XIV, figs. 9a, b ; pl. XVIII, fig. 5 ; pl. XIX, fig. 2).

? 1879. *Oppelia pugilis* (Neumayr) Fontannes, p. 45, pl. vii, figs. 1-2.

The two examples here figured are not identical, but may be united specifically with Fontannes's form which does not appear to be the same species as Neumayr's (1873, p. 167, pl. XXXII, figs. 1-2), although, unfortunately, owing to lack of comparable material, I am compelled to judge the European forms only from their figures. The Kachh species, at the diameter of Neumayr's holotype, still has the comparatively small and irregular siphonal tubercles of Fontannes's larger specimen ; but, perhaps owing to the preservation of the Indian casts, the lateral tubercles of the periphery are less prominent, although there is still the peculiar flattened aspect of the ventral area, especially in the smaller example. At the same time, however, the whorl-side has become entirely smooth as in the true *T. pugilis*, whilst on the smaller paratype (pl. XIX, fig. 2) the ornamentation of the outer whorl (to a diameter of 70 mm.) shows good agreement with that of the Crussol form. The slightly less smooth inner whorls of the holotype, figured separately in pl. XIV, fig. 9b, do not seem to differ from the young specimen figured by Fontannes, and it is interesting to note that the minute peripheral tubercles are at first transversely elongated as in certain Haploceratids and only become clavate at larger diameters. These inner whorls show some resemblance to '*Oppelia nivalis* (Stoliczka) Uhlig (1903, p. 70, pl. VII, figs. 8a-c) from Spiti, already considered by Uhlig to be extraordinarily similar to Fontannes's form.

The suture-line external and internal, is well shown, but does not differ essentially from that of *T. kachhense*.

*Horizon*.—Middle Kimmeridgian, *eudoxus* (or *beckeri* ?) zone.

*Locality*.—Unrecorded. The holotype was labelled ' Dhosa Oolite ' (G. S. I. Colln. No. K  $\frac{22}{127}$ ).

TARAMELLICERAS JUMARENSE, sp. nov. (Pl. XVII, figs. 4a, b).

1924. *Neumayriceras* aff. *kachhense* (Waagen) Spath, p. 22 (No. 116).

This species obviously belongs to the group of *T. hauffianum* (Oppel), or what Wepfer (1910, p. 63) included in a comprehensive *Ammonites flexuosus spoliatus* (Quenstedt). De Riaz (1898, pl. XVIII, figs. 1a, b) wrongly referred one of these forms, slightly more coarsely ribbed than the Kachh example, to '*Neumayria oculata*' (Bean) ; but in the Divesian *Proscaphites* to which the Yorkshire species belongs, the periphery is altogether different. Unlike any of the other forms of *Taramelliceras* here described, the present species has a definite rim round its small umbilicus, bordered by a concave area, and the ribs are much more strongly bent or biconcave. At the peripheral ends the costæ are not tuberculate until a diameter of 50-60 mm. is reached, and the median row of tubercles along the siphonal line is much more prominent or raised than in any of the other *Taramelliceras* here described. These are irregularly spaced as in Oppel's

*T. bachianum* and their bluntness or rounding as in de Riaz's example already quoted, or in his *T. bukowskii* (1898, p. 48, pl. XVIII, figs. 4a, b, non Siemiradzki), may be due to defective preservation; but the Jumara form differs from both these species in its strongly flexiradiate ribbing and raised umbilical rim.

The highly complex suture-line is well shown and is comparable to that of Rians (Var) examples of the *callicerus* group (B. M. Nos. C5822, C12552-4) with seven similarly deeply-divided saddles. Oppel's type of *T. callicerus* is not closely comparable to the species here described, and his *T. hauffianum*, of the White Jura Beta, according to various topotypes before me (e.g. B. M. No. 52089a, b) is not only more inflated and lacks the umbilical rim, but shows ventro-lateral tubercles at an earlier stage. *T. pseudoculatum* (Bukowski, 1886, p. 115, pl. XXV, figs. 11-12) which is transitional from *Proscaphites*, also develops clavate ventro-lateral tubercles at an early stage and is more inflated; the small '*Oppelia*' *ledonica* de Loriol (1900, p. 43, pl. IV, fig. 1, 1902, p. 38, pl. III, fig. 7) seems to belong to the same group and has distant primary ribs.

The strongly bent ribbing of the East African form figured by Dietrich (1925, p. 10, pl. III, fig. 4) suggests comparison with the present species and the ventro-lateral tubercles seem to appear at a similarly late stage. The primary costation, however, is different and Dietrich's suggestion that his form might belong to the group of Kimmeridgian '*trachynota*' discussed above is difficult to understand, unless the drawing be faulty. Lewinski's *Taramelliceras* (*Neumayria*) *szajnochai* (1908, p. 429, pl. XXII, fig. 1) is less elegantly ribbed than *T. jumarense*.

*Horizon*.—Argovian, *transversarius* zone?

*Locality*.—Jumara (Blake Colln. No. 116), judging by details of preservation and matrix out of the same bed as Waagen's *Perisphinctes chlorolithicus* (pl. L, fig. 3) from north west of Soorka.

#### TARAMELLICERAS sp. ind.

##### 1925. *Neumayriceras* sp. Spath, p. 113.

A poorly preserved and fragmentary example of what I called a 'true *Neumayriceras*', assumed to come from the Upper Argovian Kantcote beds, shows superficial resemblance to one of Favre's forms (1877, pl. III, fig. 2), acknowledged by Dacqué (1910, p. 10) to be indistinguishable from the true *T. trachinotum*. There are, however, prominent primary ribs, more distinct than in Favre's form or in the Portuguese examples figured by Choffat (1893, pl. XVII, figs. 1-4), and three or four intermediate ribs; and considering that the periphery is incompletely preserved, it is impossible to state whether this specimen is really closely allied to the true *T. trachinotum* or to the homœomorphous Kimmeridgian forms. The costation, near the periphery especially, where it is more prorsiradiate, is different from that of any of over hundred *Taramelliceras* from Western Kachh, dealt with above, so that in spite of its imperfect preservation this species may be listed as different or even new. The presence of the strong primary ribs suggests comparison even with the group of '*Oppelia*'

*karreri*, Neumayr, not represented in Western Kachh. The outer ribs, however, are bent forwards as in *T. nodosiusculum* (Fontannes, 1879, p. 49, pl. VII, fig. 6), not straight, as in Favre's form (1877, pl. II, fig. 13).

*Horizon*.—Upper Argovian (or Lower Kimmeridgian?).

*Locality*.—Kantcote, above zone I (Blake Colln. No. 572). It is preserved in a red ironstone, like an example of *Epipeltoceras* cf. *bimammatum* in Mr. J. H. Smith's Colln. and the (presumably) Lower Kimmeridgian *Metahaploceras pascoei*, nov.

*TARAMELLICERAS NEREIFORME*, sp. nov. (Pl. XVI, figs. 11a, b, 12a, b; pl. XIX, figs. 3a, b).

As holotype of this species is taken the example figured in pl. XVI, figs. 11a, b, which may be briefly defined as intermediate between the typical *Taramelliceras* of the finely-ribbed *subflexuosum-holbeini* group on the one hand and, on the other, those *Metahaploceras* of the *strombecki-nereus-wenzeli* type that were included by Wepfer (1912, p. 63) in Quenstedt's *Amm. flexuosus falcatus* and *Amm. flexuosus crassatus*. The periphery is arched and has a distinct median line of tubercles, already at 20 mm. diameter, whilst the ventro-lateral tubercles also appear soon after, although the strongly falciradiate ribs are still feeble at the end. The last third of the outer whorl of the holotype belongs to the body-chamber and the lateral tubercles suddenly cease with the last suture-line, although there is still an isolated pair near the anterior end of the shell. The umbilicus is fairly wide, smooth, with vertical wall, but rounded edge; the suture-line does not seem to differ from that of immature *T. kachhense* from the same bed.

The completely septate paratype figured in pl. XVI, figs. 12a, b, still has a smooth, arched, periphery at 40 mm. diameter, and there are ventro-lateral tubercles only on the last quarter of a whorl. Except in its open umbilicus, this second example shows good agreement with a Mexican form figured by Burckhardt (1906, p. 76, pl. XVI, figs. 5-7) as *Oppelia* (*Neumayria*) cfr. *nereus*, Fontannes. The measurements of this and of Fontannes's two Crussol forms (1876, pl. VII, fig. 6 and 1879, pl. V, fig. 5) compare as follows with the Kachh species:—

Holotype (pl. XVI, fig. 11)	.	.	.	.	.	41	·53	·33	·20
Paratype I (pl. XVI, fig. 12)	.	.	.	.	.	42	·52	·32	·19
„ II (pl. XIX, fig. 3)	.	.	.	.	.	72	·50	·35	·18
Dumortier and Fontannes (1876)= <i>M. nereus</i>	.	.	.	.	.	47	·53	·31	·15
Fontannes (1879)= <i>M. nereus</i>	.	.	.	.	.	30	·53	·33	·14
Burckhardt (1906)= <i>M. cf. nereus</i>	.	.	.	.	.	59	·55	·33	·13

It will be seen that the true *Metahaploceras nereus* from the *tenuilobatus* zone differs in its slightly smaller umbilicus, but principally in having strong primary and secondary costation already on its inner whorls, also no ventro-lateral tubercles even at the end.

The large example with smooth outer whorl has a corroded periphery but at the beginning of the last whorl shows a few ventro-lateral and indistinct siphonal tubercles like the smaller paratype. In those forms of *Metahaploceras* that could be mis-

taken for the present species, these tubercles are elongated, not rounded; but if we concede that the tuberculate '*Taramelliceras*' periphery has appeared repeatedly in *Metahaploceras*, and in the young, not the adult, the occurrence of intermediate form of the *nereus* as well as the *kobyi* type need cause no surprise.

The inner whorls of *T. planifrons* are indistinguishable from those of the present species; but whilst in the former the sides remain smooth and the periphery becomes more and more tuberculate, *T. nereiforme* is lineate throughout the earlier whorls, and the lateral areas are more convex and the periphery is less tabulate.

*Horizon*.—Middle Kimmeridgian, *eudoxus* (or *beckeri* ?) zone.

*Locality*.—Fakirwadi. (J. H. Smith Colln.) Two of the five examples are worn and only doubtfully included here.

*TARAMELLICERAS SUBKOBYI*, sp. nov. (Pl. XV, fig. 8; pl. XVII, figs. 8a, b).

This species was at first considered to be the same as Choffat's (1893, p. 22, pl. XVI, figs. 13-14, pl. XVI bis, fig. 2) Portuguese form; but I have now discovered a topotype in the Geol. Soc. Colln. (B.M.) collected by D. Sharpe (see Quart. Journ. Geol. Soc., vol. VI, 1850, p. 175) and labelled "*Amm. boucaultianus* d'Orbigny, pl. 90," which shows that although the dimensions are the same, the differences are considerable, at least in so far as specific distinctions go in the accepted forms. There are altogether twenty-five examples available, including various transitions to the more inflated forms here referred to *T. franciscanum* (Fontannes). Since these again are connected by intermediate forms with *T. holbeini* and *T. kachhense*, they may be more correctly referred to *Taramelliceras*, although the resemblance to *T. kobyi*, showing a return to a *strombecki*-like outer whorl, and to the species described below as *Metahaploceras pascoei*, might suggest inclusion in *Metahaploceras*.

The dimensions of the holotype are: 83(75)—59—29—09. Compared with *T. kobyi*, which, according to Choffat's measurements is also more compressed, the venter is more tabulate, the sides are flatter, and the whorl-section is much thicker near the high umbilical wall. The ribbing also is less pronounced on the inner lateral area in *T. subkobyi* and shows greater resemblance to that of *T. hemipleurum* (Fontannes, 1879, p. 47, pl. VI, figs. 6-7), but this species has *compsa*- or *pugilis*-like inner whorls. In the present form, the inner whorls are more involute, the ventral area is merely arched and never tuberculate, and the ribs are uniformly thickened as in the adult, although comparatively coarser and more distant. The suture-line is highly complex (see pl. XV, fig. 8) but shows resemblance to that of *T. franciscanum*. The smaller fragment here figured, however, represents a slightly more compressed variety. It shows the elongated ventro-lateral tubercles, arched periphery and lateral smoothness of the larger whorls, but none of the examples now available shows the body-chamber.

'*Oppelia*' *dinarica*, Furlani (1910, p. 81, pl. IV) is closer to *T. kobyi* than to the present species and retains costation to a much larger diameter. The example attached by Fontannes (1879, p. 39, pl. V, fig. 5) to his earlier '*Oppelia*' *nereus* has

ornamentation like the fragment here figured (pl. XV, fig. 8), but at a corresponding size, the inner whorls of the present species are more coarsely ornamented.

*Horizon*.—Middle Kimmeridgian, *eudoxus* zone ?

*Localities*.—Thirteen of the twenty-three specimens in Mr. J. H. Smith's Colln. are from Fakirwadi; the remainder are unlocalised. Two weathered examples in the Blake Collection (Nos. 167, 184) are from "above zone I," Walakhavas.

Genus: METAHAPLOCERAS Spath.

METAHAPLOCERAS PASCOEI sp. nov. (Pl. VIII, figs. 3a, b).

1924. *Neumayriceras kachhense* (Waagen) Spath, p. 15.

The complete example here figured shows the peristome, and this is also preserved in a second example from the same bed, representing the body-chamber, from the last septum onward, but occupying slightly less than half a whorl. The umbilicus is small in the young but opens out in the adult whilst the mouth-border is greatly projected forward. This forms a raised lip, with rounded ventral and lateral lappets, and is followed by a groove, which is pronounced especially on the umbilical half of the lateral area and disappears on the venter. The latter is arched throughout, but broadens considerably on the body-chamber. This is smooth with the exception of about four pairs of ventro-lateral tubercles as in *Metahaploceras strombecki* (Oppel). The inner whorls are finely and closely costate and the ribbing seems to differ from that of the similar inner whorls of *M. otreropleurum* (Fontannes, 1879, p. 38, pl. V, fig. 4) merely in being still more distinctly sickle-shaped and also more curved near the umbilical edge. The suture-line is extremely complex and the external saddle is becoming undercut by the outer branches of the spreading lateral lobe, almost as in Streblitids.

*Taramelliceras kobyi* (Choffat), above discussed, has a similar smooth body-chamber, but the *flexuosa*-ornamentation of the inner whorls suggests closer affinity with the *franciscana*—*holbeini* group of *Taramelliceras* than with the present species. *Metahaploceras rebouletianum* (Fontannes, 1879, p. 42, pl. VI, figs. 3a-c) has different costation, with occasional bifurcation of the secondaries near the periphery, as in Streblitids, and does not seem to be so closely related to the present species as the same author's *M. otreropleurum*, already referred to, which, however develops distant ribbing on the outer whorl.

*Horizon*.—Kimmeridgian (lower ?=*tenuilobatus* zone ?)

*Locality*.—Jurun (Belemnite Marls, Blake Colln. Nos. 161-2). The preservation suggests the bed with *Acanthosphærites wynnei*.

Sub-family: STREBLITINÆ, Spath.

I previously stated (1925a, p. 118) that *Neochetoceras*, Spath (=group of *Ammonites steraspis*, Oppel), in spite of its resemblance to the true *Ochetoceras*, which it replaces in time, was probably derived independently from Haploceratids, likewise

*Streblites*, Hyatt, which *via* forms like *Oppelia steraspidoides*, Fontannes (1879, p. 20, pl. III, fig. 1), was connected with *Metahaploceras*. Some of the forms figured by Fontannes that R. Douvillé (1913, p. 64) had considered to be transitions between *Streblites* and *Ochetoceras* merely show superficial resemblance in the ornamentation of the outer whorls, and *Substreblites zonarius* (Oppel) is almost certainly not a continuation of the 'Streblites series,' any more than *Aconeceras*, Hyatt (= 'Adolphia,' Stolley), as suggested by Rollier (1923, pl. XXII). This author, however, already recognised that *Streblites* was a development of the same stock that produced also 'Neumayriceras,' not the *Ochetoceras* branch. *Uhligites*, Kilian, created for the group of *Oppelia* (*Streblites*) *krafti*, Uhlig, is also included here, as are the genera *Semiformiceras* and *Gymnodiscoceras*, Spath, on account of their finely lineate ornamentation and serrated keel, at least on the inner whorls. Whether *Cymaceras*, Quenstedt is more correctly referred to *Streblitinae* than to *Ochetoceratinae* is doubtful. Quenstedt (1887, p. 842) considered the genotype, *C. gümbeli* (Oppel) to be close to the true *canaliculatus* (*Ochetoceras*) and R. Douvillé (1913, p. 75) classed it with *Neochetoceras canaliferus* (Oppel) in his 'rameau *Ochetoceras*.' On the other hand Rollier (1909, p. 621) first put *Ammonites gümbeli* into *Petitclercia*, but in 1923 (pl. XXII) he also accepted *Cymaceras* ('*Cymatoceras*,' non Hyatt) as a lateral offshoot of *Ochetoceras*.

The only Kachh form of the present family described by Waagen is *Oppelia plicodiscus*. This includes the two *Streblites* recorded by the writer in 1924 (p. 6). They were stated to have the high external lobe and wide first lateral saddle of *Uhligites* but subsequently (1925a, p. 116) I considered the two fragments to belong probably to Waagen's species, which, as its author correctly stated, was close to *Streblites tenuilobatus* (Oppel). Since the exact horizon of the numerous Spiti forms referred by Uhlig (1903, pp. 31 *cf.*) to the group of *Oppelia* (*Streblites*) *krafti*, the genotype of *Uhligites*, is unknown, it is important to examine carefully whether any of these presumed later types actually occur in the Kachh Jurassic, or whether the group of *Oppelia plicodiscus* is more closely allied to the true *Streblites*. Fortunately a number of well preserved examples of Waagen's *Oppelia plicodiscus* are now available and there is no longer any doubt that they are true *Streblites* of Middle Kimmeridgian age.

Three more forms of *Streblites* are now recorded but the other genera of the present subfamily have not yet been found in Kachh.

#### Genus : STREBLITES Hyatt.

STREBLITES PLICODISCUS (Waagen). (Pl. XVI, figs. 2a-c; pl. XVII, figs. 1a-d).

1875. *Oppelia plicodiscus*, Waagen; p. 56, pl. x, figs. 5, 5a.

1903. *Oppelia* (*Streblites*) *plicodiscus*, Waagen; Uhlig, p. 38.

1914. *Oppelia plicodiscus*, Waagen; Smith, p. 812.

1924. *Streblites* sp. Spath, pp. 6 and 24.

1925. *Streblites plicodiscus*? (Waagen); Spath, p. 116.

Uhlig considered that by its very slightly domed sides and by the absence of tubercles, this form appeared to be more nearly related to *Oppelia indopicta* than to *O. frotho*.

or *O. tenuilobata*, but that the specimen described by Waagen was too small and too insignificant to permit of any definite conclusions being based upon it. Since over twenty, mostly well preserved examples are now available, including a complete range from smooth young to smooth adult which definitely show that Waagen's small holotype is identical with the large fragments previously recorded, it is clear that they are not true *Uhligites*. Waagen already had correctly stated that his species "was certainly nearly allied to *Oppelia tenuilobata*"; but the undercut external saddle and wide lateral lobe suggested comparison with the more evolute *Uhligites*, although there is no resemblance to the fully grown forms of this genus, with very characteristic costation. I stated that the original fragments, one of which is now figured (pl. XV, figs. 1a, b) were still septate at over 110 mm. diameter, without showing weakening of the continuous, serrate, *Streblites*-keel, and of the distant crescents on the outer half of the side. At diameters between 30 and 100 mm. the ornamentation is of the same type as that of *S. frotho* (Oppel, 1863, p. 199, 1862, pl. I, fig. 1) which differs only in having a more acute whorl-section already at small diameters.

At 110 mm. the thickness amounts to 24% of the diameter, but the ventral area is then comparatively sharpened, whilst the species described below as *S. habyensensis* retains a broadly arched periphery, although its whorl-thickness also is only 24%. Both the secondary ribs and the inner portions of the stronger primary ribs seem to disappear at larger diameters, but like the exceptional retention of the serrated keel in the example figured in pl. XVIII, fig. 1b, this is largely a matter of preservation and not often found in casts. The outer '*Oppelia*-crescents' are not visible in pl. XVII, fig. 1a, but in oblique illumination they are as distinct as in *Neochetoceras simile* Spath (1925a, pl. XV, fig. 4a). The suture-line agrees with that of typical *Uhligites* but is less complex than that of the more compressed form described below as *S. leptodiscus*.

*S. futtereri* (Müller, 1900, p. 523, pl. XV, fig. 1) may be identical with the present species, but it is poorly preserved and its suture-line was evidently drawn in wrongly. The small Somaliland *Streblites*? sp. which was compared by the writer (1925a, p. 116) to the East African form, on account of the supposed peculiarity in the suture-line, has nothing in common with the true *Streblites* here discussed. Another East African form, apparently of the same type as the present species, but with less close and delicate costation has been figured by Dietrich (1925, p. 10, pl. II, fig. 1) as *Streblites* cf. *planopicta*, Uhlig, but it is impossible to refer it definitely either to the late *Uhligites*, or the early costate and crenulate group to which belong the Mexican forms figured by Burckhardt (1912, pls. XI-XVI).

Toula (1907, p. 22, pl. V, fig. 6) has recorded what may be a comparable fragment, with wider ventral area than *S. tenuilobata* or *S. frotho*, from the *acanthicus* beds of Giesshübl. Typical examples of the latter species from the White Jura  $\gamma$   $\delta$  (e.g. B. M. Nos. 22333b, 37752), while showing great resemblance in side-view to the example figured in pl. XVII, figs. 1c, d, have not only a less rounded periphery, but a less finely subdivided suture-line, with a less undercut external lobe.

*Horizon*.—Middle Kimmeridgian, *eudoxus* zone (Katrol Beds). *S. frotho* has been persistently quoted from lower beds (Würtenberger, 1866, table to p. 68, Wanderer, 1906, p. 509, Engel, 1908, p. 412).

*Localities*.—Waagen's type came from south of Madapur, *i.e.*, from between Hamundra and Ler, whence Mr. J. H. Smith's collection includes three more examples. Twelve others are from Fakirwadi, probably also three more unlocalised specimens, whilst another came from Walakhavas. Of the two examples in the Blake Collection, one (No. 164) from the same locality, is labelled "above zone I;" another (No. 163) is from bed No. 2, Katrol Hill. One of the Fakirwadi examples, preserved in the characteristic gritty matrix, is labelled "two feet above Dhosa Oolite."

STREBLITES LEPTODISCUS, sp. nov. (Pl. XVI, figs. 1a, b).

1914. *Oppelia* sp. (*Tenuilobata*); Smith, p. 812.

This species, in its compression and smoothness, recalls those forms of the White Jura Delta that have been included by Quenstedt in a comprehensive *Ammonites pictus* (Knorr), especially the forms figured in pl. CXIX, figs. 4, 18-21, pl. CXX, figs. 5, 13, representing the involute, smooth type. Various German and Swiss Jura examples before me (*e.g.*, B. M. Nos. 22334a, b; C27953-5) have the same compressed whorl-shape, small, almost closed, umbilicus, flat and smooth sides, with the fine secondary ribs near the periphery seen only in well preserved examples. But the suture-line of this true *S. pictus* is that of the *tenuilobatus* group, with a less spreading lateral lobe than the present form and with the external lobe less undercut by the outer branches of the lateral lobe; also its periphery is that of *S. levipictus* (Fontannes, in Dumortier and Fontannes, 1876, p. 55, pl. VII, fig. 5). In the present form the ventral area is narrowly rounded and the keel, where preserved, is much broader than in Fontannes's species. *S. weinlandi* (Oppel) also has the periphery, with its narrow keel, more definitely separated from the ventral area; and since Oppel's type figure (1863, p. 198, pl. LIII, figs. 1a, b) in any case shows little similarity to the present species, it is advisable not to suggest a possibly erroneous relationship by attaching the Kachh form, even with doubt, to Oppel's species.

The forms figured by Fontannes in 1879 (p. 22, pl. III, figs. 3-4) as *Oppelia levipicta*, owing to their lenticular whorl-section are still less closely comparable to the present species than is his earlier type; likewise the Somaliland form described by the writer (1925a, p. 115, pl. XV, figs. 8a, b), which has a continuous keel, comparatively open umbilicus, and a low external lobe, and in spite of its superficial resemblance to *S. weinlandi*, may not even be a *Streblites*.

*S. plicodiscus* is less close to the present form on account of its *frotho*-ornamentation, well shown in fig. 2a of pl. XVI and fig. 1c of pl. XVII. The suture-line is also less subdivided in *S. plicodiscus*, as can be seen on comparing the lateral lobes in figs. 1a and 2b of pl. XVI. On the other hand, the large example of Waagen's species represented in fig. 1 of pl. XVII, with distant outer crescents of the *Neochetoceras* type (not visible in the photograph) has a similar peripheral aspect but is more inflated,

its thickness being 24% of the diameter, as against 20% in *S. leptodiscus*. In the para-type figured in pl. XVI, fig. 1 b, the periphery is worn and the keel is missing.

The forms of *Uhligites*, with similarly complex suture-lines, have evolute inner whorls and are more inflated. Of the Mexican species described by Burckhardt, *Streblites striatus* (1912, p. 57, pl. XI, figs. 5, 13-16) is involute and finely ribbed, but is also far less compressed than the present species and, besides, has a crenulate keel and a simpler suture-line. The Russian *Oppelia weinlandi* and *O. tenuilobata* figured by Pavlow (1886, p. 88, pl. VIII, figs. 6-7) have already been characterised by Uhlig (1903, p. 38) as doubtful, and are probably not referable to *Streblites* at all. Sinzow's *Oppelia sublevipicta* (1888, pl. II, fig. 20) on the other hand, belongs to those transitional forms that connect the Argovian group of *Proscaphites sarasini* (de Loriol) with the parent stock *Lorioloceras*, in which *Streblites*-like forms (e.g., *L. inermis*, Quenstedt sp.) were produced.

*Horizon*.—Middle Kimmeridgian, *eudoxus* (or *beckeri* ?) zone.

In Wurtemberg, *Streblites pictus* and *S. weinlandi* are common fossils of the White Jura Delta (see Engel 1908, p. 425). Lory (1904, p. 643) recorded *Streblites levipictus* (Fontannes) from still higher beds.

*Localities*.—Five specimens are from Ler, the holotype (unlocalised) is probably from Fakirwadi ('Katrol Beds,' J. H. Smith Colln.).

#### STREBLITES HABYENSIS, sp. nov. (Pl. VIII, fig. 1).

This species is based on the large example figured in pl. VIII, fig. 1 of dimensions: 140—59—24—06, and it may be briefly defined as a more coarsely costate and more inflated development of the same stock that produced *S. plicodiscus*. It is thus intermediate between this species and *S. sp. nov.*? discussed below, which may yet turn out to be merely a variety of the present form. The differences, however, are at least as important as those between corresponding 'species' of *Uhligites*; and in view of Uhlig's (1903, p. 38) remarks concerning the Kachh species of *Streblites*, and the fact that they may not be strictly contemporaneous, it seems advisable to list them as independent forms.

In the present species the primary ribs are distant and coarse, about 9 per whorl, but closer on the inner volutions. There are some transitional examples, resembling the large *Streblites* cf. *frotho* (Oppel) figured by Quenstedt (1888, pl. CXX, fig. 8) as *Ammonites pictus*, which differ from *Streblites plicodiscus* merely in having more distant secondaries and a more inflated whorl-section. These intermediate forms could perhaps be taken to be identical with *Streblites mediogranosus* (Fontannes, 1879, p. 24, pl. III, figs. 8a, b), but in the text this is described as even thinner than the typical *S. frotho*, whereas the Kachh forms all have a widely arched periphery, not much narrower than the region of greatest whorl-thickness at the middle of the side. In the holotype, however, the outer whorl, after 110 mm. diameter, tends to become compressed again peripherally and the ventral aspect then is that of the (considerably smaller) example of *S. plicodiscus* figured in pl. XVII, fig. 1b.

The suture-line is corroded in the holotype but shows quadrifid subdivision of the first lateral lobe with the three saddle-like leaflets of its base placed obliquely and its two longest lateral branches in a straight line above the summits of these three leaflets, an arrangement that is found in *S. leptodiscus*, and in *Uhligites indopictus* and *U. planopictus* (Uhlig, 1903, pl. III, figs. 3c, 4d). The former species of *Uhligites*, with ornamentation somewhat similar to that of *S. habyenssis*, has an open umbilicus and at the same diameter would probably have acquired the characteristic *Uhligites* ribbing, so typically developed in *U. hectori* Spath (1923, p. 298, pl. XVII, fig. 1) and somewhat reminiscent of that of *Mazapilites*.

*Horizon*.—Middle Kimmeridgian, *eudoxus* zone.

*Localities*.—The holotype is from Habye, and four examples are from Fakirwadi ('Katrol Beds,' J. H. Smith Colln.) Two of the latter are transitional to *S. plicodiscus*, also one example from Ler.

*STREBLITES* sp. nov.? (Pl. XVI, fig. 6).

This species differs from the last in its greater whorl-thickness and closely-set primary ribs, which are not of the *frotho*-type (seen also in *S. plicodiscus*), but are gently biconvex as in the early Mexican *Streblites* figured by Burckhardt (1912, pls. XI-XV).

On the other hand, as in *S. habyenssis*, there is a more definite separation of the secondaries from the primary ribs, some of which are very prominent and club-shaped, and thicken continuously from the edge of the very small umbilicus to about the middle of the side, where they subdivide. On a fairly well-preserved, second, fragment of a quarter of a whorl, there are five principal ribs, three prominent and two feebler ones in between, and twenty-five slightly crescentic secondaries. This type of ornamentation is almost more typical of *flexuosi* than of *tenuilobati*, but the nearly closed umbilicus, and the *Streblites* suture-line are decisive. Moreover, the larger specimen here figured has a serrated *Streblites* keel, like the large example of *S. plicodiscus* figured in pl. XVII, fig. 1b, but the periphery, of course, is much wider and the whorls are more inflated. '*Streblites*' *nouhuysi* (G. Boehm, 1904, p. 29, pl. III, fig. 3) has a similarly wide siphonal band, but is a true *Uhligites* and belongs to quite a different stock, as does *U. motutaranus* (G. Boehm, 1911, p. 17, pl. II, figs. 5a, b) which has somewhat similar primary costæ on the last quarter of its outer whorl. The proportions are: 132—57—26—06, and it will be seen that the whorl-thickness exceeds that of *S. habyenssis* by only 2%. The suture-line is also closely similar, so that ornamentation alone may have to be relied on for specific distinction.

*Horizon*.—Middle Kimmeridgian, *eudoxus* zone.

*Locality*.—Habye (pl. XVI, fig. 6), also an unlocalised fragmentary example (J. H. Smith Colln.).

*APTYPCHI* (ad fam. Oppelidæ).

1875. *Aptychus* of *Oppelia*. Waagen, p. 59, pl. xi, figs. 8a-c.

1912. *Aptychus* of *Oppelia*. Smith, p. 714.

Waagen figured an *Aptychus* of the group of the *imbricati* from an unknown Kachh locality and stated that its large size indicated the existence, in the Katrol Beds, of

yet another species of *Oppelia*. A similar fragmentary specimen (No. 8) from a soft, yellow, sandstone although labelled by Mr. J. H. Smith:—"Dhosa Oolite or *athleta*, Fakirwadi," may also be referable to Oppel's *Aptychus euglyptus* (1863, pl. LXX, figs. 4-5). A third example (No. K  $\frac{22}{131}$ ), with slightly closer lamellæ and said to be from 'Samatra Beds,' shows a harder and more gritty matrix and is indistinguishable from Solnhofen examples of the *steraspis* zone. According to Mr. Smith (1912b, p. 1351) there is 'no sign of Katrol beds at Samatra,' but the numerous *Sublunuloceras* of the *dynastes-lavrense* type that occur at this locality are less likely parent forms for this *Aptychus* than Katrol Taramelliceratids. A fourth *Aptychus*, in the Blake Collection (B. M. No. C27540) already recorded (1924, pp. 5 and 23) as from the '*athleta* beds' of Jikadi (bed 22), unfortunately, cannot even be definitely referred to the *imbricati*, but it is also associated with *Sublunuloceras*. It is too wide for *Aptychus hectici*, Quenstedt (1887, pl. LXXXII, figs. 51-57, etc.), but only shows the concave side and is too firmly embedded in the matrix (yellowish limestone) to be developed. *Cellulosi* as well as *imbricati* may show similarly curved inner striæ, so that the example cannot be definitely determined.

Apart from this last doubtful specimen, the three lamellose *Aptychi* so far known may then be considered to have belonged to Oppelids and correspondingly large *Metahaploceras* and *Taramelliceras* are now known from the Katrol Beds. Quenstedt (1887, p. 903) also attributed the plicated *Aptychus lamellosus* (Parkinson) Oppel, to *Ammonites flexuosus* (= *Taramelliceras*), but it is quite possible that the three Kachh forms belonged to *Fontannesella* or *Neochetoceras* of higher beds from which no ammonites are yet known. The distinctions between the lamellose *Aptychi* recorded throughout the upper Jurassic are however, perhaps, too inappreciable to be of value to the stratigraphical palæontologist, apart from the fact that they are also apparently extremely rare. The three Cuban "species" of imbricate *Aptychi* recently described by M. O'Connell (1921) with general similarity to *A. euglyptus* are said to occur in beds with only rare small forms of Haploceratids.

I have mentioned before (1925a, p. 153) that in the Upper Argovian to Lower Kimmeridgian Montejunto and Abadia Beds of Portugal cellulose *Aptychi* are far more common than *imbricati* and that in the Middle Kimmeridgian Giesshübl Beds the *imbricati* are far more numerous than the *cellulosi*. It is noteworthy that no example of *Aptychus* of the division *cellulosi*, so abundant also in the Kimmeridgian of Somaliland, has yet been found in Kachh.

#### Family: *HAPLOCERATIDÆ*, Zittel emend. Spath.

The typical genera of this family are *Haploceras*, Zittel, and *Lissoceratoides*, Spath. They replace the Lower Oolitic Lissoceratidæ which were similarly replenishing Oppelids from the persisting liostromatic (Phylloceratid) root-stocks, and are characterised by more or less smooth shells with arched venters and suture-lines that show regularly trifid principal lobes and bifid saddles. They differ from those of *Sowerbyceras* (the dominant ammonite in Mediterranean deposits of Upper Jurassic age) merely in loss

of phylloid terminations, a common phenomenon with increasing complexity. **Holcolissoceras**, gen. nov. created for *Lissoceras pintacudæ*, De Stefani, 1884, p. 30, pl. II, figs. 11a, b, is transitional between *Sowerbyceras* and *Haploceras*, yet later than any of the Katrol forms here described. With these typical Haploceratids must be grouped the genus *Glochiceras*, Hyatt (genotype:—*Amm. nimbatus*, Oppel), which includes the group of *Amm. fialar*, Oppel, well represented in Kachh, but probably also some degenerate (dwarf) offshoots of other Oppelid stocks that cannot at present be satisfactorily separated. Quenstedt's polyphyletic '*Amm. lingulatus*,' discussed by Wepfer (1912, p. 33) illustrates the difficulty of correctly placing these small eared forms found at so many horizons.

With these typically unornamented forms I formerly grouped certain trachyotracous offshoots, several of which are now transferred to the family Taramelliceratinæ. *Hildoglochiceras*, however, may still be retained in the present family on account of its resemblance to *Glochiceras*, but it develops a continuous keel. *Metahaploceras* again is excluded although it is probably polyphyletic and comprises transitions to Streblitinæ (*M. rebouletianum* and *M. subnudatum*, Fontannes sp.) as well as to Taramelliceratinæ (*M. strombecki* Oppel sp.). *Mazapilites*, Burckhardt, really requires a subfamily of its own (subfam. Mazapilitinæ, nov.).

One of the Kachh species, namely Waagen's '*Haploceras*' *propinquum*, resembles a Spiti Shale form described by Uhlig as *Haploceras dieneri*. This is an entirely new but as yet incompletely known Haploceratid, whilst *Glochiceras*? *propinquum* is probably transitional from the typical *fialar* group to *Hildoglochiceras*. To this last genus is also now assigned Waagen's *Oppelia plana* which shows great resemblance to *Hildoglochiceras latistrigatum* (Uhlig), but there is only one doubtful *Haploceras*; for the small and incomplete example described by Waagen (1875, p. 43, pl. VII, figs. 4a, b) as *Haploceras* cf. *tomephorum*, Zittel, and recorded again by Oldham (1893, p. 224) is probably an immature Physodoceratid, to judge by its wide and low saddles. It came from the ferruginous bed with *Acanthosphærites wynnei* of Jadura, south of Bhuj, just above the Umia[-Katrol] conglomerate.

Genus: HAPLOCERAS Zittel.

HAPLOCERAS sp. ind. juv.

1924. '*Haploceras*' (*Glochiceras*?) sp., Spath, p. 6.

The single specimen in the Blake Collection is too immature and poorly preserved to be identified specifically but in whorl-shape there is general resemblance to *Haploceras carachtheis* (Zeuschner) as figured by Zittel (1868, pl. XV, figs. 1-3). The suture-line has a deeper external lobe than any of the *Glochiceras* here recorded, but it is also more indented (at a diameter of only 11 mm.) than that of Zeuschner's species, so that the example may even be a young *H. elimatum* (Oppel), with the flattening of the whorl-sides due only to weathering.

Horizon.—Umia Group, Tithonian, *transitorius* zone?

*Locality*.—North of Moondan ("Small Bed"), Blake Colln., No. 605, associated with *Ptychophylloceras tithonicum* and *Virgatosphinctes* spp.

Genus: GLOCHICERAS Hyatt.

GLOCHICERAS DEPLANATUM (Waagen). (Pl. XVI, fig. 3; pl. XVII, figs. 9a, b).

1875. *Haploceras deplanatum*, Waagen; p. 44, pl. xi, figs. 9a, b.

The writer pointed out on a previous occasion (1925, p. 13) that the inner whorl in Waagen's fig. 9b was wrongly restored, *i.e.*, drawn more inflated than it really is. It was thus clear that Lemoine's *Lissoceras deplanatum* (1910, p. 13), the whorl-section of which was stated to be very close to that of Uhlig's *Haploceras indicum* (1903, p. 21, pl. III, figs. 2a-d), was not identical with the Kachh form. The additional material available, including specimens much larger than the holotype, indicates that with increase in size the whorl-thickness becomes even less and in some more inflated examples that, however, do not seem to be sufficiently distinct to be separated as a variety, the thickness is only 26% as against 33% in Uhlig's species. The measurements compare as follows:—

Waagen's holotype	. . . . .	28	·48	·27	·23
Pl. XVII, fig. 9	. . . . .	70	·45	·24	·24
Pl. XVI, fig. 3	. . . . .	67	·44	·25	·24
J. H. Smith Colln. ('K')	. . . . . (at)	20	·50	·30	·22
Ditto	. . . . . (at)	52	·48	·23	·23
Inflated form ('F')	. . . . .	55	·46	·26	·25

The spiral groove is pronounced in only one example (pl. XVI, fig. 3) and generally does not appear until a diameter larger than that of Waagen's type is reached. Some of the larger examples show fine crescents near the periphery but this is obviously dependent on the preservation and in two cases the ornamentation is more distinct on the chambered portion than on the body-chamber.

*Haploceras complanatum*, Burckhardt (1919, p. 15, 1921, pl. IV, figs. 13, 15-17) is more inflated and its suture-line is comparatively simple. Burckhardt considered that Waagen's figure of the suture-line of the Indian form might be inaccurate, but from the larger example now figured (pl. XVII, fig. 9) it will be seen that the elements are indeed as deeply divided as drawn by Waagen. There is great variability, however, and in some examples (pl. XVI, fig. 3) the saddles are more broadly-stemmed, a feature that becomes especially noticeable on weathering. In the Madagascan examples of *Haploceras elimatum* (Oppel), recorded by myself (1925, p. 13, pl. I, figs. 1a-c), which were thought to be probably identical with Lemoine's (1910, p. 13) numerous examples wrongly referred to the present species, the suture-line is similarly divided and in its slender saddles resembles that of *H. stazycki* (Zeuschner), as figured by Gemmellaro (1873, pl. VII, fig. 3). The suture-line of Waagen's small type is already far more subdivided than that figured by Lemoine (text-fig. 8, p. 14) apparently from a larger example.

*Horizon*.—Middle Kimmeridgian, *beckeri* zone ?

*Locality*.—Waagen's type came from the Charwar Range, south of Bhuj, and those of the thirteen specimens in Mr. J. H. Smith's Collection that are localised are also from Fakirwadi and Walakhavas, and are preserved in the same phosphatic grit. The larger and more typical of the figured examples, in a different (ironstone) matrix is from Habye.

GLOCHICERAS cf. FIALAR (Oppel).

cf. 1906. *Haploceras fialar* (Oppel) Burckhardt, p. 77, pls. xxiii and xxiv.

A weathered cast of a smooth *Glochiceras*, 33 mm. in diameter, by its cross-section and peripheral notches, seems to be referable to this species in its more comprehensive interpretation. It is septate to the end and shows well the characteristic suture-line, with a high lateral saddle. This agrees with the illustrations given by Burckhardt (1906, pls. XXIII and XXIV) for certain Mexican forms of *Glochiceras*, but not with Zittel's (1868, pl. XV, figs. 3a, b) drawings of the Tithonian *Haploceras carachtheis* (Zeuschner), which has a similar whorl-shape, and which has recently again been listed by Jekelius (1925, p. 67) together with *Glochiceras fialar* from the *acanthicus* zone of Brasso in Hungary. Toucas's Ardèche examples of *Haploceras carachtheis* (1890, p. 577, pl. XIII, figs. 5a, b ; p. 594, pl. IX, figs. 7-8) are more inflated than the Kachh specimen, and Retowski's Crimian form (1893, p. 242, pl. IX, figs. 10-11) is greatly compressed, whilst the var. *subtilior* Zittel (1870, p. 54, pl. III, fig. 11) has more convex sides, especially near the umbilical border. These forms, according to M. Gemmellaro (1922, p. 76, etc.), moreover, belong to later faunas.

The resemblance to a number of White Jura examples of *Glochiceras fialar* in the British Museum, more inflated than the example previously (1925, p. 114) referred to, is however, equally great, and considering the imperfect preservation of the specimen and its resemblance to other forms of *Glochiceras* here described, in its high external lobe, it may be excluded from the genus *Haploceras* in spite of superficial similarity. Moreover, another imperfect specimen, which differs merely in a less tabulate periphery, connects this not only with the more inflated varieties of *G. deplanatum*, already referred to, but probably also with the ribbed form discussed below as *G. aff. somalicum*. Again *Haploceras carachtheis*, which is the only species of *Haploceras* to which the present example could be attached on account of similar whorl-shape, has even been brought into relationship with Oppel's *Amm. wöhleri* and Canavari's genus *Eurynoticeras*, an assemblage of which there is no trace in Kachh. The immature *Haploceras* sp. ind. listed above is easily distinguished by its slender external saddle and deep siphonal lobe.

*Horizon*.—Middle Kimmeridgian, *beckeri* zone ?

*Locality*.—Fakirwadi (Katrol Beds).

GLOCHICERAS sp.

A fragmentary cast with the external and internal suture-lines well displayed has a compressed whorl-section, flat, smooth, sides, and transverse peripheral notches,

The arched ventral area is only very slightly narrower than the region of greatest whorl-thickness near the vertical but rounded umbilical slope. There is superficial resemblance to the compressed Crimean form figured by Retowski (1893, p. 242, pl. IX, figs. 10-11) as *Haploceras carachtheis* (Zeuschner), but the siphonal bullæ are prominent already at a very small diameter, and persist throughout, so that the specimen is certainly not referable to the Crimean form which, moreover, is said to have *Haploceras-lobes*, as described by Zittel. In the present form, the suture-line is less complex than in *G. deplanatum* but is more subdivided and has slenderer saddles than that of *Hildoglochiceras planum*. The form probably belongs to the *fialar* group and the absence of a spiral groove and ribbing may be due partly to its defective preservation, partly to its small size; but the specimen cannot be identified with any of the other forms of *Glochiceras* here recorded. The example last described has a less compressed whorl-section, also '*Oppelia*' *perglabra*, Steuer (1897, p. 74, pl. VII, figs. 13-15), which, moreover, does not show peripheral notches.

*Horizon*.—Middle Kimmeridgian ?

*Locality*.—Unrecorded; Katrol Beds, probably of Fakirwadi.

#### GLOCHICERAS aff. SOMALICUM Spath.

? 1906. *Haploceras* aff. *fialar* (Oppel) Burckhardt pars, p. 80, pl. xx, figs. 10-11 ?

1925. *Glochiceras somalicum*, Spath, p. 114, pl. xvi, fig. 7.

A fragment showing about four camerae (with the last two suture-lines approximating) and part of the body-chamber closely resembles in side-view the Mexican examples figured by Burckhardt (pls. XIX and XX), but the venter is slightly more narrowly arched, the groove is wider, and the umbilical edge is sharply defined. The true *G. fialar* as represented by Fontannes (1879, p. 8, pl. II, fig. 1) and by de Loriol (1877, pl. II, figs. 3-5) is far less distinctly grooved, has less pronounced crescentic ribbing and a more inflated whorl-section with wide and flattened venter.

The '*Oppelia flexuosa vermicularis*' figured by Wepfer (1910, p. 31, pl. II, fig. 4) has similar, if finer outer crescents and the lateral canal is not distinct in the illustration. It was recognised already by Berkhemer (1922, p. 71) that this form has nothing to do with Quenstedt's original (1888, p. 1091, pl. CXXVI, fig. 7), probably referable to *Fontannesiella thoro* (Oppel); but *F. percevali* (Fontannes, 1879, p. 33, pl. IV, figs. 10a, b) also differs from the present form merely in the possession of peripheral tubercles. It is interesting to note that according to Berkhemer (1922, p. 78) and Fischer (1922, p. LIII) these forms occur in the *steraspis* zone (*xio-wepferi* horizon), whereas Bataller (1922, p. 97) listed a 'Zone of *Lissoceras fialar*' (and *Simoceras doublieri*) as 'Sequanian'. Fragments like the present may thus occur at any horizon between the *tenuilobatus* and *steraspis* zones, but from Ambal, Somaliland, whence came the type of *Glochiceras somalicum*, I have now before me numerous young *Haploceras* of the group of *H. transatlanticum*, *zacaticanum* and *mexicum*, Burckhardt, associated with *Phy-sodoceras* cf. *cyclotum* (Oppel), *Sutneria* spp., *Subdichotomoceras* spp. and the first Soma-

lil and lamellose *Aptychus*, all suggestive of the higher *Waagenia hybonota* beds, or the *stereaspis* zone, not the lower *beckeri* zone of the ammonitiferous (basal) Katrol beds.

The fact that in the present fragment the whorl-section is compressed near the venter and thickest at the inner (umbilical) half of the lateral area, makes it possible that it represents an extreme form of *G. deplanatum*, in which not only ribbed, but widely sulcate forms have been noticed. There is considerable more resemblance, however, to the Somaliland form previously figured, than to Waagen's type of *G. deplanatum*. The second doubtful example referred to above under *G. fialar* has the peripheral portion of the outer whorl corroded, but shows traces of ribs and may, perhaps, be as close to the present form as it is to *G. fialar*.

*Horizon*.—Middle Kimmeridgian, *eudoxus* zone ?

*Locality*.—Unrecorded ; probably Katrol beds of Fakirwadi (J. H. Smith Colln.).

#### GLOCHICERAS ? PROPINQUUM (Waagen). (Pl. XIX, fig. 6).

1875. *Haploceras propinquum*, Waagen, p. 45, pl. xi, figs. 4a, b.

1903. *Haploceras propinquum*, Waagen ; Uhlig, p. 20.

1914. *Haploceras propinquum*, Waagen ; Zwierzycki, p. 51.

Waagen's original is still the only specimen available, but his figure and description enable it to be distinguished from all the species of the *fialar* group. Waagen called his specimen 'fully grown,' but it is septate to the end, and the suture-line is well displayed and shows resemblance to that of *Hildoglochiceras* ? *planum* (pl. XIX, fig. 5), except in the subdivision of the first lateral saddle and the presence of a fourth auxiliary lobe. It is now figured (pl. XIX, fig. 6) for comparison with that of *Hildoglochiceras kobelliforme* (pl. XIII, fig. 17).

In side-view there is some resemblance to at least one of the '*Haploceras fialar*' (non Opper) figured by Burckhardt (1906, pl. XIX, fig. 15) but the narrowly rounded periphery, which tends to actual sharpening on the outer whorl, is very distinctive. This makes the present species somewhat transitional to *Hildoglochiceras*, and it is probable that Uhlig's *Haploceras dieneri* (1903, p. 19, pl. VII, fig. 9) is a much closer ally. Uhlig thought his species to be assignable to a new genus and the narrow lateral lobes alone might justify separation from the present species in spite of almost identical proportions and external appearance. But we must agree with Uhlig that his new Haploceratid group is as yet unknown in detail, and some African examples lately described by Zwierzycki, and united with the Chidamu species, make it doubtful whether this is really generically distinct from *Hildoglochiceras*. The dubious *Glochiceras* ? figured by the same author (1914, p. 50, pl. V, figs. 5-6) as *Haploceras priscum* does not appear to be close to the present species and has a very different suture-line.

*Horizon*.—Middle Kimmeridgian.

*Locality*.—South side of Khera Hill. This species and *Torquatisphinctes sparsiplicatus* were especially mentioned by Waagen (p. 232) as coming from the lowest bed of the Katrol Sandstone.

Genus : *HILDOGLOCHICERAS* Spath.

*HILDOGLOCHICERAS* *KOBELLI* (Oppel).

1875. *Harpoceras kobelli* (Oppel) ; Waagen, p. 72, pl. xiii, figs. 11a, b, 13a, b.  
 1885. *Ludwigia kobelli* (Oppel) ; Haug, p. 691.  
 1893. *Hecticoceras* (*Lunuloceras*) *kobelli* (Oppel) ; Bonarelli, p. 96.  
 1903. *Hecticoceras kobelli* (Oppel) ; Uhlig, p. 25, pl. lviii, figs. 3-4.  
 1906. *Hecticoceras kobelli* (Oppel) ; Lemoine, pp. 144, 5, 7, 9.  
 1910. *Hecticoceras kobelli* (Oppel) ; Lemoine, p. 10, pl. iv, fig.  
 1914. *Haploceras* (*Hecticoceras*) *kobelli* (Oppel) Zwierzycki, p. 46, pl. v, figs. 1, 2.  
 1924. *Hildoglochiceras kobelli* (Oppel) Spath, pp. 6 and 19.  
 1925. *Hildoglochiceras kobelli* (Oppel) Spath, p. 160.  
 1925. *Hecticoceras* (*Lunoloceras*) *kobelli* (Oppel) Dietrich, p. 21.

Lemoine drew attention to the variability of this well-known species, but erroneously referred Waagen's figs. 11 and 13 and some of his Madagascan forms to the variety '*kobelliforme*,' discussed below. He also considered Uhlig's *H. latistrigatum* (the genotype) to be merely a variety, and we may go further and take it to be only an individual variation, since the width of the groove in the group of *Glochiceras fialar* is equally variable. But in any case it is necessary to separate the *kobelli* group from *Hecticoceras* with which it has no more connection than it has with the later homœomorphous offshoot *Sanmartinoceras*, Bonarelli and Nagera, of the Aptian.

*Horizon*.—Upper Kimmeridgian ? ('*Zamia*' Shales). I had formerly described the ammonites of the corresponding *Trigonia Smeei* beds of Tanganyika as of Middle Kimmeridgian age ; Dietrich (1925, p. 21) listed them as Upper Kimmeridgian to Lower Tithonian, but the exact age of *H. kobelli* is not yet known. Dietrich called this species one of the most characteristic forms of the Katrol Beds, but the *Zamia* Shales (of Wynne) at Nurrha, where *H. kobelli* was collected, are certainly later than various *Oomia* fossils listed by Waagen.

*Locality*.—South-west of Nurrha ('Middle Katrol Group'). Waagen recorded another example, not seen by the writer, out of the same beds from north-east of Gudjinsir, but preserved in a red ferruginous sandstone nodule, the usual matrix of Lower Katrol Beds.

*HILDOGLOCHICERAS* *KOBELLIFORME* (Bonarelli). (Pl. XIII, fig. 17).

1875. *Harpoceras kobelli* (Oppel) var. Waagen, p. 72, pl. xiii, figs. 12a, b, only.  
 1887. *Harpoceras kobelli* (Oppel) var. Nøetling, p. 20.  
 1893. *Hecticoceras* (*Lunuloceras*) *kobelliforme*, Bonarelli, p. 95.  
 1903. *Hecticoceras kobelliforme*, Bonarelli ; Uhlig, p. 24.  
 1910. *Hecticoceras kobelli* (Oppel) pars, Lemoine, p. 10.

On the examination of more abundant material it may be found that this form can not be accepted as specifically different from the species last described, Bonarelli having been misled by Waagen's erroneous figure. There is no trace of costation on the type,

which might, but for the presence of part of the body-chamber, have been considered to represent merely the inner whorls of an unusually delayed example of *Hildoglochiceras kobelli*. Oppel's smaller example, however, refigured by Uhlig, at a corresponding diameter, shows already the characteristic ribs and its whorl-section is less compressed, whilst *H. latistrigatum* (Uhlig) is differently coiled and has a much wider spiral groove. Bonarelli, who also put the present species into the "Lower Oxfordian (*transversarius* zone ?)", compared it to *Brighia nodosa* (Quenstedt) var. *solinophora*, Bonarelli, and the resemblance extends even to the suture-line which is now figured. It differs very little from that figured by Lemoine (p. 12, fig. 6) on the one hand and the suture-lines of *H. ? planum* and *Glochiceras ? propinquum* on the other.

The two examples referred by the same author to Bonarelli's form are probably not identical with the smallest Kachh specimen that Bonarelli had in view when creating the present 'species,' but Lemoine seems to have been under the impression that all Waagen's forms had been separated from *H. kobelli*.

Noetling thought he recognised in his '*Harpoceras*' *kersteni* an early representative of the group of *H. kobelli*, till then known only from India; but the Syrian species probably is merely an immature *Eochetoceras* of the *divense-hersilia* group.

It is doubtful whether *Haploceras* (*Hecticoceras*) *spira*, Zwierzycki (1914, p. 49, pl. V, figs. 11-13) is specifically distinct from *H. kobelliforme*. Its author compared it to *H. latistrigatum*, but not to the much more involute species here discussed which has dimensions: 35—37—25—34 as against 33—40—27—32 in *H. spira*.

*Horizon*.—Upper Kimmeridgian ? ('*Lamia*' Shales).

*Locality*.—South-west of Nurrha (Middle Katrol Beds).

#### HILDOGLOCHICERAS ? PLANUM (Waagen). (Pl. XIX, fig. 5).

1875. *Oppelia plana*, Waagen; p. 56, pl. xi, figs. 3a, b.

The fragmentary example described by Waagen is entirely septate and represents the inner whorls of a larger form, probably of the *kobelli* group, but its preservation is too defective for accurate identification. The venter is rounded at first and then tends to become acute but unfortunately it is corroded on the outer whorl. Similarly at a diameter of under 20 mm. already there are traces of crescents on the outer area, but these also cannot be followed owing to the imperfect preservation at a larger diameter. The suture-line is distinctly visible near the beginning of the outer whorl and a comparison of fig. 5 of pl. XIX with fig. 17 of pl. XIII, representing the suture-line of *Hildoglochiceras kobelliforme*, will show that they are closely similar. Waagen described the suture-line as very simple and barely ramified, but although the saddles are less subdivided and more broadly-stemmed, the suture-line is not greatly simplified in comparison with that of *Glochiceras ? propinquum* or even *G. deplanatum*.

On first examining large examples of the latter species such as that figured in pl. XVI, fig. 3, with broad groove, I considered them to represent the adult of the species here discussed. This view, however, proved untenable; for apart from the differences

in the suture-lines, *G. deplanatum* does not acquire a spiral groove until a comparatively late stage and never shows a tendency to sharpening of the periphery.

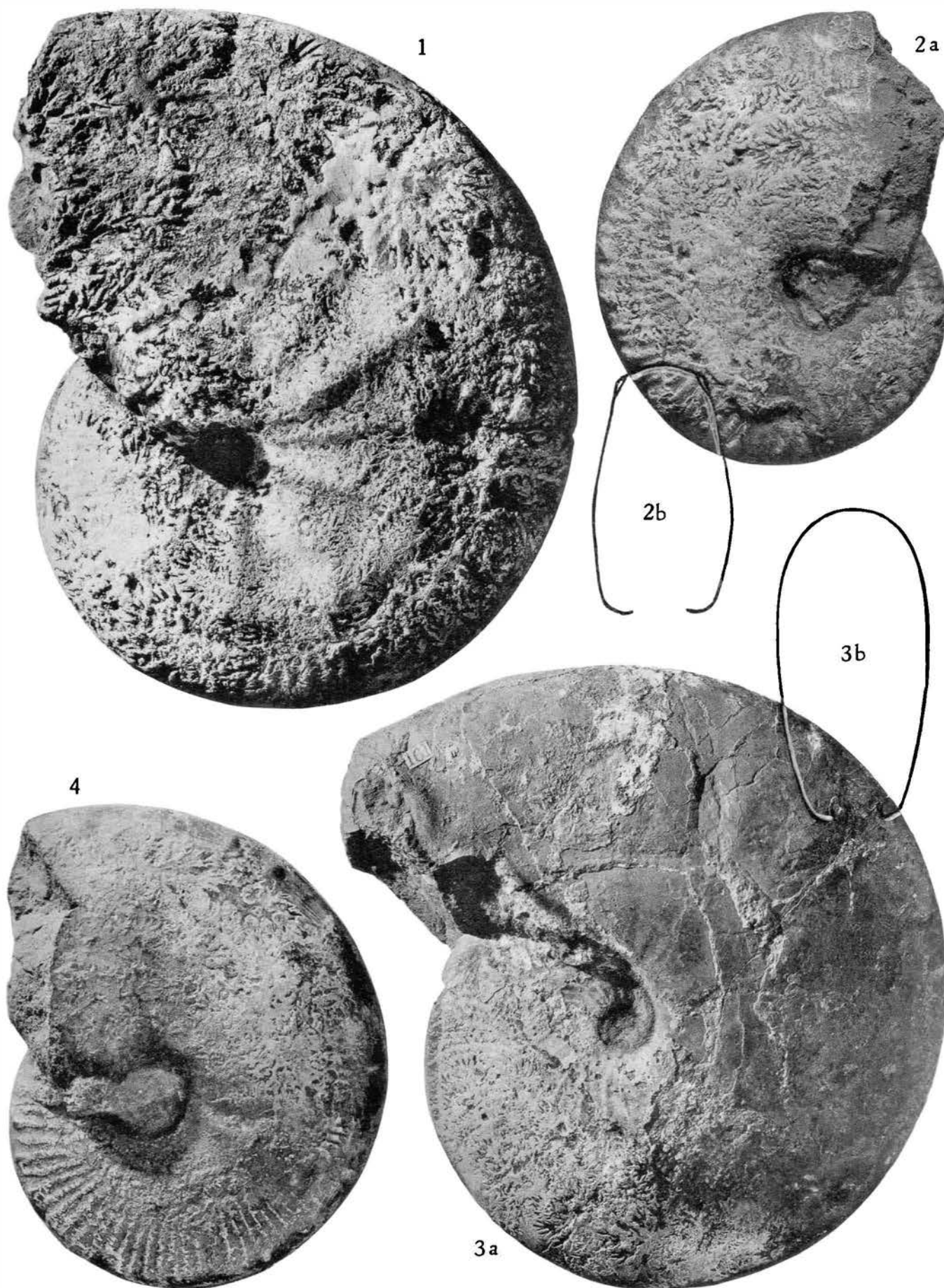
Uhlig did not refer to Waagen's species in his discussion of the *kobelli*-group, but the small *Hecticoceras* sp. nov. ind. he figured (1903, p. 29 ; 1910, pl. LVIII, figs. 5a-d) with similar suture-line, differs merely in its smaller umbilicus and a more definitely acute periphery at a smaller size.

*Horizon*.—Kimmeridgian.

*Locality*.—South-west of Nurrha.

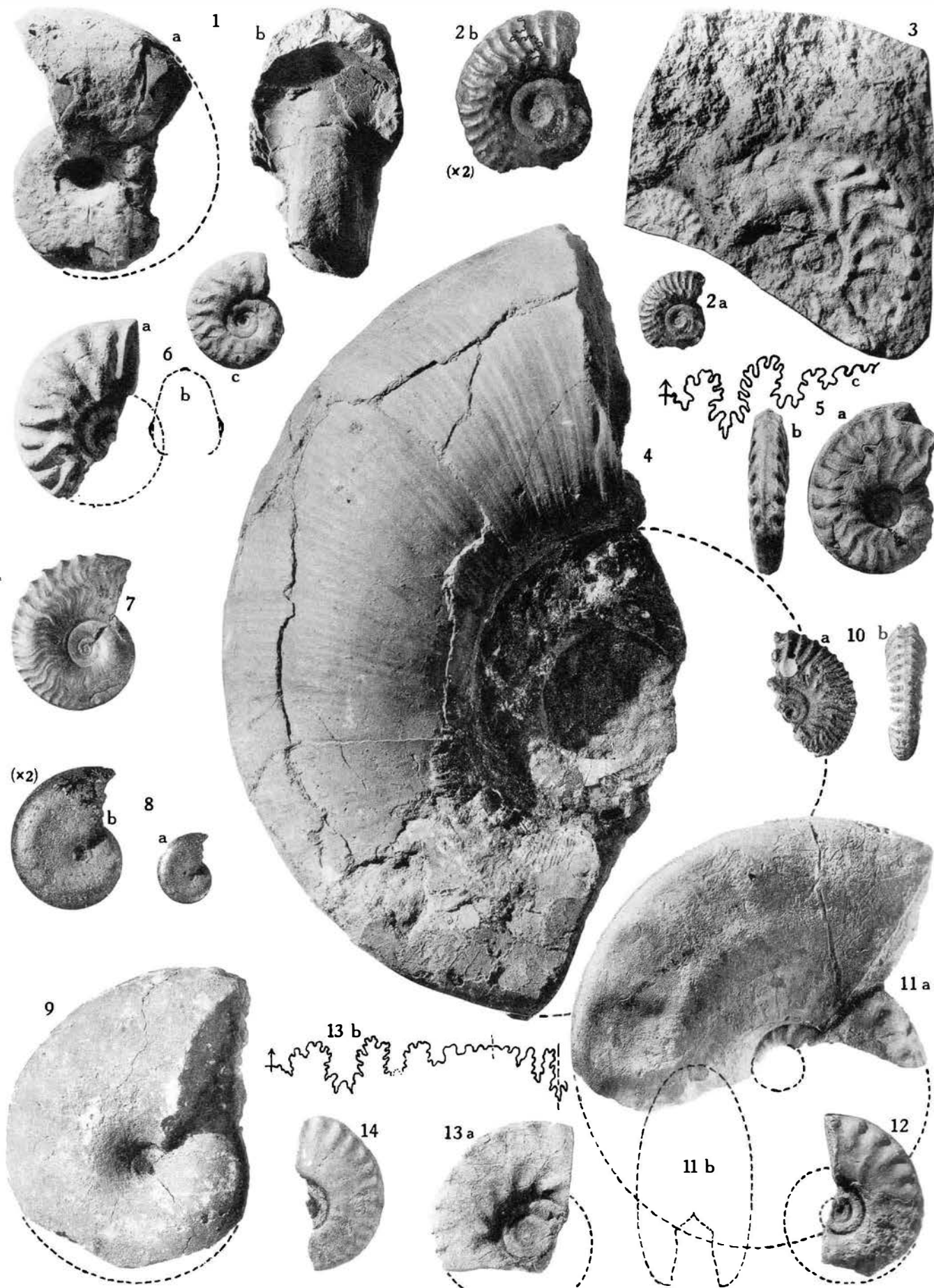
## PLATE VIII.

- Fig. 1. *STREBLITES HABYENSIS*, sp. nov. Side-view of holotype from the Katrol Beds (Middle Kimmeridgian) of Habye. J. H. Smith Colln. No. 42. P. 151.
- Figs. 2a, b. *TARAMELLICERAS KACHHENSE* (Waagen). Side-view and outline whorl-section of an example transitional between Waagen's type and the smooth variety illustrated in fig. 4. Katrol Beds (Middle Kimmeridgian) of Ler. J. H. Smith Colln. No. 37. P. 134.
- Figs. 3a, b. *METAHAPLOCERAS PASCOEI*, sp. nov. Side-view and sectional outline of holotype, complete with body-chamber and peristome, from the 'Belemnite Marls' (Lower Kimmeridgian, Katrol Group) of Jurun. Blake Colln. No. 161. P. 147.
- Fig. 4. *TARAMELLICERAS KACHHENSE* (Waagen). Side-view of an example with finer costation than the type. Katrol Beds (Middle Kimmeridgian) of Fakirwadi. J. H. Smith Colln No. 10. P. 134.



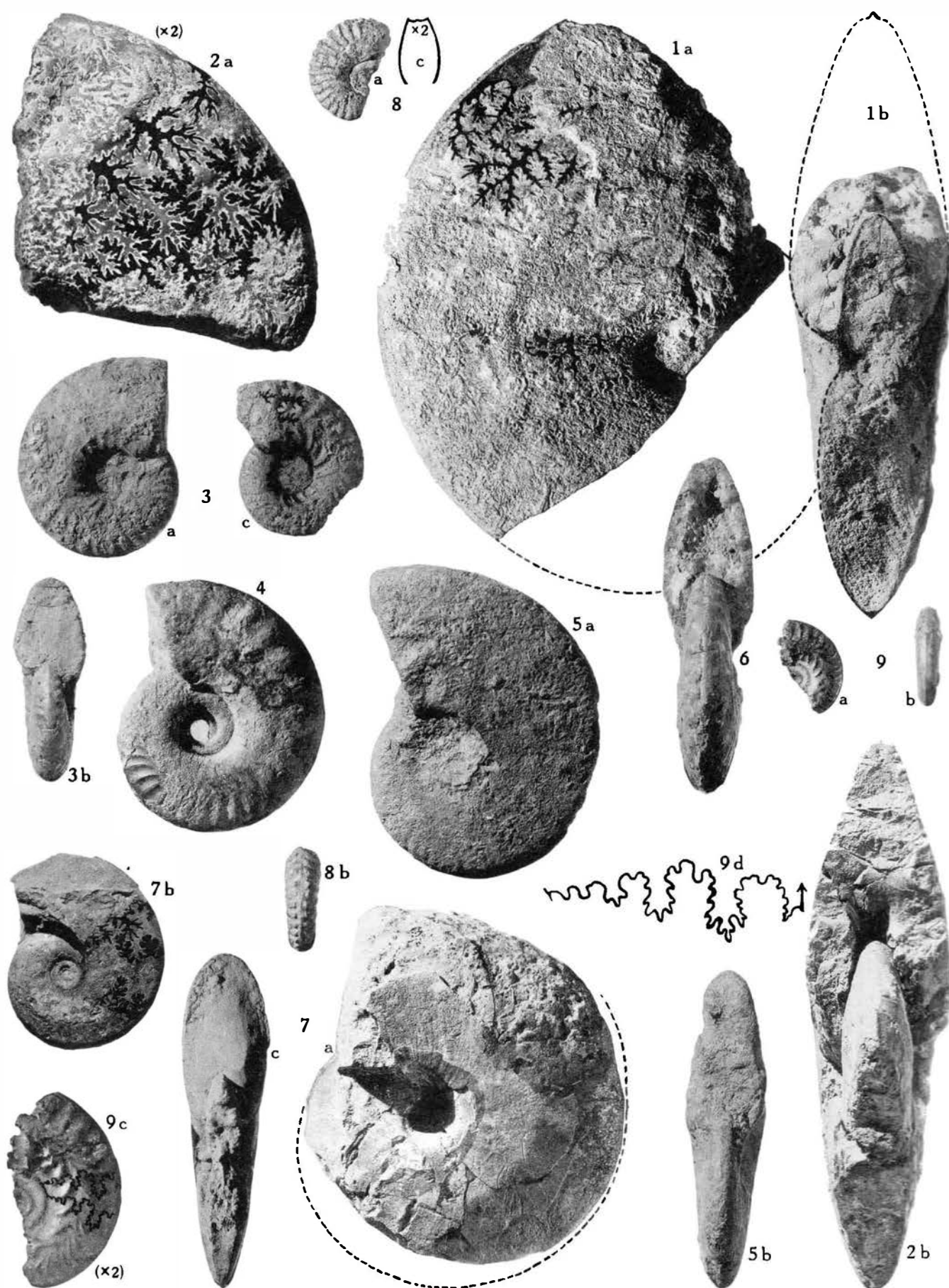
# PLATE IX.

- Figs. 1a, b.** *PARACENOCERAS*, sp. nov. ? Side and front-views of a fragmentary example from the Divesian ('*athleta* beds') of Fakirwadi, received after completion of fasc. I. In whorl-shape it is between *P. hexagonum* (Sow.) and *P. granulosum* (d'Orb.), but the venter of the inner whorls shows beginning of differentiation, as in *Somali-nautilus*. J. H. Smith Colln. (No. 1).
- Figs. 2a, b.** *SINDEITES* aff. *SINDENSIS*, sp. nov. Side-view in natural size (a) and enlarged  $\times 2$  (b) of a small example from the Callovian of Jessulmir, Sind, India. B. M. No. C. 23547. Maj. Gen. B. M. Skinner Colln. P. 98.
- Fig. 3.** *PARÆCOTRAUSTES* (*ECOTRAUSTES* ?) sp. nov.? Plaster cast of original impression (Waagen's pl. X, fig. 3) with two indistinct smaller examples. Bathonian (?), Patcham Group, South of Nurrha. P. 80.
- Fig. 4.** *HEMILYTOCERAS* ? *REX* (Waagen) Fragmentary example from the red ironstone Katrol Beds (Kimmeridgian) of Ler, received after completion of fasc. I. It is figured to show resemblance to *Hemilytoceras sutile*, Oppel sp. (Zittel, 1868), pl. XII. J. H. Smith Colln. No. 2.
- Figs. 5a—c.** *SUBBONARELLIA DECIPIENS*, sp. nov. Side and peripheral views, and suture-line (enlarged and diagrammatic) of holotype. Callovian, *anceps* beds (*fraasi* zone ?), Fakirwadi. J. H. Smith Colln. P. 98.
- Figs. 6a—c.** *KHERAITES FERRUGINEUS*, sp. nov. Side-view and outline whorl-section of fragmentary holotype (a, b), and side-view of a smaller paratype (c), from the Upper Callovian (*anceps* beds) of the Ler-Hamundra Ellipse. J. H. Smith Colln. Nos. 10a, b. P. 110.
- Fig. 7.** *PROTÆCOTRAUSTES DUNDREYENSIS* (H. Woodward MS) nov. Genotype. Inferior Oolite, *sauzei* zone (B. M. No. 67855), Dundry, Somerset. P. 78.
- Figs. 8a, b.** *PHYLLOCERAS CHANTREI* (Munier-Chalmas) Petitclerc (1917, p. 37, pl. V, figs. 10-11). Divesian ('*athleta* beds') *lambergi* zone ?, Fakirwadi. J. H. Smith Colln. This was received too late for incorporation in Mem. No. 2 of this volume. The whorl-section and thickness (36%) as well as suture-line, show very good agreement with Petitclerc's types. *P. kunthi* (Neumayr) referred to on p. 40 of Vol. IX, Mem. No. 2, has more convex sides. Roman and Riche (1921, p. 174) stated that *P. chantrei* seemed to be the Oxfordian (*cardatus* zone) representative of the Callovian *P. obtusum* (Kuder-natsch) from Swinitza; but in 1924 (p. 41) Roman recorded and figured *P. chantrei* from the Callovian of Naves.
- Fig. 9.** *PTYCHOPHYLLOCERAS*, sp. ind. Side-view of an imperfect specimen, resembling *P. vicarium* (Waagen), but from a higher bed. The suture-line is not visible (matrix being crystalline calcite) so that it is difficult to compare this specimen with *P. euphyllloides* (Till). Upper Callovian, *anceps* beds, Fakirwadi. J. H. Smith Colln. (Received after completion of fasc. I).
- Figs. 10a, b.** *SINDEITES SINDENSIS*, sp. nov. Side and peripheral views of holotype from the Callovian of Jessulmir, Sind, India. B. M. No. C. 23545, Maj.-Gen. B. M. Skinner Colln. (For suture-line see Bull. Amer. Pal. 1925, No. 44, pl. I, fig. 6b). P. 98.
- Figs. 11a, b.** *SUBBONARELLIA DECIPIENS*, sp. nov. Side-view and restored outline whorl-section of a body-chamber fragment, with portion of inner whorls. Callovian, upper *anceps* (*fraasi* ?), zone, Fakirwadi (Bowl). J. H. Smith Colln. P. 98.
- Fig. 12.** *SUBBONARELLIA MANIALENSIS*, sp. nov. Side-view of fragmentary holotype. Callovian ? (or *fraasi* zone ?), bed No. 2, S. Manjal. Blake Colln. No. 123. (Referred to, 1924a, p. 24, as *Oecotraustes* cf. *conjugens*, Loczy). P. 99.
- Figs. 13a, b.** *SUBBONARELLIA MANIALENSIS*, sp. nov. Side-view and complete suture-line (enlarged and diagrammatic) of paratype. Callovian "*anceps* beds," Fakirwadi (Bowl). J. H. Smith Colln. P. 99.
- Fig. 14.** *SUBBONARELLIA*, sp. ind. Side-view of a body-chamber fragment from the Callovian ? (or *fraasi* zone ?) of S. Manjal, bed No. 2. Blake Colln. No. 126 (referred to, 1924a, p. 24 as *Oecotraustes* sp. ind.). P. 100.



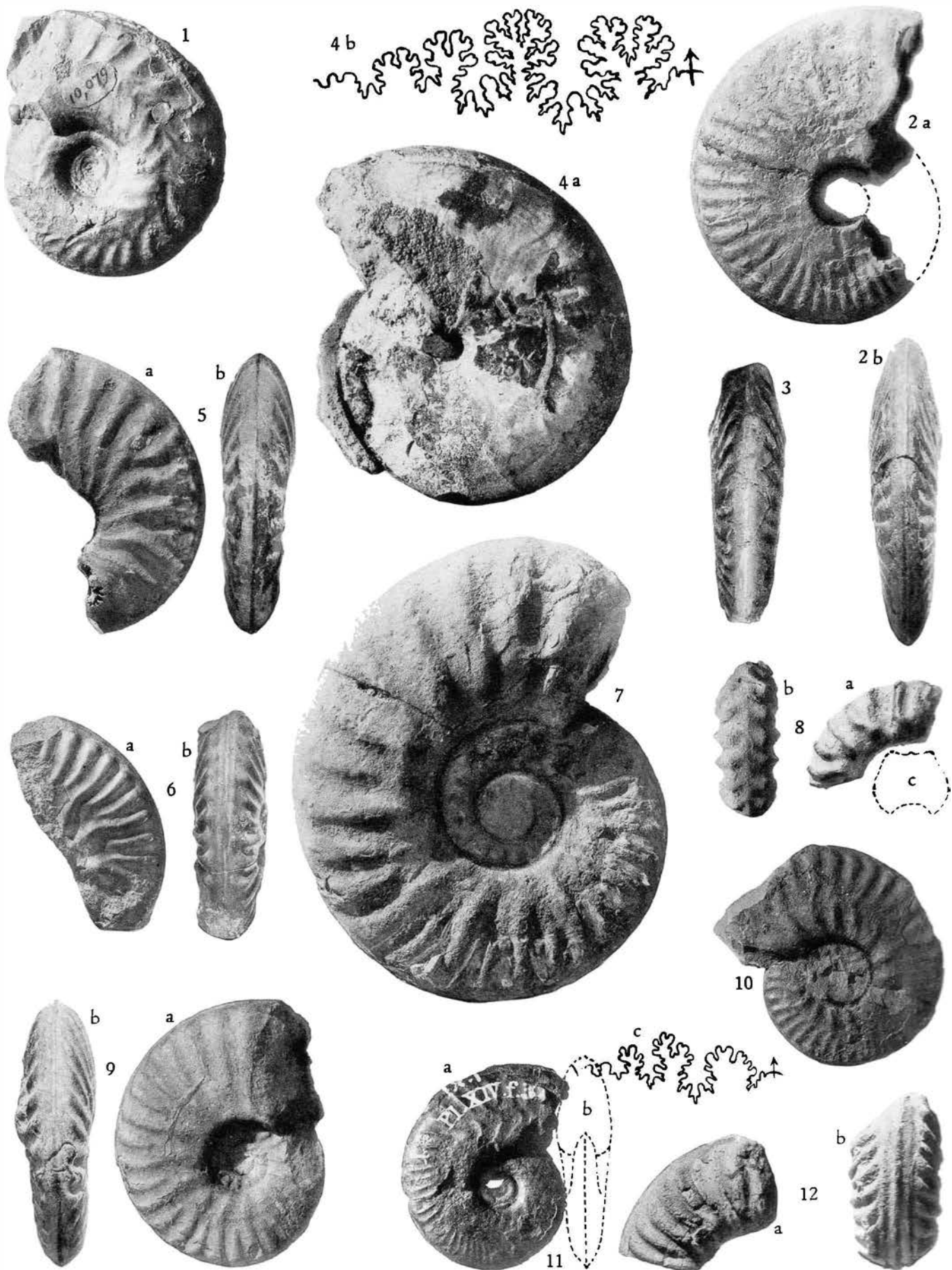
## PLATE X.

- Figs. 1a, b. *ALCIDIA*, sp. ind. Lateral- and peripheral views (with restored outlines) of a fragmentary example from Khera Hill (belt No. 4= Golden Oolite). Lower Callovian, upper *macrocephalus* (= *diadematus*) zone. J. H. Smith Colln. (No. 6). P. 84.
- Figs. 2a, b. *ALCIDIA* aff. *OBSOLETA* (Rollier). a. Small fragment (enlarged  $\times 2$ ) showing suture-line. b. Specimen previously (1924, pp. 5 and 22) recorded as *Alcidia* cf. *subdiscus*. Jumara, bed No. 10. Lower Callovian, upper *macrocephalus* (= *diadematus*) zone. Blake Colln. Nos. 112 and 111. P. 83.
- Figs. 3a-c. *ALCIDIA INFLATA*, sp. nov. (a, b). Side- and peripheral views of larger holotype. (c). Side-view of smaller paratype, with suture-line. Jumara, Bed No. 10. Lower Callovian, upper *macrocephalus* (= *diadematus*) zone. Blake Colln. Nos. 113 and 115. P. 85.
- Fig. 4. *BONARELLIA FORNIX* (J. de C. Sowerby). Side-view of a slightly worn example from Khera Hill, "bed No. 6," Lower Callovian, upper *macrocephalus* (= *diadematus*) zone?. J. H. Smith Colln. P. 96.
- Figs. 5a, b. *ALCIDIA DUBIA* nom. nov. Side- and peripheral views of Waagen's *Oppelia subcostaria* pl. X, fig. 1). Golden Oolite, Khera. (Lower Callovian, upper *macrocephalus* [= *diadematus*] zone). G. S. I. Colln. No. 1/917. P. 82.
- Fig. 6. *ALCIDIA MIMETICA* nom. nov. Peripheral view of the second example figured by Waagen as *Oppelia subcostaria* (pl. X, fig. 2). Golden Oolite, Khera. Lower Callovian, upper *macrocephalus* (= *diadematus*) zone. G. S. I. Colln. No. 1/918. P. 86.
- Figs. 7a-c. *PARALOIDIA KHENGARI*, sp. nov. Side-view (a) of a fragmentary example from Samatra, with separated inner whorls of the same (b), and peripheral view of another specimen (c) from Fakirwadi. Divesian, upper 'athleta beds' (= *lamberti* zone). G. S. I. (K<sub>120</sub><sup>22</sup>) and J. H. Smith Collns. P. 88.
- Figs. 8a-c. *SINDEITES WAAGENI*, sp. nov. Side-(a) and peripheral (b) views of type and restored outline whorl-section, (c) enlarged  $\times 2$ . For suture-line see pl. XII, fig. 6. Callovian, Chari. (Waagen's original of his pl. XI, fig. 6 and pl. XII, fig. 8 = *Oppelia orientalis*, pars, non d'Orbigny). P. 97.
- Figs. 9a-d. *CHANASIA*, sp. juv. ind. Side- and peripheral views in natural size (a, b); side-view enlarged  $\times 2$  (c), and suture-line, enlarged (d), of the Madagascar example, recorded in 1925 (b, p. 11, No. 20). Callovian, Ankidabe. J. Stansfield Colln. P. 98.



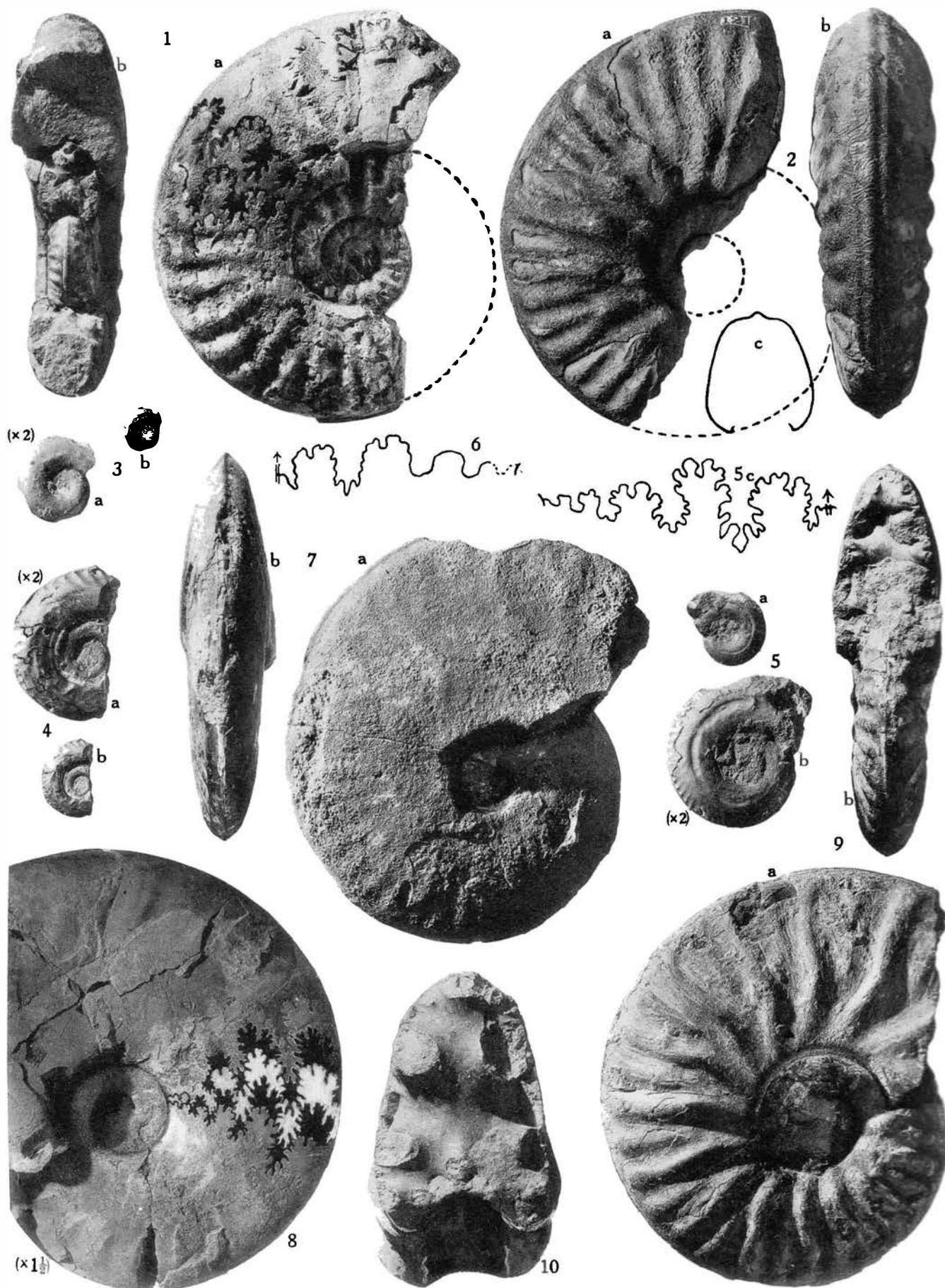
# PLATE XI.

- Fig. 1.** *BONARELLIA FORNIX* (J. de C. Sowerby). Side-view of holotype. Hills 12-15m. north of Bhuj. Geol. Soc. Colln. (B. M. No. 10079) : Lower Callovian, upper *macrocephalus* (= *diadematus*) zone? P. 96.
- Figs. 2a, b.** *SUBLUNULOCERAS DYNASTES* (Waagen). Side- and peripheral views of septate inner whorls, from the Divesian ('*athleta* beds'). North of Fakirwadi village. J. H. Smith Colln. No. 8. P. 125.
- Fig. 3.** " " " Peripheral view of inner whorl of holotype (Waagen's pl. XIII, figs. 6a, b), from the Divesian '*athleta* beds' south-east of Nurrha. G. S. I. Colln. No. 1/948. P. 125.
- Figs. 4a, b.** *PARALOIDIA GLABELLA* (Bean MS) Leckenby sp. Side-view and suture-line of holotype from Castle Rock, Scarborough, Yorks. Divesian, *lamberti* zone? B. M. No. 39562 (W. Bean Colln.). P. 88.
- Figs. 5a, b.** *SUBLUNULOCERAS PRELAIRENSE*, sp. nov. Side- and peripheral views of holotype (body-chamber) from the upper Callovian (*anceps* beds) of Fakirwadi. J. H. Smith Colln. P. 122.
- Figs. 6a, b.** *SUBLUNULOCERAS*? sp. nov. [? aff. *LAIRENSE* (Waagen)]. Side and peripheral views of a fragment transitional to *Campylites*, showing tricarination of periphery. Divesian (Lower Dhosa Oolite) of Fakirwadi. J. H. Smith Colln. No. 19. P. 123.
- Fig. 7.** *PUTEALICERAS VIJAYA*, sp. nov. Side-view of holotype from the Divesian '*athleta* beds' of Fakirwadi. (For peripheral view see pl. XIII fig. 2). J. H. Smith Colln. No. 13. P. 111.
- Figs. 8a-c.** *KHERATTES*? *VARICOSUS*, sp. nov. Side- and peripheral views of a body-chamber fragment, and outline whorl-section. Upper Callovian, *anceps* beds, Fakirwadi. J. H. Smith Colln. P. 109.
- Figs. 9a, b.** *PUTEALICERAS INTERMEDIUM*, sp. nov. Side- and peripheral views of holotype, from the Divesian ('*athleta* beds') of Samatra. J. H. Smith Colln. No. 7. P. 112.
- Fig. 10.** *SUBLUNULOCERAS LAIRENSE* (Waagen) var. *PLANA*, nov. Side-view of a nearly complete example from the Divesian ('*athleta* beds') of Fakirwadi. J. H. Smith Colln. No. 11. P. 123.
- Figs. 11a-c.** *ALCIDIA*, sp. juv. Side-view, outline whorl-section and suture-line of one of Waagen's syntypes of *Oppelia nurrhaensis* (pl. XIV, fig. 3 only). East of Nurrha, Upper Chari Group, *fraasi* zone. P. 87.
- Figs. 12 a, b.** *PUTEALICERAS BISULCATUM* sp. nov. Side- and peripheral views of body-chamber fragment from the Divesian ('*athleta* beds') of Samatra. J. H. Smith Colln. No. 10. P. 114.



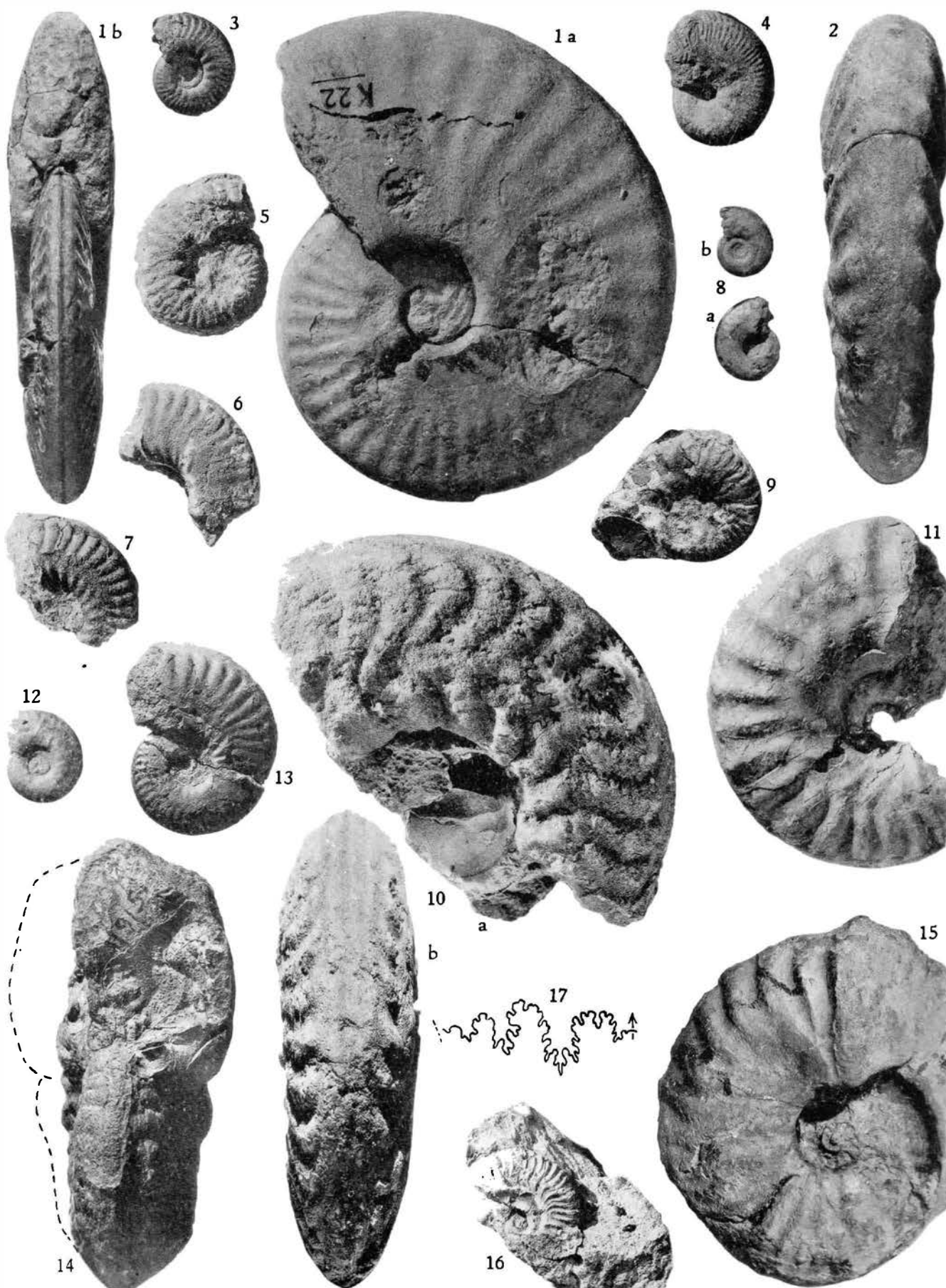
## PLATE XII.

- Figs. 1a, b. *PUTEALICERAS VIJAYA*, sp. nov. Side- and sectional views of a fragmentary paratype from the Divesian, 'athleta beds' of Fakirwadi. G. S. I. Colln. No. K<sub>133</sub><sup>12</sup>. P. 111.
- Figs. 2a-c. *PUTEALICERAS TRILINEATUM* (Waagen). (a, b). Side- and peripheral views of a body chamber fragment, with portions of inner whorls from the *fraasi* zone bed No. 2, of S. Manjal. Blake Colln. No. 121. (c) Outline whorl-section of var. *CRASSA* nov., from the 'athleta beds' of Samatra. J. H. Smith Colln. P. 110.
- Figs. 3a, b. *BONARELLIA FORNIX* (J. de C. SOWERBY). Side-view in natural size (b) and enlarged  $\times 2$  (a) of a young example entirely septate, and smooth, but with angular periphery and spiral groove. Out of matrix of holotype (pl. XI, fig. 1). Geol. Soc. Colln. (B. M.). P. 96.
- Figs. 4a, b. *BONARELLIA FORNIX* (J. de C. Sowerby). Side-view in natural size (b) and enlarged  $\times 2$  (a) of an evolute and coarsely ribbed example, out of same block of matrix. P. 96.
- Figs. 5a-c.               "               "               "               Side-view in natural size (a) and enlarged side-view ( $\times 2$ ) of opposite side (b) and enlarged suture-line (c) of a finely crenulate example. Out of same block of matrix. P. 96.
- Fig. 6. *SINDEITES WAAGENI*, sp. nov. Suture-line (enlarged and diagrammatic) of the example figured in pl. X, figs. 8a-c. Callovian, Chari. P. 97.
- Figs. 7a, b. *SUBLUNULOCERAS DISCOIDES*, sp. nov. Side- and peripheral views of holotype, marked "*Harpoceras* ? Without label, facies is 'athleta' of Samatra". Divesian. J. H. Smith Colln. P. 126.
- Fig. 8. *ALCIDIA NURRHAENSIS* (Waagen). Part of Waagen's holotype (enlarged  $\times 1\frac{1}{2}$ ) to show suture-line. North-west of Jumara, Upper Chari Group, *fraasi* zone. G. S. I. Colln. No. 1/915. P. 87.
- Figs. 9a, b. *PUTEALICERAS INTERMEDIUM*, nov., var. *ROBUSTA* nov. Side- and peripheral views. Divesian, 'athleta Beds' of Fakirwadi (Bowl). J. H. Smith Colln. P. 112.
- Fig. 10. *PUTEALICERAS TRILINEATUM* (Waagen). Septal surface, at posterior end of body-chamber of a very large example from the Divesian, 'athleta beds,' of Fakirwadi. J. H. Smith Colln. No. 22. P. 110.



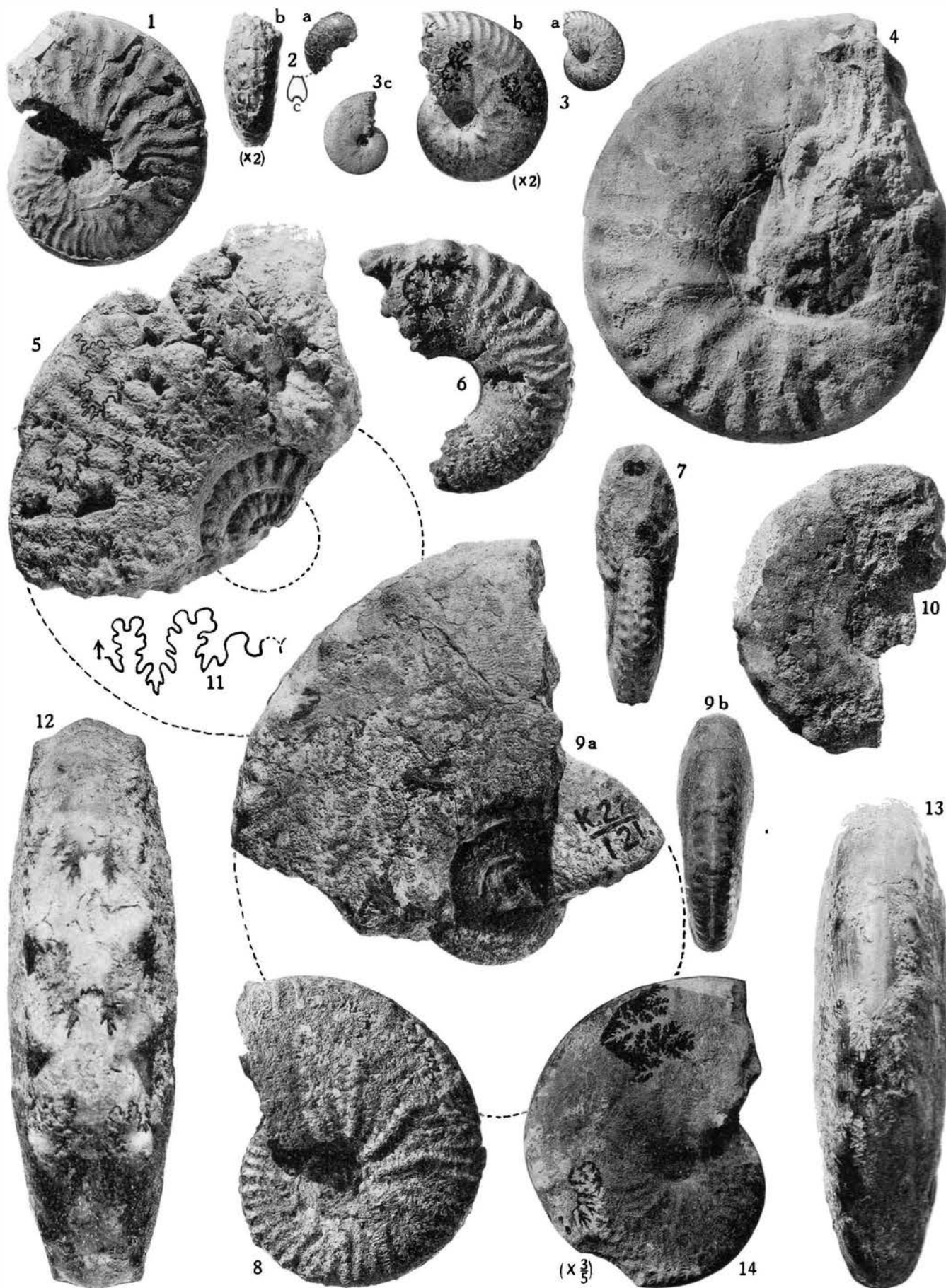
# PLATE XIII.

- Figs. 1a, b.** *SUBLUNULOCERAS DISCOIDES*, sp. nov. Side- and ventral views of an example, transitional to *S. dynastes*, from the Divesian ('*athleta* beds') of Fakirwadi. G. S. I. Colln. K.  $\frac{22}{113}$ . P. 126.
- Fig. 2.** *PUTEALICERAS VIJAYA*, sp. nov. Peripheral view of holotype, figured in pl. XI, fig. 7, from the Divesian ('*athleta* beds') of Fakirwadi. J. H. Smith Colln. No. 13. P. 111.
- Fig. 3.** *PUTEALICERAS*, sp. juv. Immature example which differs from the young of all the species here described. Callovian or Divesian ('*athleta* beds?') of S. Manjal, bed No. 2, Blake Colln. (No. 127). P. 115.
- Fig. 4.** *PROSCAPHITES* cf. *BERMONIS* (Noetling). Side-view of the example previously recorded (1924, pp. 6, 25) as *Taramelliceras* sp. (cf. *episcopalis*, de Loriol). From the Divesian (*renggeri* zone = base of Dhosa Oolite) of West Juria ("Upper zone"). Blake Colln. No. 183. P. 134.
- Fig. 5.** *PUTEALICERAS*? sp. ind. nov. Side-view of a badly preserved example from the Dhosa Oolite (Divesian, *renggeri* zone?) of Ler. J. H. Smith Colln. P. 115.
- Fig. 6.** *CAMPYLITES SECUA* (Bean MS) nov. Side-view of a fragment with inconspicuous umbilical tubercles, transitional to *Lunuloceras*. Divesian, *renggeri* zone, of Samatra. J. H. Smith Colln. P. 128.
- Fig. 7.** *CAMPYLITES SECUA* (Bean MS) nov. Side-view of a fragment agreeing with Waagen's '*Harpoceras rauracum* (Mayer)', from the Divesian (*renggeri* zone?) of Samatra (*Mayaites pelyphemus* bed). J. H. Smith Colln. P. 128.
- Figs. 8a, b.** *LUNULOCERAS*, sp. juv. Side-views of two small examples from the Divesian? ('*athleta* beds') of Charwar, bed No. 2. Blake Colln. Nos. 137, 138. P. 121.
- Fig. 9.** *LUNULOCERAS ORIENTALE* (Cribigny). Side-view of J. de C. Sowerby's original of '*Ammd*' *corrugatus*' (1840, pl. XXIII, fig. 12), the holotype of the species, from Chari, Callovian, *anceps* beds. B. M. (Geol. Soc. Colln. No. 9924). P. 118.
- Figs. 10a, b.** *PSEUDOBRIGHTIA DHOSAFENSIS*, sp. nov. Side- and peripheral views of holotype, from the Dhosa Oolite (Divesian or Lower Argovian) of Fakirwadi. J. H. Smith Colln. P. 116.
- Fig. 11.** *HECTICOCERATOIDES SUBORIENTALIS*, Spath. Side-view of the example in the Blake Colln. (No. 117) previously (1924, pp. 5 and 22) recorded from Bed No. 10 of Junnara. Lower Callovian, *diadematus* beds. P. 106.
- Fig. 12.** *SUBLUNULOCERAS*? (*LUNULOCERAS*?), sp. ind. Side-view of a doubtful, immature example, with asymmetrical suture-line. Divesian ('*athleta* beds') of Jikadi (No. 22). Blake Colln. No. 144. P. 121.
- Fig. 13.** *CAMPYLITES SECUA* (Bean MS) nov. Side-view of a complete example, with last half of body-chamber accidentally displaced, from the Dhosa Oolite (Divesian, *renggeri* zone) of Wanda (zone 1). Blake Colln. No. 156. P. 128.
- Fig. 14.** *PHLYCTICERAS WAAGENS* S. Buckman. Peripheral view of Waagen's holotype, with restored outline of aperture. N. E. of Gudjinsir. Upper Chari Group, *fraasi* zone. G. S. I. Colln. 1/195. P. 90.
- Fig. 15.** *PHLYCTICERAS SCHAUMBURGI* (Waagen). Side-view of a complete body-chamber, with impression of septate inner whorls. Samatra. Upper Chari Group, *fraasi* zone. G. S. I. No. K.  $\frac{22}{113}$ . J. H. Smith Colln. P. 91.
- Fig. 16.** *SINDEITES*, sp. nov. ind. Side-view of an example (in matrix) from the '*athleta* beds', Fakirwadi. (Callovian? exact horizon unknown). J. H. Smith Colln. No. 16. P. 98.
- Fig. 17.** *HILDOGLOCHICERAS KOELLIFORME* (Bonarelli). Suture-line (enlarged and diagrammatic of Waagen's type (pl. XIII, fig. 12) from the Upper Katrol Group (*Zambia Shalen*), south-west of Nurrha. G. S. I. Colln. No. 1/954. P. 159.



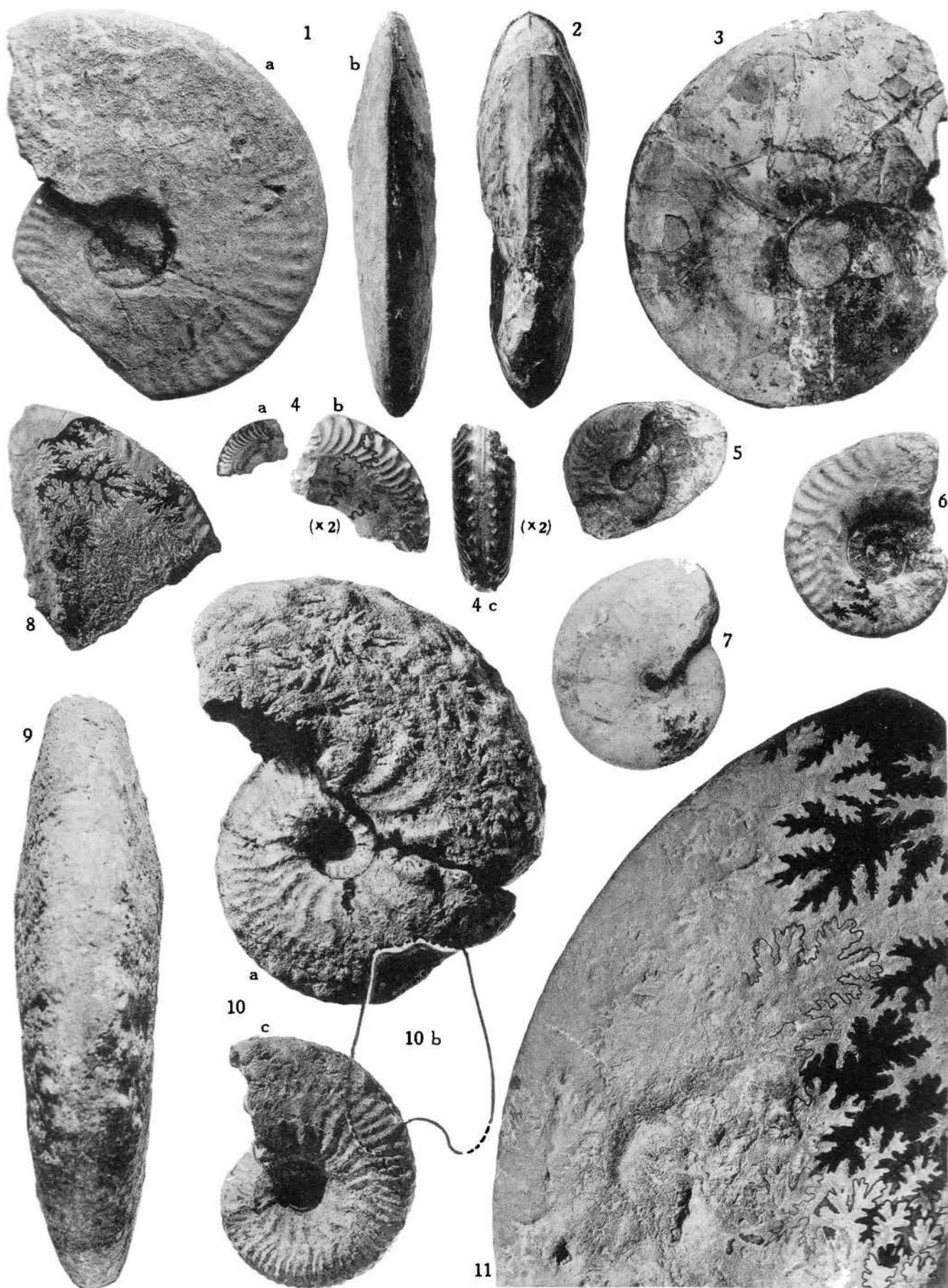
# PLATE XIV.

- Fig. 1.** *SUBLUNOCERAS LAIRENSE* (Waagen). Side-view of a closely ribbed example from the 'athleta beds' (Divesian) of East Ler (bed No. 8). Blake Colln. No. 153. (For suture line see pl. XVIII, fig. 8). P. 123.
- Figs. 2a-c.** *BONARELLIA*, sp. ind. Side-view of body-chamber fragment (a) with peripheral view, enlarged  $\times 2$  (b) and restored outline whorl-section (c). Divesian, probably *lam-berti* zone, Fakirwadi. J. H. Smith Colln. P. 95.
- Figs. 3a-c.** *LORIOLOCERAS* cf. *INCONSPICUUM* (de LORIO). Side-views in natural size and enlarged  $\times 2$  (a, b), and side-view of another example (c), from the Divesian ('athleta beds') of Fakirwadi. J. H. Smith Colln. P. 132.
- Fig. 4.** *PUTEALICERAS INTERMEDIUM*, sp. nov. var. *SAMATRENSE* nov. Side-view of complete example from the Divesian, 'athleta beds,' of Samatra. J. H. Smith Colln. No. 9. P. 112.
- Fig. 5.** *PUTEALICERAS PSEUDODYNASTES*, sp. nov. Side-view of holotype, from the Divesian ('athleta beds') of Fakirwadi. J. H. Smith Colln. P. 113.
- Fig. 6.** *TARAMELLICERAS KACHHENSE* (Waagen). Side-view of fragmentary inner whorls of an example transitional to *T. gibbosum*, showing suture-line. Katrol Beds (Middle Kimmeridgian) of Fakirwadi. J. H. Smith Colln. No. 26a. P. 134.
- Fig. 7.** *TARAMELLICERAS TRANSITORIUM*, sp. nov. Peripheral view of paratype from Katrol Beds (Middle Kimmeridgian) of Ler. J. H. Smith Colln. P. 142.
- Fig. 8.** *TARAMELLICERAS TRANSITORIUM*, sp. nov. Side-view of holotype from the Katrol Beds (Middle Kimmeridgian) of Ler. J. H. Smith Colln. P. 142.
- Figs. 9a, b.** *TARAMELLICERAS PLANIFRONS*, sp. nov. Side-view of holotype, and peripheral aspect of separated inner whorls of the same. Katrol Beds (Middle Kimmeridgian). Locality unrecorded. (Marked 'Dhosa Oolite'). G. S. I. Colln. No. K. 22. P. 143.
- Fig. 10.** *TARAMELLICERAS* cf. *SUCCEEDENS* (Oppel) Zittel sp. Side-view of a body-chamber fragment from the Katrol Beds (Middle Kimmeridgian) of Fakirwadi. G. S. I. Colln. No. K. 22. P. 141.
- Fig. 11.** *LUNULOCERAS NISOIDES*, sp. nov. Suture-line, enlarged and diagrammatic, of holotype figured in pl. XV, fig. 5. Divesian, 'athleta beds,' unlocalised. J. H. Smith Colln. P. 120.
- Fig. 12.** *TARAMELLICERAS KACHHENSE* (Waagen). Peripheral view of a coarsely ornamented example from the Katrol Beds (Middle Kimmeridgian) of Ler. J. H. Smith Colln. No. 17. P. 134.
- Fig. 13.** " " " Peripheral view of the smooth example figured in pl. VIII, fig. 4. From the Katrol Beds (Middle Kimmeridgian) of Fakirwadi. J. H. Smith Colln. No. 10. P. 134.
- Fig. 14.** *TARAMELLICERAS* aff. *HOLBEINI* (Oppel). Side-view (reduced  $\times 3/5$ ) of a septate example, showing suture-line. Katrol Beds (Middle Kimmeridgian), Habye. J. H. Smith Colln. No. 13 (Photo J. H. Smith). P. 138.



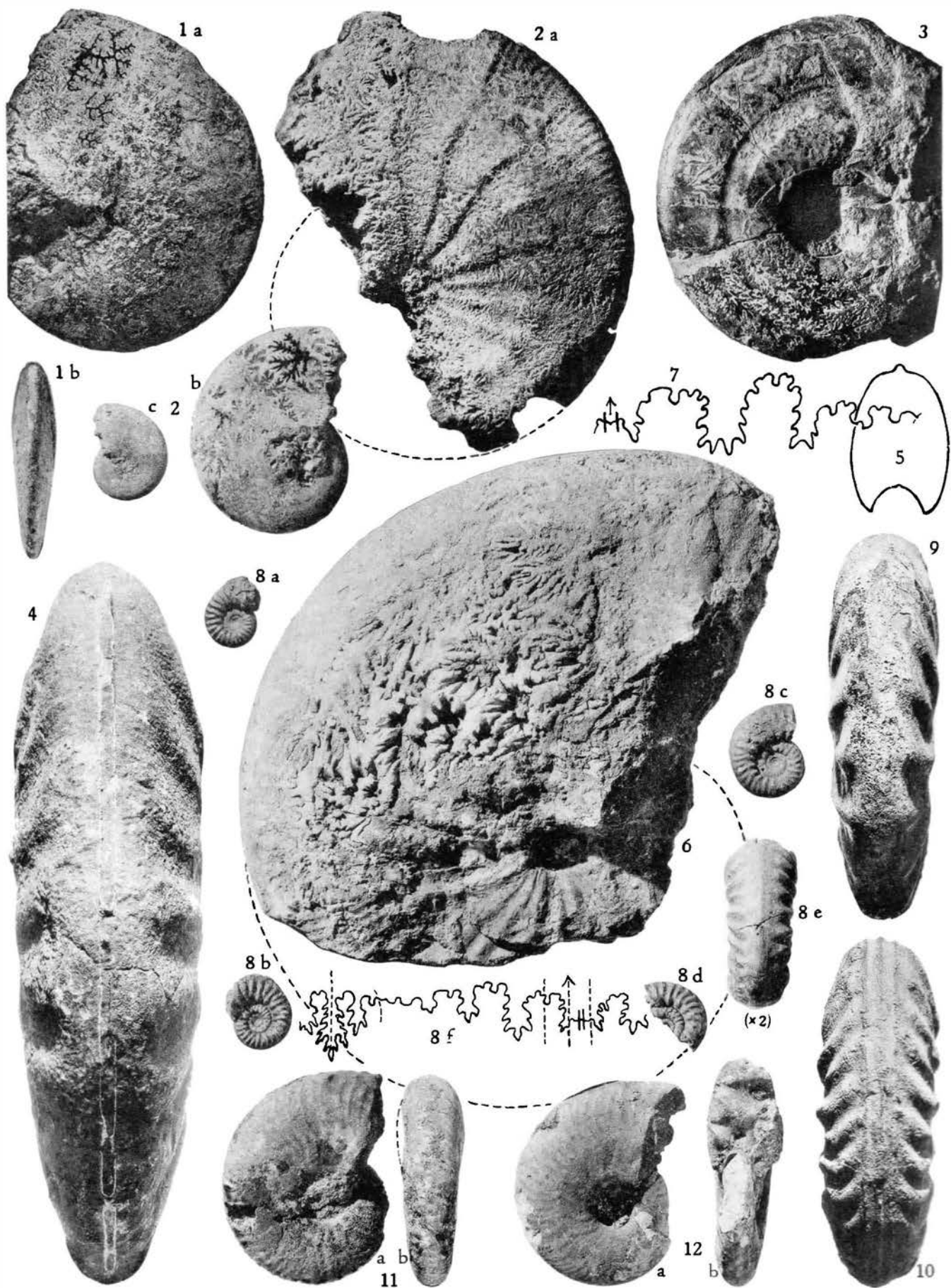
## PLATE XV.

- Figs. 1a, b.** *SUBLUNULOCERAS* aff. *NODOSULCATUM* (Lahusen). Side- and peripheral views of a completely septate specimen, weathered at the end, from the (Divesian) ('*athleta* beds') of Ler. J. H. Smith Colln. P. 124.
- Fig. 2.** *KHERAITES* *IGNOBILIS* (J. de O. Sowerby). Peripheral view of holotype from near Chari. Lower Callovian, *diadematus* (or *rehmanni*?) zone. (B. M. Geol. Soc. Colln. No. 9983). P. 108.
- Fig. 3.** *PARALCIDIA* *KHENGARI*, var. *APERTA* nov. Side-view of type, with over half-a-whorl of body-chamber. Fakirwadi. Divesian, upper '*athleta* beds'=*lamberti* zone. J. H. Smith Colln. No. 51. P. 88.
- Figs. 4a-c.** *BONARELLIA* *BICOSTATA* (Stahl). Side-view, natural size (a), side-view of opposite side (b, enlarged  $\times 2$ ) and peripheral view [c,  $\times 2$ ] of septate fragment, with suture-line. Divesian, *lamberti* zone (upper '*athleta* beds'), Fakirwadi. J. H. Smith Colln. P. 95.
- Fig. 5.** *LUNULOCERAS* *NISOIDES*, sp. nov. Side-view of holotype. '*Athleta* beds' (Divesian?), unlocalised, probably Fakirwadi. J. H. Smith Colln. (For suture-line, see pl. XIV, fig. 11). P. 120.
- Fig. 6.** *HECTICOERAS* sp. ind. Side-view of a doubtful example, with inner whorls corroded. Probably from the '*athleta* beds' (Callovian) of Ler. J. H. Smith Colln. (found by Dr. Tambe.) P. 105.
- Fig. 7.** *PHYLLOCERAS* *LODAENSE*, Waagen. Side-view of unusually well-preserved, septate, inner whorls, showing six faint constrictions and various layers of test, from the '*athleta* beds' of Ler. J. H. Smith Colln. (Received too late to be figured in fascicule I).
- Fig. 8.** *TARAMELLICERAS* aff. *SUBKOBYI*, sp. nov. Whorl-fragment showing suture-line and representing a more compressed variety. Katrol Beds (Middle Kimmeridgian), probably from Fakirwadi. J. H. Smith Colln. P. 146.
- Fig. 9.** *TARAMELLICERAS* aff. *FRANCOISCANUM* (Fontannes). Peripheral view of a large example from the Katrol Beds (Middle Kimmeridgian) of Fakirwadi. J. H. Smith. Colln. P. 139.
- Figs. 10a-c.** *TARAMELLICERAS* *GIBBOSUM*, sp. nov. Side-view and outline whorl-section, and inner whorls (separated) of holotype from the Katrol beds (Middle Kimmeridgian) of Ler. J. H. Smith Colln. No. 35. P. 140.
- Fig. 11.** *SUBLUNULOCERAS* cf. *DISCOIDES* sp. nov. Side-view of part of the outer whorl of a doubtful example (slightly weathered), showing suture-lines. This is the "huge *Oppelia*," recorded by Mr. J. H. Smith, (1913b, p. 418). Divesian ('*athleta* beds') of the Ler-Hamundra Ellipse. J. H. Smith Colln. P. 126.



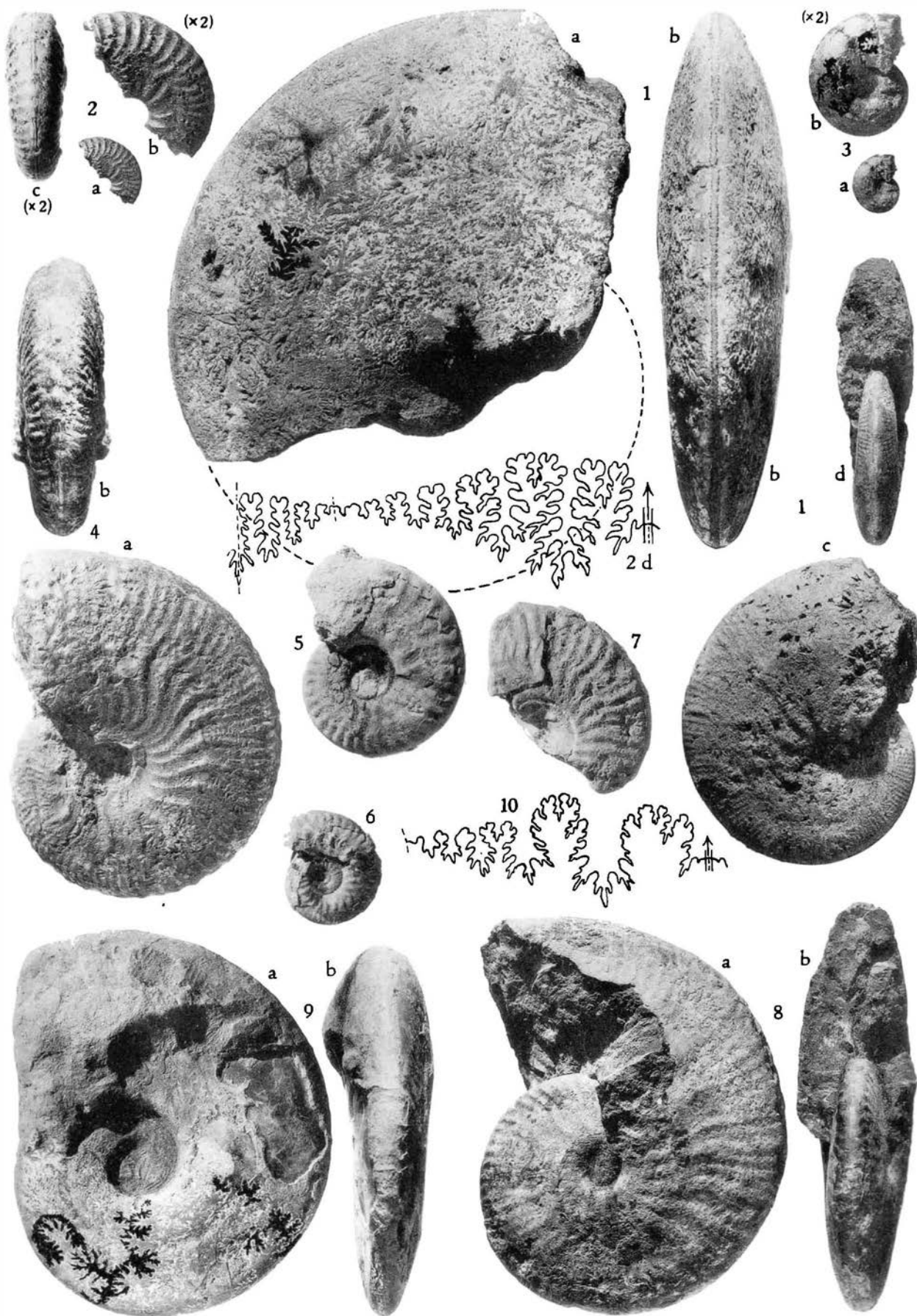
# PLATE XVI.

- Figs. 1a, b.** *STREBLITES LEPTODISCUS*, sp. nov. Side-view of holotype and peripheral view of a small paratype from the Katrol Beds (Middle Kimmeridgian), probably of Ler. J. H. Smith Colln. P. 150.
- Figs. 2a-c.** *STREBLITES PLICODISCUS* (Waagen). Side-views of (a) a large example showing typical ornamentation, (c) a small specimen, with (b) opposite side of the same enlarged  $\times 2$ . Katrol Beds (Middle Kimmeridgian) of Fakirwadi. J. H. Smith Colln. Nos. 3 and 22. P. 148.
- Fig. 3.** *GLOCHICERAS DEPLANATUM* (Waagen). Side-view of an example with unusually wide spiral groove. Katrol Beds (Middle Kimmeridgian) of Fakirwadi. J. H. Smith Colln. No. 2. P. 155.
- Fig. 4.** *HECTICOCERAS* aff. *TURGIDUM*, Loczy. Peripheral view of a large, septate, fragment from Khera Hill (bed No. 6), Lower Callovian, upper *macrocephalus* (= *diadematus*) zone. J. H. Smith Colln. No. 27. P. 105.
- Fig. 5.** *HECTICOCERAS GIGANTEUM*, nom. nov. Cross-section of median whorl of Waagen's original (pl. XII, fig. 3) from the Golden Oolite of Khera Hill. Lower Callovian, upper *macrocephalus* (= *diadematus*) zone. G. S. I. Colln. No. 1/935. P. 104.
- Fig. 6.** *STREBLITES* sp. nov.? Side-view of a fragmentary example, slightly corroded, from the Katrol Beds (Middle Kimmeridgian) of Habye. J. H. Smith Colln. P. 152.
- Fig. 7.** *HECTICOCERAS* sp. juv. ind. Suture-line of a fragment from the 'sub-*anceps*' beds (Callovian) of the Ler-Hamundra Ellipse. J. H. Smith Colln. P. 105.
- Figs. 8a-f.** *PUTEALICERAS*, spp. juv. aff. *BISULCATUM*, sp. nov. (a-d). Side-views of four examples, with periphery of *d* enlarged  $\times 2$  (a) and complete suture-line, enlarged and diagrammatic (f). Divesian ('*athleta* beds') of Fakirwadi. J. H. Smith Colln. Nos. 21a-d. P. 114.
- Fig. 9.** *KHERAITES SMITHI*, nom. nov. Peripheral view of a body-chamber fragment from Khera Hill, bed No. 6. J. H. Smith Colln. Callovian (*rehmanni*? or *diadematus* zone. P. 108.
- Fig. 10.** *PUTEALICERAS*, sp. ind. nov. Peripheral view of an example transitional between *Pseudobrightia dhosaensis* and *Putealicerus trilineatum*. Divesian? Bed and Locality unrecorded. J. H. Smith Colln. No. 16. P. 115.
- Figs. 11a, b.** *TARAMELLICERAS NEREIFORME*, sp. nov. Side- and peripheral views of holotype with last third of outer whorl belonging to body-chamber, Katrol Beds (Middle Kimmeridgian) of Fakirwadi. J. H. Smith Colln. P. 145.
- Figs. 12a, b.** „ „ „ Side- and peripheral views of completely septate paratype, from same beds. G. S. I. Colln. No. K. 218. P. 145.



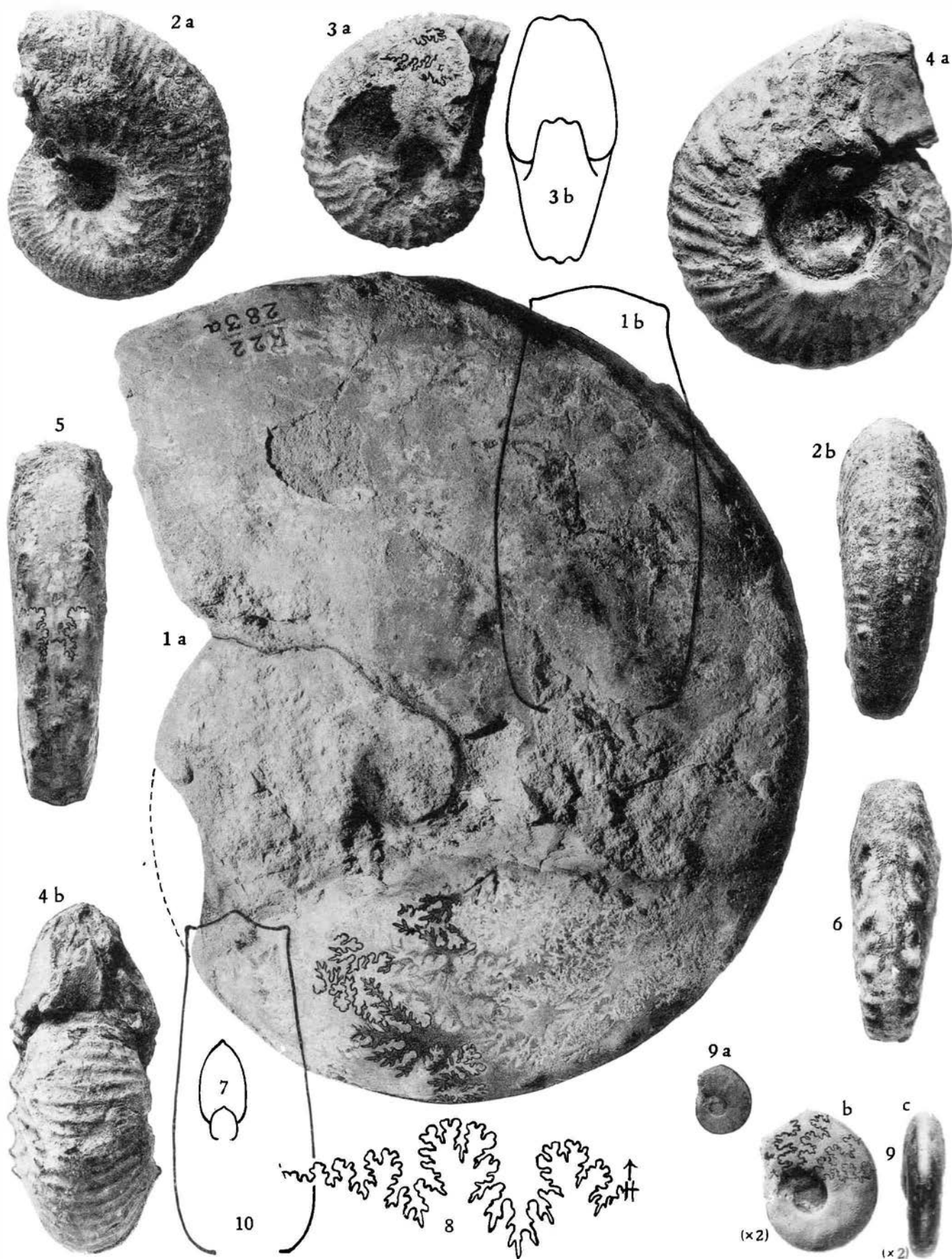
## PLATE XVII.

- Figs. 1a-d. STREBLITES PLIOODISCUS (Waagen).** (a, b) Side-and peripheral views of a fragmentary example from the Katrol Group (Middle Kimmeridgian) of Walakhavas ("above zone 1"). [The figure does not show the distant outer crescents]. Blake Colln. No. 164. (c, d). Side- and front-views of a smaller Fakirwadi example. J. H. Smith Colln. P. 148.
- Figs. 2a-d. LORIOLOCERAS CANALICULATUM (Quenstedt).** Side-view (a), side and peripheral views enlarged  $\times 2$  (b, c), and complete suture-line, enlarged and diagrammatic (d), of fragmentary examples from the Divesian ('athleta beds') of Fakirwadi. J. H. Smith Colln. P. 133.
- Fig. 3a, b. TARAMELLICERAS sp. juv. (KACHHENSIS group).** Innermost whorls, (natural size and enlarged  $\times 2$ ) showing suture-lines. Katrol Group (Middle Kimmeridgian) of Fakirwadi. J. H. Smith Colln. No. 26a. P. 134.
- Fig. 4a, b. TARAMELLICERAS JUMARENSE sp. nov.** Side-and peripheral views of holotype from the Dhosa Oolite (Argovian, *transversarius* zone?) of Jumara. Blake Colln. No. 116. P. 143.
- Fig. 5. SUBLUNULOCERAS aff. LAIRENSE (Waagen) var. PLANA nov.** Side-view of a complete example, transitional to *Lunuloceras*, from the Divesian ('athleta beds') of Samatra. G. S. I. Colln. No. K. 188. P. 123.
- Fig. 6. SUBLUNULOCERAS LAIRENSE (Waagen).** Immature example with striking resemblance to *Cardioceras*, from the Divesian ('athleta beds') of West Katrol (bed No. 4). Blake Colln. No. 207. P. 123.
- Fig. 7. SUBLUNULOCERAS ? (LUNULOCERAS ?) sp. ind.** Side-view of a doubtful fragment, transitional between *Lunuloceras* and *Sublunuloceras lairensis* (Waagen). From the 'athleta beds' of Fakirwadi (Bowl). J. H. Smith Colln. No. 11. P. 125.
- Figs. 8a, b. TARAMELLICERAS SUBKOBYI, sp. nov.** Side-and peripheral views of holotype from the Katrol Beds (Middle Kimmeridgian) of Fakirwadi. J. H. Smith Colln. P. 146.
- Figs. 9a, b. GLOCHICERAS DEPLANATUM (Waagen).** Side-and peripheral views of adult example from the Katrol Beds (Middle Kimmeridgian) of Habye. J. H. Smith Colln. P. 155.
- Fig. 10. PUTEALICERAS TRILINEATUM (Waagen) var. COMPRESSA nov.** Suture-line, enlarged and diagrammatic, of an unlocalised fragment, presumably from the 'athleta beds' of Fakirwadi. J. H. Smith Colln. P. 110.



# PLATE XVIII.

- Figs. 1a, b.** *TARAMELLICERAS KAHHENSE* (Waagen). Side-view and outline whorl-section of a fully-grown example from the Katrol Beds (Middle Kimmeridgian) of East Ler. G. S. I. Colln. No. K.  $\frac{22}{28} \frac{2}{3} a$ . P. 134.
- Figs. 2a, b.** *TARAMELLICERAS PSEUDOFLEXUOSUM* (Favre). Side- and peripheral views of an example from the Katrol Beds (Middle Kimmeridgian) of Ler. J. H. Smith Colln. No. 14. P. 141.
- Figs. 3a, b.** *TARAMELLICERAS*, sp. nov. ? Side- and outline sectional views of an unique example from the Katrol Beds (Middle Kimmeridgian) of Fakirwadi. J. H. Smith Colln. P. 137.
- Figs. 4a, b.** *ERYMNOCERAS DOROTHEA*, sp. nov. Side- and peripheral views of the example described by Mr. J. H. Smith (1914b, p. 813) as "*Holcostephanus*." 'Athleta Beds,' Fakirwadi. (The contracting body-chamber, as Mr. Smith pointed out, is probably uncrushed).
- Fig. 5.** *TARAMELLICERAS PLANIFRONS*, sp. nov. Peripheral view of paratype, figured in pl. XIX, fig. 2. From Katrol Beds (Middle Kimmeridgian). Locality unrecorded. J. H. Smith Colln. No. 23. P. 143.
- Fig. 6.** *TARAMELLICERAS* aff. *KAHHENSE* (Waagen). Peripheral view of a coarsely tuberculate example, transitional to *T. akher*. From the Katrol Beds (Middle Kimmeridgian) of Walakhavas. J. H. Smith Colln. P. 134.
- Fig. 7.** *BRIGHTIA*, sp. ind. Outline whorl-section of fragment from the Callovian?, 'athleta beds', of Ler. J. H. Smith Colln. (found by Dr. Tambe). P. 121.
- Fig. 8.** *SUBLUNULOCERAS LAIRENSE* (Waagen). Suture-line, enlarged and diagrammatic, of example figured in Pl. XIV, fig. 1, from the Divesian of E. Ler (bed No. 8). Blake Colln. No. 158. P. 123.
- Figs. 9a-c.** *LUNULOCERAS* sp. juv. Side-view (a) and side- and peripheral views enlarged  $\times 2$  (b, c) of a doubtful immature example from the Divesian ('athleta beds') of Fakirwadi. J. H. Smith Colln. P. 121.
- Fig. 10.** *TARAMELLICERAS* cf. *COMPSUM* (Oppel). Outline whorl-section of an example from the Katrol Beds (Middle Kimmeridgian) of (probably) Ler or Fakirwadi. J. H. Smith Colln. P. 137.



## PLATE XIX.

- Figs. 1a-c.** *INDOCEPHALITES KHERAENSIS*, sp. nov. Side-view (a) of original of J. de C. Sowerby's *Amm. herveyi* var. (1840, pl. XXIII fig. 5) from Chaii. B. M. (Geol. Soc. Colln. No. 9976). Macrocephalitan (Lower Callovian, *diadematus* zone). Agrees with the inner whorls of the large example figured in Waagen's pl. XXVI; (b and c) outline whorl sections, full diameter apart. (See also pl. XXI, fig. 5).
- Fig. 2.** *TARAMELLICERAS PLANIFRONS*, sp. nov. Side-view of paratype, from the Katrol Beds (Middle Kimmeridgian). Locality unrecorded. J. H. Smith Colln. No. 23. P. 143.
- Figs. 3a, b.** *TARAMELLICERAS NEREIFORME*, sp. nov. Side-view and outline whorl-section of a second paratype from the Katrol Beds (Middle Kimmeridgian) of Fakirwadi. J. H. Smith Colln. P. 145.
- Figs. 4a, b.** *TARAMELLICERAS AKHER*, sp. nov. Side-view and sectional outline of a variety with more tabulate periphery and more flattened sides than the type. Katrol Beds (Middle Kimmeridgian), locality unrecorded. J. H. Smith Colln. P. 135.
- Fig. 5.** *HILDOGLOCHICERAS ? PLANUM* (Waagen). Suture-line, enlarged and diagrammatic, of holotype (Waagen's pl. XI, fig. 3) at diameter of 20mm. Katrol Beds (Kimmeridgian ?) Southwest of Nurrha. G. S. I. Colln. No 1/926. P. 160.
- Fig. 6.** *GLOCHICERAS ? PROPINQUUM* (Waagen). Suture-line, enlarged and diagrammatic, of holotype (Waagen's pl. XI, fig. 4) at diameter of 25mm. Katrol Beds (Middle Kimmeridgian), Khera. G. S. I. Colln. No. 1/927. P. 158.
- Fig. 7.** *PACHYCERAS INDICUM*, sp. nov. Inner whorls of a large example from the upper 'athleta beds' (*auncani* ? zone) of Ler. J. H. Smith Colln.
- Figs. 8a, b.** *KAMPTOKEPHALITES LAMELLOSUS* (J. de C. Sowerby). Side-view and outline whorl-section of holotype of J. de C. Sowerby's *Amm. lamellosus* (1840, pl. XXIII, fig. 8) from Chari. B. M. (Geol. Soc. Colln. No. 9979). Macrocephalitan (Lower Callovian, *diadematus* zone).

