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On the Blake Collection of Ammonites from Kachh, India,

By

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ON THE BLAKE COLLECTION OF AMMONITES FROM KACHH, INDIA.

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

The collection of Kachh ammonites made by the late Prof. J. F. Blake, and already referred to by Dr. Kitchin (43) in these memoirs, is now preserved in the British Museum (Natural History) and includes an interesting suite of over 570 specimens. Through the kindness of Drs. Smith Woodward and Bather the writer was permitted to study this collection, a few specimens in which Prof. Blake had named himself. Though there are a certain number of new species, these are not specially dealt with in the present paper, the object of which is rather to give a provisional account of the examination of the collection as a whole.

In order satisfactorily to revise the species of Jurassic ammonites from Kachh, a study of Waagen's types (100) would be necessary. The writer has unfortunately not been able to re-examine these types, so that it is feared that the true affinities of some of Waagen's species may still remain uncertain. According to Noetling (63) Waagen's figures are in many cases considerably, and not always happily, restored. But Noetling himself misrepresented the Baluchistan fauna he was describing; for the majority of his ammonite species are of Argovian, not Callovian age. Noetling not only followed Waagen in misinterpreting Sowerby's *A. lamellosus* and *A. opis* but also mistook Waagen's *Perisphinctes spirorbis* for *P. aberrans*, owing to the wrong numbering of Waagen's plates, though he re-examined Waagen's type.

Noetling's "*Sphaeroceras bullatum*," very distinct from the Kachh "*Sphaeroceras*" *cosmopolita*, Parona and Bonarelli sp. (70a), also "*Perisphinctes*" *balinensis* and "*P.*" *baluchistanensis*, Noetling, are probably of Callovian age; and the two latter species are of the type of *Grossouiria furcula* and *G. aff. spirorbis* (Neumayr) Waagen, here recorded from the Middle and Lower Chari groups of Jumara. The large example of *Macrocephalites macrocephalus*, figured by Noetling on pl. viii, may also belong to the *formosus*-group of early *macrocephali*, discussed below, though similar forms, here referred to a new genus, occur again, e.g. in the upper beds of Gangta Bét, associated with typical Argovian *Perisphinctes*. There seems to be no doubt, however, that the forms described by Noetling as *Macrocephalites polyphemus*, *lamellosus*, *opis*, *subcompressus* and *transiens* do not belong to the Callovian true *macrocephali*, and the confusion of many developments of different dates by Lemoine (48a) who more recently published a revision of the genus "*Macrocephalites*," has greatly complicated, instead of simplified, matters.

Again. Parona and Bonarelli (70b), who had dealt with the genus "*Macrocephalites*" ten years earlier, compared with *M. tumidus* (Reinecke) the holotype of *A. herveyi*. Sowerby (88, pl. 195, upper figure) though the more finely costate original of Sowerby's very misleading lower figure may be closer to Reinecke's species than the true *A. herveyi*. Parona and Bonarelli also included in *Macrocephalites tumidus* both *M. grantanus* (Oppel) and *Stephanoceras tumidum*, Waagen (non Reinecke), also *A. herveyi*, Sowerby 1840, (89, pl. xxiii, fig. 5) all of which species are quite distinct, as is Blake's (2a) "*Macrocephalites*" *herveyi* (non Sowerby).

There is thus a far too comprehensive interpretation of species and genera by many writers, and it may be recalled that Kitchin (43) in 1900, thought that the proportion of Kachh Cephalopoda formerly considered to be identical with European types, namely, 47 out of 156, was too large. Nevertheless, when strictly contemporaneous faunas are compared, e.g. the *Aspidoceras-Peltoceratoides-Perisphinctes* assemblage of Vieil St. Rémi, Ardennes, with the corresponding faunas in the Dhosa Oolites, there is striking agreement, though *Cardiocerates* are absent in India. It is hoped that the present attempt to correlate the Kachh fauna with European equivalents will prove of interest, likewise the incorporation in this paper, of a revision of the generic nomenclature, and the addition of the writer's interpretation of Sowerby's types of Kachh ammonites (89, 90), also preserved in the British Museum (Geological Society Collection) (1 & 21), and, like Waagen's species, generally much misunderstood.

The localities represented by the largest number of specimens are :—Kantcote (109), Khera (= Keera) (59), Jumara (57), Jikadi (21), Badi (40), Wanda (30), South Maujal (30), Katrol (28), Barodia (23), Ler (= Leir or Lair) (East 17, West 4), Jooria (20). The remaining localities include Jarra (= Jara), Gangta Bét, Soorka, Lodai, Narrha (= Nurrha), Charvar, known from Waagen's descriptions, and eighteen others. Lists of ammonites from some of these localities are given at the end of this paper, with the zonal information as marked by Prof. Blake on the specimens. Unfortunately there appears to be no manuscript record of these beds with their thicknesses and other desirable information, and the remainder of the specimens bear merely locality labels.

Eight examples of Cretaceous Ammonoids from the "Top-Beds" of Artara are referred to the Aptian. The Jurassic ammonites range from the Callovian to the Kimmeridgian, but do not represent a continuous succession of zones. Dacqué (26) considered the 1,800 m. of Kachh deposits to form a complete series from the Bathonian to "beyond the Tithonian." The Kachh ammonites as yet known, however, represent but fragments of the various divisions of the Middle and Upper Jurassic, as will be seen on perusal of Table II.

To take only the case of the *macrocephali*, there are several Callovian horizons containing these forms (not separated in Table II) in addition to those of the Cornbrash. The *macrocephalus* beds of Kachh may not correspond with the exact horizons studied by Model (57) in Franconia and by Buckman (11, vol. IV,

part 32) in England, but until exact data are to hand from other comparable localities, and the ideal universal sequence of the various horizons in the "*macrocephalus* beds" is established, an exact determination of the position within the old "*macrocephalus* zone" of the Kachh representatives is impossible.

As regards the larger divisions, equal caution must be exercised. The Kachh fauna, *e.g.*, does not appear to include deposits corresponding with undescribed Madagascar and Somaliland faunas of Argovian? and "Tithonian" ages, or anything comparable to the very peculiar (Callovian?) fauna described by Neumayr (59) and Crick (20) from Western Australia, whence Moore (58) had recorded a very doubtful *A. macrocephalus*. There may be enormous gaps, probably very incompletely bridged by plant-bearing beds; and a frequency of non-sequences is now found to be very general, though mostly not evident, in apparently continuous sections. When facies and lithology are similar, and the beds have, as in the Alps, been metamorphosed and disturbed tectonically, serious errors of observation have resulted (73). Any Bathonian or Callovian remnant in the Alps that happens to follow, non-sequentially, on the Bajocian is referred to the "Klaus Beds" and the dissimilarity of the ammonite faunas of these beds of different ages is erroneously attributed to horizontal variation. When the full sequence of all the horizons is known the thickness of the Jurassic will be found to be incomparably greater than is believed at present. The evolution of the ammonites could not have been nearly so rapid as is generally supposed on account of the discontinuous nature of even the most representative sections.

A few words are necessary with regard to the classification here adopted. The writer feels that the conventional "laws" of development, as enunciated by Hyatt and Buckman, will not enable us to solve the problem of ammonite phylogeny. The widespread simplification of suture-lines in post-Triassic stocks has not been fully appreciated and highly significant is the fact that *Phylloceratidae* alone survive into the Jurassic and, with *Lytoceratids*, persist to the uppermost Cretaceous. The appearance of ornamentation in *Phylloceratids* and *Lytoceratids*, from the Hettangian *Pleuracanthites* up to *Phylloceras strigile* of the Spiti Shales, with consequent modification of the suture line, also has not attracted attention. In the writer's opinion the natural order of Jurassic ammonites may well be from complex to simple, *i.e.* the reverse of that given by Buckman (10c). In the circumstances, it is impossible to regard the classification here adopted as anything but provisional.

With highly specialised nomenclature and the popular skipping of hypothetical stages the lineal descendance of the family *Oppelidae* from Bajocian *Oppelia* might be brilliantly elaborated; but it is far more probable that this family comprises merely a heterogeneous assemblage of genera that occupy a position intermediate between the persisting *Phylloceratidae* and *Lytoceratidae* on the one hand, and the trachyostracous families on the other, corresponding to that of the Cretaceous *Desmoceratidae*. That is to say, successive waves of so-called

Lissoceras, "*Haploceras*" and other intermediate types, derived probably via Sowerbycerates and Rhacophyllitids, like the earlier *Pleuracanthites*, *Ectocentrites*, **Aegolytoceras** (gen. nov.¹), *Derolytoceras*, (²), *Amphiceras* and others, took on coarse ornamentation, with corresponding change in the suture line. In Cretaceous times, the same two more or less stationary parent-stocks (*Phylloceratidae* and *Lytoceratidae*) still persist and radiate continuously short-lived adaptive offshoots. Some of the less specialised (or ornamented) of these, appearing seemingly as "discontinuous modifications" or "de Vriesian mutations" at successive levels, may simulate a series and the "family" *Desmoceratidae* includes such a heterogeneous assemblage of transitional forms, having a common origin in *Phylloceratidae* whereas the (sculpturally) more highly differentiated but suturally reduced mutations and certain aberrant lateral offshoots we include in a convenient family *Hoplitidae*, also a heterogeneous group of descendants of the polyphyletic *Desmoceratidae*. Suffice for the present to point out that the ammonite families here discussed are morphological rather than genetic units, and that family names like *Pachyceratidae*, *Proplanulitidae*, *Perisphinctidae*, &c. are used, as appeared to the writer most expedient with the material at hand, for groups of genera connected (*morphologically*) by transitions, by geological occurrence and close association in date. These families will of course be revised later with a view to their direct or indirect connection with the fundamental families *Phylloceratidae* and *Lytoceratidae*.

PHYLLOCERATIDAE.

The family is represented by twenty-three specimens of *Phylloceras*, including the Callovian *Ph. disputabile* (Zittel) Waagen, *Ph. vicarium* Waagen, and the group of *Ph. mediterraneum* (Neumayr) var. *indica*, Lemoine. *Ph. lodaense*, Waagen, from the Dhosa Oolite, is numerous represented, and three examples from the Upper Jurassic are referred to *Ph. insulare*, Waagen. No *Sowerbyceras* has yet been recorded from Kachh.

The writer, on a previous occasion, (92a) rejected the divisions within the genus *Phylloceras* proposed by Prinz (74), and must oppose similarly the attempts of Jullien (41) and Buckman (11a) to split up the genus *Phylloceras*, though Douvillé (29) indeed has adopted Jullien's '*Triphyllites*' for the well-known *Ph. disputabile*, here recorded.

LYTOCERATIDAE.

The family includes four examples of *Lytoceras* ('*Thysanolytoceras*') *adeloides* (Kudernatsch) Waagen, from the Chari group, and one specimen of a *Lytoceras* of the *montanum* group, from the Kimmeridgian (?) of North Moondan.

¹ For *Geyeria*, Fucini, non auct. Type; *A. serorugatus*, Stur. (Fucini: "Cetona." *Pal. Ital.*, Vol. VII, 1901, p. 76, pl. XII, fig. 9).

² Restricted to *D. tortum*, Quenstedt (Rosenberg) of the Middle Lias ("Lias. Ceph. Fauna d. Kratz-A. &c." *Beitr. Pal. Geol. Öst.-Ung.*, Vol. XXII, 1909, p. 250, pl. XI(II), figs. 29a-d.).

The absence of the very evolute and compressed Lytoceratids of the group of *Lytoceras* ('*Protetragonites*') *tripartitum*, Raspail sp. (= **Polystomiceras**, gen. nov.) as of the genus *Sowerbyceras* is interesting; for in East Africa they occur with *Phylloceras* cf. *disputabile* and other forms in Callovian beds that present close analogy with those of the Crimea, described by Tsyrovitch (97), and that were thought to correspond in age with at least part of the *macrocephalus* beds of Kachh. The writer may here also recall that when describing this East African fauna (92b) he stated that the zone of *M. macrocephalus* (Cornbrash) should be included in the Bathonian, and the Callovian considered to begin with the zone of *Proplanulites koenigi*. Subsequent study of Blake's types of Cornbrash ammonites and numerous Continental forms of *Macrocephalites* has, however, shown that the typical *Macrocephalites*, that belong to the Callovian, are not represented in Blake's Bathonian (Cornbrash) fauna. The genus *Polystomiceras* thus ranges into the Callovian.

OPPELIDAE.

The family is represented by fifty-nine specimens, besides an example of an *Aptychus*, from the Dhosa Oolite of Jikadi (Bed 22), somewhat like Waagen's fig. 8a of Plate XI, but wider, which may possibly belong to a different family. The Callovian Opepids include *Alcidia* cf. *subdisca*, d'Orbigny sp., *A. nurrhaensis* Waagen sp., and *A. cf. subcostaria* (Waagen non Opep) and a slightly later group of species, perhaps true *Hecticoceras*, including *H. lairensis*, *H. trilineatum*, and *H. crassefalcatum*, Waagen sp., with some resemblance to Buckman's genus *Putealicerias*. The writer's opinion on the grouping of certain forms of *Hecticoceras* was given in a previous paper (92c). To this group also belongs '*Opepia*' *orientalis*, d'Orbigny non Waagen = *A. corrugatus*, J. de C. Sowerby 1840, pl. XXIII, fig. 12, No. 9983, Geol. Soc. Coll., non *A. corrugatus*, J. de C. Sowerby, Min. Conch. 1824, pl. 451, fig. 3 = *Opepia ignobilis*, Waagen non Sowerby sp. The forms are probably not directly related to the earlier '*Hecticoceras*' of the *primaevum* group, also found in the British Stonesfield Slate (= *A. waterhousi*, Phillips non Morris & Lycett) and there associated with a new genus **Neactinoceras** (type: *Ammon. micromphalus*, Phillips, [72], as represented by B. M. No. Ci4082) which was not recorded by Woodward (101). This new genus includes also *Amm. busqueti*, Grossouvre (37a).

There are also three specimens of *Oecotraustes* cf. *conjungens* (Mayer) Waagen and "*Oe. conjungens*", Loczy (50a) non Waagen, and an example of '*Opepia*' *orientalis* Waagen non d'Orbigny, for which latter the new name **suborientalis** and the new genus: **Hecticoceratoides**, gen. nov. (type = specimen No. 117, agreeing with Waagen's fig. 5 of pl. XI) are proposed. This may be a development of the *subpunctata*-group of "*Hecticoceras*".

A. fornix, J. de C. Sowerby (No. 10079, Geol. Soc. Coll.) is transitional from *Alcidia* to the more involute *Petitclercia* but has the peculiar rows of fine tubercles of *P. multiformis*, Grossouvre sp. (36).

Twenty-one Upper Callovian and Dhosa Oolite examples are referred to '*Lunuloceras*' and Sowerby's type of *A. ignobilis* (non Waagen, No. 9984, Geol. Soc. Coll.) is probably an immature specimen of a species of this group. Since *Hecticoceras lunula* Reinecke sp., according to Reuter (77b), however, occurs below the *punctata*-group of *Hecticoceras*, the term *Lunuloceras* cannot really be used for these untuberculate Oxfordian forms. Some at least, e.g. the Wanda examples mentioned below, may belong to *Trimarginites*.

There are also one *Taramelliceras* (cf. *episcopalis*, de Loriol) and two doubtful *Ochetoceras* (*hersilia*-group).

The Upper Jurassic forms include mostly *Neumayriceras* (*kachhensis*, Waagen and allied species) but also one '*Haploceras*' (= *Glochiceras*?) and two *Streblites*. There are no examples of '*Haploceras*' *deplanatum* Lemoine (non Waagen?) sp., so common in Madagascar, and associated with peculiar Aspidocerates and other undescribed forms, also unrepresented from India. The Madagascar beds are classed by Lemoine (48e) and Haug (38) as Sequanian or Kimmeridgian and compared with the Katrol Group of India and the Mombasa beds of East Africa (27) but are probably of different age from either. The *Streblites* are not well enough preserved for exact comparison with *Uhligites hectori*, n. n. = *Ammonites* (Kawhia) in Hector (40) and the Tithonian group of *U. krafftii* (Uhlig & Suess) and *U. crassicostatus*, Uhlig sp. (98), dealt with by the writer in a paper on "Ammonites from New Zealand" (94). The suture-line, however, of the Kachh *Streblites* is of the same type as that of *U. nouhuysi*, Boehm (5) or of *U. motutaranus*, Boehm (6a) with the ventral lobe reaching not lower than the apex of the first lateral saddle, and with an extremely wide first lateral lobe.

"*Hecticoceras*" *kobelli*, Oppel sp., also from the Katrol-group (?), but not represented in the present collection belongs to a group of forms for which the new genus **Hildglochiceras**, gen. nov. (genotype: *H. latistrigatum*, Uhlig sp. (98), p. 27, pl. II, figs. 4a-c, pl. III, fig. 5, cast in B. M. No. C8596) is proposed. This genus has no affinity whatever with the Callovian *Hecticoceras* here discussed.

Apart from the eight Aptian ammonites described in the final paragraph of this paper, the remaining 475 examples belong to what formerly was regarded as one super-family "*Stephanoceratidae*." This is now subdivided into a number of families, the inter-relations of which, however, have yet to be determined. If, as the writer believes, the fundamental and persisting ammonite families *Phylloceratidae* and *Lytoceratidae* have repeatedly, during the Jurassic period, replenished e.g., "Oppelids," by the acquisition of ornamentation and consequent modification of the suture-line, it will seem unnecessary temporarily to emend the existing families. This is done here merely to facilitate the grouping together of genera of corresponding sets of strata; moreover very restricted families comprising only more or less contemporaneous genera, are more likely to include genetically allied units.

The genus "*Macrocephalites*" in the customary interpretation, is represented by 116 specimens, but of these only certain Callovian species are here included in that genus. Mr. Buckman's family:—

MACROCEPHALITIDAE,

not yet defined. is adopted for this very large group, sufficiently distinct from the earlier *Sphaeroceratidae*, *Morphoceratidae* and *Tulitidae*, which successively produced somewhat similar types. The *bullati* of the *macrocephalus*-zone, for which the new genus **Kheraiceras** is proposed (genotype: *K. cosmopolita*, Parona and Bonarelli sp. = *Stephanoceras bullatum*, Waagen, pl. 129, pl. xxxii, fig. 1) and which are not directly related to the Bathonian so-called '*bullati*' of the family *Morphoceratidae*, belong to the family *Macrocephalitidae*, but not the Cadoceratid group of '*Macrocephalites*' *ishmae*, Keyserling sp., which probably includes the form compared to *M. compressus* (Quenstedt) by Madsen (53). This lineage is renamed **Arcticoceras**, gen. nov. (genotype=*A. ishmae*, Keyserling sp., in Keyserling & Krusenstern: 'Petschora' 1846; p. 331, pl. xx, figs. 8-10) and is related to *Pseudocadoceras*, Buckman, but does not comprise '*A. ishmae*, var. *arcticus*,' Newton (61j).

The collection includes twenty-four specimens of the typical *Macrocephalites madagascariensis*, Lemoine, *M. chariensis* and *M. semilaevis* (Waagen), *M. tumidus* (Waagen non Reinecke), and *M. formosus*, Sowerby sp., the examples of the last species shewing perfect agreement with Sowerby's holotype (B. M. No. 9978, Geol. Soc. Coll.). Waagen's *St. macrocephalum*, depicted on pl. xxvii, figs. 1a, b, included in the synonymy of *M. madagascariensis* (= *noetlingi*) by Lemoine (48c), is close to Sowerby's species, but there is only one fragmentary British example from Northamptonshire in the B. M. (No. 82389) that has some resemblance to the forms of this *formosus*-group.

The specimen figured by J. de C. Sowerby as *A. herveyi* (89, pl. xxiii, fig. 5, non 90, p. 719, nec 88, pl. 195) agrees with Waagen's *St. tumidum*, pl. xxvi, and has the suture-line of fig. 1c of pl. xxvii (B. M. No. 9976, Geol. Soc. Coll.). It is thus not identical with *Macrocephalites grantanus* as Oppel (66) and Waagen (100a) thought, or with *M. tumidus*, Reuter (77a), though the latter form which also occurs in the Kellaways Clay of Chippenham, appears to be very similar. An example agreeing with Waagen's fig. 2, pl. xxvii, also erroneously called *Steph. tumidum*, but with a much wider whorl-side and smaller umbilicus, connects the two species *M. tumidus* (Waagen non Reinecke) and *M. madagascariensis*, Lemoine.

The true *M. herveyi* (Sowerby) and its compressed representative (*M. compressus*, Blake pars, non Quenstedt) and the tumid varieties, leading to *M. typicus*, Blake, and *M. herveyi*, Lissajous (49) non Sowerby, on the one hand, and to *M. macrocephalus*, Blake non auct., *M. tumidus* (Reinecke) Blake, and *M. terebratus*, Phillips sp., on the other, may not be represented in India (*Pleurocephalites* and *Catacephalites*, S. Buckman).

Another twenty-four specimens include the more coarsely ornamented group of *Macrocephalites dimerus*, *diadematus*, *chrysoolithicus*, *magnumbilicatus* (Waagen),

grantanus (Oppel, Waagen), *subtrapezinus* (Waagen), and *lamellosus*, Waagen non Sowerby sp. The true *M. lamellosus* Sowerby (B. M. No. 9979, Geol. Soc. Coll.) is not represented in the Blake Collection. It differs from Waagen's *St. lamellosum* and from the forms figured by Bukowski (13) and Burckhardt (14) in having the ribs simply concave forwards, not biconcave; but its suture-line is not visible, and it is not certain that it belongs to this genus. The European forms closest to the true *A. lamellosus* appear to be undescribed types of the *herveyi*-group (B. M. No. 82389 from Northants, and 74227 from Niort, Deux Sèvres), which, however, are more evolute, whereas the true *Macrocephali* (e.g., C 10564 from Chanaz, Savoy) have quite a different rib-curve. *M. diadematus*, Waagen, as here interpreted, however, may be distinguished from *M. macrocephalus*, Blake non auct., (2b) only by greater thickness.

A new compressed form of the group of *M. chrysoolithicus* somewhat resembles '*M. rotangi*, Boehm (4a) mentioned below, and is another species that might be mistaken for one of the later '*Macrocephalites*' of the *maya*-group; but its suture-line is of the type of that of *M. chrysoolithicus*, and there are comparable examples in the British Cornbrash, apparently connecting this species with *M. terebratus*, Phillips sp. (= *M. macrocephalus*, Blake, pl. III, fig. 6 only). The difference in the type of suture-line, namely, a radial or descending line in the Callovian, and an ascending, arched line in the Argovian forms, mentioned by Waagen (100b) and Uhlig (98) generally holds good, notwithstanding Boehm's criticisms (8) but the bases of the lobes are ascending in most '*Macrocephalites*.'

Four examples, including one new species, of the group of *M. subcompressus* (Waagen) and *keeuwensis*, Boehm (7a), lead to *Steph. eucyclum*, Waagen, for which the new genus **Eucycloceras**, gen. nov. (type = specimen 246, agreeing with Waagen's fig. 1 of pl. XXXV) is proposed. This is represented by six examples, from No. 10, Khera Hill, associated with *Macrocephalites* (*Eucycloceras*?) of the *subcompressus* type (Middle Chari Group) and thus not of Dhosa Oolite age as Waagen and Boehm thought. In the Kosmoceratid genera *Kepplerites* and allies, with somewhat similar outer whorls, the ventral area has a distinct flattened zone (runcinate stage) in the young. Quenstedt's *M. compressus*, which is more finely ornamented than *M. typicus*, Blake, has nothing to do with this Indian *subcompressus*-group, characterised by peripheral projection of the radii; and Blake's *M. compressus* includes both forms such as the figured example, comparable to the inner whorls of Quenstedt's '*Riesen-tumidus*' (76a) and resembling *M. canizzaroi* (Gemmellaro) and *M. pilleti*, Parona and Bonarelli, and the new but common species of the *herveyi*-group, referred to before.

The later '*Macrocephalites*,' belonging to a number of lineages, are here provisionally included in the family:—

PACHYCERATIDÆ, Buckman emend.

A fragmentary specimen of the Oxfordian genus *Pachyceras*? with rounded umbilical tubercles, comes from No. 22 at Jikadi, associated with *Peltoceras diversi-*

forme, *Lunuloceras*, etc. Considering the complete absence of *Cadoceratidae* and *Cardioceratidae* in the Kachh Jurassic (see 85) the record of this unique *Pachyceras*? is of interest. Now the stock which gave rise to *Pachyceras* and *Tornquistes* in the European Jurassic may also include the ancestral forms of the 'Macrocephalites' here discussed: for the young of *A. maya*, J. de C. Sowerby and of allied species (Waagen, pl. XXVIII, fig. 2 and pl. XXXII, fig. 4) reveal very broad, strongly rursiradiate costae, and a suture-line like that of *M. greppini*, P. de Loriol (51a), thus suggesting affinity with a tumid Quenstedtoceratid stock (compare e.g., *Quenstedticeras(?) tumidum*, Reeside) (80). Direct connection, perhaps, is improbable, but at any rate the stocks here discussed seem more closely allied to the family *Cadoceratidae* and especially its branch *Pachyceratidae*, than to the group of 'Perisphinctes' *praecursor*, Waagen. This was included in *Grossouwia* by Siemiradzki (87a), but may be nearer to *Poculisphinctes*, S. Buckman and the writer was at first inclined to regard it as the ancestor of the *maya*-group.

For this latter group the new genus

Mayaites, gen. nov.

(genotype *A. maya*, J. de C. Sowerby, 1840, Trans. Geol. Soc. (II), vol. v, pl. lxi, fig. 8, B. M. No. 10074, Geol. Soc. Coll.) is proposed. Waagen's "*Steph.*" *maya* is thinner and has finer secondary costation than Sowerby's type, and is here renamed *M. Lemoini*, n. n. Apart from this typical group represented by twenty-seven examples, and comprising in addition, 'Macrocephalites' *rotangi* and *batavo-indicus*, Boehm (4b), '*M.*' *subtrapezinus*, Lemoine non Waagen, and, probably, '*Kossmatia*' *uhligi*, Lemoine (48b), and the East African forms figured by Tornquist (96) &c., the genus *Mayaites*¹ includes also the compressed *M. transiens* (Waagen) and allied species (15 examples), further the depressed *M. subtumidus* Waagen sp. To the last species represented by eleven examples, some being varieties, also belongs *A. herveyi*, J. de C. Sowerby, 1840, p. 719 (woodcut), No. 10067, non *A. herveyi*, J. Sowerby 1818, nec *A. herveyi*, J. de C. Sowerby, 1840, pl. xxiii, fig. 5 (= *Macrocephalites tumidus* (Reinecke) Waagen, see ante).

The group of *Mayaites polyphemus*, Waagen sp., which grows to gigantic size and shews a striking similarity to *Tornquistes* on the outer whorl, is represented by two examples.

Some new forms, of *Otoites*-aspect, are coarser in costation than the typical young *Mayaites*, and widely umbilicated, i.e., are close to the young "*St.*" *elephantinum*, figured by Waagen on pl. XXXII, fig. 4. The type of *A. elephantinus*, Sowerby (No. 9977, Geol. Soc. Coll.) unfortunately does not show the suture-line, but with a number of ribs equal to that of Waagen's specimen

¹ '*M.*' *waageni* and '*M.*' *kitchini*, Uhlig (98a) probably belong to *Grayiceras*.

(pl. XXXI, fig. 3) there is a decided sinus forward peripherally and the costae are very sharp. The new genus :—

Dhosaites, gen. nov.

is proposed for this *elephantinus*-group, connected with the genus *Mayaites* by forms like No. 266, somewhat resembling the evolute varieties of "*M.*" *palmarus*, and "*M.*" *cocosi*, Boehm. The genus also includes *D. grayi*, n. n. (= *Steph. nepalensis*, Waagen non Gray, p. 136, pl. XXXV, fig. 2, No. 279) and a new intermediate species (No. 322). The last two shew a striking resemblance, except in suture-line, to the Callovian group of *Macrocephalites dimerus* and *M. magnum-bilicatus*, Waagen sp.; Lemoine, indeed, considered the closely similar *D. bambusae*, Boehm sp. to be near to the Callovian species, though Boehm had correctly compared it to Waagen's "*Steph. nepalensis*." Boehm's (7b) comparison of *D. bambusae*, however, to the true *Macrocephalites mantavaranus*, Boehm, of the *formosus*-group, is less fortunate.

'*Stephanoceras (Ammonites) macrocephalus*' recorded by Newton (60) from North of Andranosamonta, Madagascar, may represent a globose development of *Dhosaites*, but in the bluntness of its ribs resembles *Tornquistes*. It is distinct in matrix from the ammonites described by the same author from South of Ankaramy, also preserved in the British Museum, namely, "*Steph. calloviense*," (perhaps *Mayaites tenuicostatus*, Boehm. sp.) "*S. macrocephalum*" and "*S. herveyi*," one example of the last species (No. C. 3589) possibly identical with "*Macrocephalites*" *elephantinus*, of Lemoine and thus a *Dhosaites*.

The Mombasa fauna, according to the rich collections in the British Museum, includes an undescribed species (No. C. 10988) that is transitional in shape and ornamentation from *Mayaites olcostephanoides*, Tornquist, to *Dhosaites*.

In connection with the genera *Mayaites* and *Dhosaites* it may be convenient to refer to *A. fissus* and *A. opis*, Sowerby, and to a number of other groups that have erroneously been attached to the Upper Jurassic "*Macrocephalites*." Sowerby's type of *A. fissus* (pl. LXI, fig. 11, B. M. No. 10077, Geol. Soc. Coll.) is poorly preserved but quite unlike Waagen's figure of the same species (pl. XXXVII, fig. 1, p. 134); for whereas the latter shews a smooth periphery on the body-chamber, bringing it close to *A. opis*, Sow. the holotype has extremely coarse and blunt ribbing across the siphonal area of the body-chamber. This type of costation is not found in any other Indian form known to the writer, but in some Portlandian Perisphinctids of the *gorei* and *pseudogigas* zones, and possibly pathological. The wide external saddle of the suture-line of this doubtful species is somewhat like that of *Eucycloceras eucyclum* (Waagen, pl. XXXV, fig. 1c).

A. opis, Sow. was apparently confused by Waagen with the Callovian *Eucycloceras*, but his Argovian form, as represented probably by the last quarter of a whorl of the example depicted on pl. XXXVI, fig. 1a, is before the writer in a specimen from Kalabagh (Dr. Fleming Coll., Geol. Soc. 9377. "below Coal-

Shale," 65). The new genus **Subkossmatia** (genotype: *A. opis*, Sowerby, non Waagen, 1840, pl. XXIII, fig. 9, B. M. No. 9980, Geol. Soc. Coll.) is proposed for this stock, perhaps allied to the unconstricted Upper Argovian "*Idoceras*" of the *planula*-group.

Sowerby's type does not shew the weakening of the costae on the periphery characteristic of Waagen's form and found also in Waagen's "*Steph.*" *fissum*, doubtfully included in this genus. Both these species will require new specific names, if the figures are reliable.

The peripheral aspect and distinctive ribbing of these forms of *Subkossmatia*, to which may perhaps be added *S. alfurica*, Boehm sp. suggest that they are not related to *Mayaites* of the *transiens*-group as Waagen and later authors held. *Subkossmatia* is provisionally included with *Ringsteadia* in the family **Idoceratidae**, n.

Some forms of the genus *Dhosaites* superficially resemble *A. nepalensis*, Blanford (3) non Gray (= **blanfordi**, n. n.) refigured as "*Simbirskites*" *nepaulensis*, Gray, by Uhlig. The new genus **Grayiceras** is here proposed for this development (genotype; *G. blanfordi*, n. n. = *Simbirskites nepaulensis*, Blanford non Gray, in Uhlig (98), pl. XLV. A, fig. 1, B. M. No. 1016, Geol. Soc. Coll. 22). This Tithonian development has no affinity with the later, equally sharply ribbed, but tuberculate genus *Simbirskites* of the family *Olcostephanidae*, to which Uhlig had referred it with a number of allied species. "*Simbirskites*" *mexicanus*, Burckhardt, from the *Durangites* Beds, is very close to Gray's type of *G. nepaulense* (B. M. No. C5052) and also belongs to the genus *Grayiceras*.

The genus *Kossmatia*, Uhlig, which includes only *K. tenuistriata*, Gray sp. (genotype, see 35 and Crick 22 and 23), *K. desmidioptycha*, Uhlig, *K. richteri*, Oppel sp., and such Mexican and Crimean forms as *K. victoris*, Burckhardt sp. (16 & 17) and *K. pontica*, Retowski sp. (81) is not represented in the Blake Collection. Like *Durangites*, it may belong to the family *Berriasellidae*, and it shews close resemblance to the Tithonian Spiti-Shale genus *Paraboliceras* (type: *P. jubar*, Strachey-Blanford sp., B. M. No. C. 5043) which probably is closely allied to *Berriasella*. The resemblance of *Paraboliceras propinquum*, Uhlig sp. to *Grossouvria* is merely an illustration of homoeomorphy, and it may be added here that the ammonite from New Guinea, figured by Etheridge (31) as allied to *A. lingulatus* (Quenstedt) probably belongs to a species morphologically intermediate between *Kossmatia desmidioptycha* and the genus *Paraboliceras*. It was compared by Etheridge to *A. levi*, Forbes (34) but that species (holotype in B. M. Geol. Soc. Coll.) is a Barremian *Pulchellia*, close to *P. didayana* (d'Orbigny) Kilian (42).

REINECKEIDAE.

The family is represented by five examples of the Callovian genus *Reineckeia*, one (413) of which seems to agree with J. de C. Sowerby's type of *R. arthritica* (B. M. No. 9981, Geol. Soc. Coll.). *A. arthriticus*, d'Orbigny (68) = *R. gigonda-*

Lower Chari Group—*contd.*

- No. 11 . . . *Macrocephalites* aff. *formosus*, Sow. sp. (245).
 No. 12 . . . *Grossouiria* cf. *curvicosta* (Op.) W. sp. (352).
 No. 14 . . . *Phylloceras disputabile* (Zitt.) W. (86, 7) ; *Macrocephalites* cf. *formosus*,
 Sow. sp. (240), *M.* cf. *lamellosus*, W. non Sow. sp. (239).
 No. 15 . . . *Macrocephalites?* sp. ind. (350).
 No. 20 . . . *Grossouiria?* *congener*, W. sp. (349).
 "Below Oxfordian" *Phylloceras mediterraneum* (Neum.) var. *indica*, Lem. (88) ; *Lytoceras*
adeloides, Kud. sp. (110) ; *Macrocephalites tumidus* (Rein.) W. sp. (252),
M. formosus, Sow. sp. (253), *M.* sp. juv. cf. *dimerus*, W. sp. (255), *M.*
chrysoolithicus, W. sp. (256, 7), *M.* cf. *chariensis*, W. sp. (254), *Grossouir-*
ria sp. ind. (372).
 Up. Gold. Oolite *Macrocephalites* aff. *formosus*, Sow. sp. (241, 3), *M. chariensis*, W. sp.
 (242) ; *Grossouiria?* (*Subgrossouiria?*) aff. *evoluta*, Neum. sp. (351).
 Gold. Oolite . *Macrocephalites* cf. *chrysoolithicus*, W. sp. (244).
 Low. Gold. Ool. *Macrocephalites* sp. (238).
 Khera? . . . *Macrocephalites formosus*, Sow. sp. (237).

II.—Jamura.

Katrol Group—

- Unclassified . . . *Neumayriceras* aff. *kachhense*, W. sp. (116) ; " *Perisphinctes* " sp. ind. (348).

Dhosa Oolite—

- No. 1 . . . *Phylloceras* sp. ind. (94) ; *Mayaites maya* (Sow.) var. (284) ; *Perisphinctes*
rota W. (342), *P. indogermanus*, W. (343, 5-7), *P. subevolutus*, W. (341),
P. sp. juv. (344) ; *Peltoceratoides* sp. n? aff. *semirugosus*, W. sp. (173-4,
 205) ; *Aspidoceras* cf. *ponderosum* (W.) Bor. (187).

Middle Chari Group—

- No. 3 . . . *Kinkelinceras* aff. *omphalodes*, W. sp. (437), *K. mutans*, W. sp. (340).
 No. 7 . . . *Subgrossouiria aberrans*, W. sp. (339).
 No. 8 . . . *Kinkelinceras* aff. *omphalodes*, W. sp. (335), *K.* aff. *mutans*, W. sp. (336) ;
Reineckeia cf. *nodosa*, Till (337, 8).

(?Middle and) Lower Chari Group—

- No. 10 . . . *Phylloceras* cf. *vicarium*, W. (105) ; *Alcidia* cf. *subdisca*, d'Orb. sp. (111),
A. cf. *subcostaria* (Op.) W. sp. (112-3, 15) *Hecticoceratoides suborientalis*,
 nov. (117) ; *Oecotraustes* cf. *conjungens* (May.) W. (114). *Macrocephalites*
(Eucycloceras?) cf. *subcompressus* W. sp. (223), *M.* spp. (235, 6, 6a) ;
Grossouiria aff. *spirorbis* Neum. sp. (334).
 Nos. 9-11 . . . *Macrocephalites chariensis*, W. sp. (222), *M. diadematus*, W. sp. (226), *M.*
 cf. *chrysoolithicus*, W. sp. (225, 229).
 No. 11 . . . *Macrocephalites chariensis*, W. sp. (221, 228), *M.* cf. *diadematus*, W. sp.
 (234), *M.* cf. *subtrapezinus*, W. sp. (224), *M. dimerus*, W. sp. (233),
M. magnumbilicatus, W. sp. (232), *M.* cf. *semilaevis*, W. sp. (227),
M. spp. (230, 1) ; *Grossouiria* aff. *curvicosta*, (Op.) W. sp. (331), *G.*
furcula, Neum. sp. 330, *G. patina* Neum. sp. (332), *G. euryptycha*, Neum.
 sp. (333).

Lower Chari Group—

- Below 12 . . . *Macrocephalites* cf. *chariensis* W. sp. (219), *M.* sp. (220) ; *Grossouiria?*
 aff. *congener*, W. sp. (329).
 No. 13a . . . *Phylloceras* sp. ind. (85).
 13 or 14a . . . *Macrocephalites madagascariensis*, Lem. (217), *M.* aff. *chariensis*, W. sp.
 (218).

