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A CLASSIFICATION OF THE JURASSIC AMMONITES

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PURPOSE OF THIS PAPER

THE subject of this paper has been pondered by the author for a considerable time in the course of systematic work on particular groups. Two facts have stood out. First, that the Ammonoidea offer perfect material for experimenting with, improving, and moulding a classification that shall reflect current ideas of relationships in time and space. Second, that all the textbooks are at least a quarter of a century out of date and to judge by the literature the present state of classification of the order is chaotic.

A long-term program to reconcile these two facts has been given urgency by the project for an international Treatise on Invertebrate Paleontology initiated by the Paleontological Society in America. The present paper propounds a scheme of classification in the hope of attracting constructive criticism, so that by the time the Treatise goes to press the Mesozoic Ammonoidea shall have the best possible systematic treatment compatible with present-day knowledge. Any corrections and criticisms, whether privately communicated or printed, will be welcomed and considered.*

TAXONOMIC SCALE

Genera and species.—It has repeatedly been pointed out by Bather and others that the primary object of a classification is to be useful. The systematic categories most frequently, and in ordinary interchange of ideas between paleontologists invariably, used are the genus and species. Neither in speech nor in writing do we say that a bed is dated by the finding of a "Mollusca, Cephalopoda, Ammonoidea, Stephanoceratacea, Macrocephalitidae, *Macrocephalites* (*Kamptokephalites*) *herveyi*." We say that we have found a *Macrocephalites herveyi*. The other systematic categories are an academic matter, and they must be scaled up or down in such a way that they shall be subservient to the usable, conventional genus. They never appear except in monographs and textbooks, and it is immaterial in practice what value is placed on any particular term in the hierarchy and how many terms the hierarchy shall contain.

Theoretically, at least, the number of species named reflects the number of forms, and so is more or less an objective matter. The genus, however, represents a subjective grouping of species to indicate supposed relationships and is wholly dependent on the judgment of the paleontologist. Here is where the systematist has the opportunity to pitch his classification on such a scale that it shall be acceptable and useful to his colleagues. If he insists on too many genera his judgment is at fault and his classification will be unusable and remain unused. He need not compromise with his conscience and suppress differences which he knows exist, for these can be expressed in the creation of subgenera. Anyone making a collection of *Kosmoceras* from an Oxford Clay pit will want to classify them in Buckman's "genera" *Kosmoceras*, *Bikosmokeras*, *Lobokosmokeras*, *Spinikosmokeras*, *Kuklokosmokeras*, etc., but he will never feel called upon to abandon the generic name *Kosmoceras* in favor of these in practical parlance; in any case, the differences between them are often so subtle, and their nomenclatural stability so dubious and unpredictable, that full justice is done them when they are enshrined as subgenera in the monographs and forgotten.

Moreover, the creation of too many genera defeats one of the principal objects of binomial nomenclature: namely, to indicate relationships between species by grouping like species under the same name. The logical conclusion of such a procedure as Buckman's in splitting up the genus *Dac-*

* For preliminary reading of the typescript and for suggestions, I am grateful to Mr. C. W. Wright, Mr. D. T. Donovan, Dr. B. Kummel, and Mr. Francis Hemming.

tylioceras into some thirty new genera is to have every species in a different genus: at which point all genera might as well be abandoned and a return made to *Ammonites*.

Families and subfamilies.—Families and subfamilies again are purely subjective categories, representing convenient and supposedly significant groupings of genera. The numbers of each required will be largely dependent on the number of genera recognized; but to some extent the quantity is determined by convention and the number of names already existing and usually recognized. In the 1920's new families were created at a great pace, but in the 1930's and 1940's there has been a tendency to down-grade many of them to subfamilies. It is unavoidable that the subfamilies of some authors should overlap with or be equivalent to the genera of others.

HIGHER TAXONOMIC CATEGORIES, AND THE BASES OF CLASSIFICATION

The higher taxonomic categories, however, begin to be controlled from above, by the necessity that they shall reflect the major natural subdivisions of the order Ammonoidea and the main relationships indicated by current evolutionary theory.

Having started at the bottom of the hierarchy, with the genus and species, and worked upwards, we now turn to the top, to the Order Ammonoidea, and work downwards, leaving the families and subfamilies in the middle to take care of themselves.

In subdividing the Ammonoidea, and confining ourselves for simplicity to the Jurassic and Cretaceous members, the first objective is to reflect in our classification the three great subdivisions recognized by E. Suess in 1865, when he split off from the rest of the ammonites the two genera *Phylloceras* and *Lytoceras*. The importance of these two conservative stocks and their special relationships to the rest of the order have been brought out with increasing clarity as research has progressed (though the details of those special relationships are still far from certainly understood). These three great main trunks of the Ammonoidea are here expressed as the suborders Phylloceratina, Lytoceratina, Ammonitina, using the form of suborder termination first recommended for the international Treatise on Invertebrate Paleontology.

Within the suborders Phylloceratina and Lytoceratina little further subdivision is necessary for the Jurassic forms until the rank of family. But within the suborder Ammonitina there are major subdivisions of fundamental significance in the light of evolutionary theory, and for these the category of superfamilies is now used.

Since 1920, the basis of classification at the superfamily level has been revolutionized by Salfeld's theory of Iterative Evolution. According to this theory the Ammonitina were again and again replenished, sometimes perhaps wholly replaced, by evolutionary radiations from the conservative suborders Phylloceratina and Lytoceratina, mainly from the latter. How often major replenishments have taken place is highly controversial, but some seem to be fairly satisfactorily established. The first of these radiations, from some offshoot probably of the Triassic Monophyllitidae, gave rise to the Psiloceratidae of the Hettangian and through them presumably to the other Arietitaceae of the Sinemurian and early Pliensbachian. In the Sinemurian there was a wave of evolutionary radiations from Lytoceratina, which gave rise to the Eoderoceratacеae (olim Deroceratida). These continued to flourish until the end of the Pliensbachian; for it has been shown that the Liparoceratidae of the uppermost Lower Lias probably gave rise to the Amaltheidae of the Middle Lias. During the lower Pliensbachian another radiation from the Lytoceratina produced *Prodactylioceras* and thence at least part of the family Dactylioceratidae, though Dr. Spath thinks that another part of the family was derived more indirectly from Eoderoceratidae.

In the Domerian another great superfamily arose, the Harpoceratacеae, which flourished through the Toarcian and Aalenian, giving rise to the important families Hammatoceratidae, Sonninidae and Graphoceratidae of the Aalenian and Bajocian and probably lingering on for a final burst as the Clydoniceratidae of the Bathonian. The Harpoceratacеae probably rose from the Polymorphitidae. (See footnote below.)

During the Bajocian three new superfamilies arose, the Stephanoceratacеae,

Perisphinctaceae, and Oppeliaceae. The first died out in the Lower Kimeridgian with *Amoeboceras*, the last of the Cardioceratidae.[1] The second and third lasted until the Cretaceous and between them account for the whole vast "trachyostracous" ammonite population of the second half of the Jurassic period; for after the Bajocian there were no more major innovations. Before the last Stephanoceratids died out, the Oppeliaceae like the "leiostraca" left British seas, and although they continued to flourish in the Tethys and elsewhere until the Cretaceous, Britain was left from the end of Lower Kimeridgian times onwards in sole possession of the Perisphinctaceae. This fact is certainly to be correlated with the progressive differentiation and isolation of marine faunas in the Upper Jurassic. The next new invaders were the Russian Craspeditidae that came into Lincolnshire in the Neocomian.

The Oppeliaceae are regarded with Buckman as including the Haploceratidae, because almost certainly Haploceratidae gave rise to Oppelidae, not only once but perhaps several times. The two stocks are too intimately linked at various levels to separate as two superfamilies; though a separate origin for some Bajocian Oppelidae from the Harpoceratacean Sonninidae cannot be ruled out. The origin of the Haploceratidae in turn is problematic. As shown in the diagram, they may have arisen direct from Phylloceratina or from Harpoceratacеae via the Middle Toarcian *Praehaploceras*, as supposed by Monestier.

On the other hand, the perisphinctids, usually included in the Stephanoceratacеae, are here regarded (with Wedekind) as a separate superfamily Perisphinctaceae, partly because of their cryptic and probably independent origin and partly because of their distinctiveness, their vast numbers, and their long range, which far transcends that of all the Stephanoceratacеae. The first European Perisphinctaceae appear (as true Neumayrian cryptogenes) at the base of the Upper Bajocian (basal Subfurcatum Zone), but in Sinai true Perisphinctids occur in the Middle Bajocian Humphriesianum Zone, where they are already quite distinct from any Stephanoceratacеae. Perisphinctaceae therefore may have had a common and simultaneous origin with Stephanoceratacеae in the Lower Bajocian *Erycites;* which would give both superfamilies a descent from Hammatoceratidae (Harpoceratacеae).

A logical classification of the Perisphinctaceae is perhaps an impossibility. To bring any order into so baffling a mass of forms remains the hardest task in ammonite systematics. In general, two kinds of evolutionary changes can be distinguished. First there are specialized dead-end radiations from the main stock, which may be compared to buds given off from a twig or branches from a tree. Secondly there are more general and more subtle changes of the main stock itself, generally expressed as changes of ribbing habit, which produce groups that may be compared to the drums composing a column (though the joints between the drums are usually oblique). Criteria of the second kind are the only reliable ones for dating, but it is not always easy to disentangle the two kinds, and still more difficult to decide how they should be expressed in a classification.

The dead-end offshoots take the form of a number of trends in well-known directions, which may be repeated an indefinite number of times. Four trends are the most important: (1) towards a smooth, more or less involute, discoidal shape, imperfectly copying the oxycones of other superfamilies. Examples: certain *Procerites* in the Middle Bathonian, *Proplanulites* in the Callovian, *Ringsteadia* in the Upper Oxfordian, *Sublithacoceras* in the early Upper Kimeridgian, *Craspedites* in the Upper Volgian. (2) towards depressed, sphaeroidal cadicones. Examples: *Gravesia* in the Middle Kimeridgian, *Polyptychites* in the Neocomian: (3) a smooth band on the venter. Examples: *Parkinsonia* in the Upper Bajocian and Lower Bathonian, *Proplanulites* in the Callovian, *Idoceras* and *Aulacostephanus* in

[1] The resemblance of the Stephanoceratacean end-forms *Prionodoceras* and *Amoebites* (subgenera of *Amoeboceras*) to the Eoderoceratacean end-forms *Amaltheus* and *Pleuroceras* is truly remarkable. It suggests to me a common origin for Amaltheidae and Cardioceratidae in Eoderoceratacеae; and since Stephanoceratacеae were derived from Harpoceratacеae, this implies that Harpoceratacеae were derived from Eoderoceratacеae, as held by Haug.

the Kimeridgian, *Berriasella* in the Upper Tithonian: (4) shortening of the primary ribs and elongation of the secondaries. Examples: *Wagnericeras* in the Upper Bathonian, *Indosphinctes* in the Callovian, *Aulacostephanus* in the Kimeridgian. At certain times and certain places, for example during the Koenigi and again the *Cymodoce-Pseudomutabilis* zones in England, some of these offshoots dominated the scene and may be mistaken for the main stem; but other areas show that the more conservative perisphinctid main stock persisted all the time and later migrated to repopulate the outlying northern areas after extinction of the specialized offshoots.

The progressive changes that occurred independently of these offshoots are more subtle and difficult to define. If plaster casts of certain Leptosphinctinae from the Upper Inferior Oolite and *Choffatia* from the Cornbrash were inserted into a collection of plaster casts of Upper Oxfordian perisphinctids from the Corallian Beds it might be impossible to sort them out; so little did the "typical" perisphinctid characters change throughout that long span of time. But in the Kimeridgian definite pecularities of rib habit and furcation set in, which make approximate dating less hazardous. Such changes are the basis of the families Ataxioceratidae, Virgatosphinctidae and Pseudovirgatitidae, but in the present classification they are down-graded to two subfamilies (the distinction between the last two does not seem to be objective). It is a fault for which no remedy is apparent, that these cross-sections of the main stock, or "columndrum" divisions, should have to be equated with the "dead-end" offshoots as equal taxonomic units.

At the end of the Jurassic, when the progressive geographical isolation of the marine faunas reached its climax, the Perisphinctaceae split up in different regions into several parallel branches, of which at least three carried over into the Cretaceous.

NOMENCLATURAL PRINCIPLES

Genera and Subgenera.—The International Rules of Zoological Nomenclature are explicit on the use of these categories. The type species of each has been checked in the light of the Rules. Correction of the type of a genus may radically affect the concept of the family based upon the genus (e.g. in Ammonitidae and Arietitidae; see Note 8 below.) Some points that in the past have caused uncertainty were cleared up by revision of the Code of Rules at the 1948 meeting of the International Zoological Congress, and decisions affecting them will be incorporated in the revised Code now being drafted.

The most important of these points affecting ammonites is the decision that when a genus is based on a named existing species and a misidentified specimen or specimens, the nominal species is the type. Again (a variant of the foregoing case), when a genus is based on a numbered specimen in a museum, identified even only tentatively by its author with an existing named species, that named species is the type of the genus: the specimen referred to, being unnamed and unpublished, has no status in nomenclature and the first named species mentioned in connection with the new genus is automatically the genotype by monotypy. The object of this decision of the Commission is to ensure that the names of genera shall be based upon objective nomenclatorial facts and shall not be subject to change in the light of subjective opinions of later revisers. The decision affects a number of Liassic genera.

An application has also been made to declare null and void the doubtful and disused early generic names *Orbulites* and *Planulites* Lamarck 1801, *Ellipsolithes* Montfort 1808, *Globites* and *Planites* de Haan 1825. Irresponsible selection of type species for these forgotten nominal genera is a potential menace to the whole of ammonite classification.

Buckman's list of 1898 (Quart. Journ. Geol. Soc. London, vol. 54, p. 459) headed "In most cases the name which stands first may be considered as the type-species" cannot be accepted as giving valid type-designations for genera of which the types had not already been fixed, for Article 30, rule (g) states that "the meaning of the expression "select the type" is to be rigidly construed." Buckman's "names which stand first" therefore become valid only from the date at which they may have been specifi-

cally cited as type species by a subsequent author.

Families and subfamilies.—These have been treated as nearly as possible in the same way as genera and in accordance with Articles 4 and 5 of the Rules and with Opinions 133 and 141.

The rule of priority applies to families only in a special sense; for Article 5 states that if the name of the type genus of a family has to be changed, the name of the family must change also. In other words, the priority attaches to the genus and not to the name. (For examples see Notes 11 and 26 below.)

The Rules do not clearly state in what form a term to denote a supergeneric group must be published in order to qualify as a family name. In this paper, in accordance with the general practice of workers on the Ammonoidea, any term published in Latin or Latinized form for a group of genera is accepted as a family name, irrespective of the termination with which it was first published. By Article 4 the root-stem of the name of the type genus automatically takes the termination *-idae* when the name is used as a family, or *-inae* when used as a subfamily. (For examples see Notes 12, 32, below.)

A family name need not be based upon the oldest genus in the family; family names can be based upon any included genus at the discretion of the proposer (Opinions 133 and 141).

Family names not formed on a type genus are invalid. (For examples see Notes 6, 31, below.)

The scope of a family, provided that it contains the type genus, is (like the scope of a genus) a subjective matter depending on the judgment of individual systematists. The expression "Emended X" is unnecessary, because most families and genera have been emended out of recognition by successive authors, until often nothing but the type genus or type species remains of the original group.

I have discussed the question of family nomenclature with the Secretary to the International Commission on Zoological Nomenclature, who informs me that it was decided by the International Congress of Zoology at its meeting held in Paris in July, 1948 that the whole question of the rules governing the nomenclature of families shall be the subject of a special report, with recommendations, to be prepared in consultation with specialists, for consideration by the Commission and the Congress at the meeting to be held in Copenhagen in 1958. The Secretary is anxious to receive suggestions from specialists regarding particular aspects of this problem which it may be thought should be dealt with in the revision of Articles 4 and 5 at the Copenhagen Congress. Meanwhile, as the Secretary points out, the whole question of the rules governing the nomenclature of families must be regarded as *sub judice*. Pending the Copenhagen revision, the existing rules remain in force unaltered, and the Secretary to the Commission authorizes me to state that, in his personal opinion, the procedure here adopted is in agreement with the rules as they exist at present.

Superfamilies.—The category "Superfamily" is not at present recognized in the Rules, but it is reasonable to apply to the nomenclature of this category the provisions of the rules governing the nomenclature of families, so far as they are relevant. The termination *-aceae*, here used, is that recommended for use in the forthcoming international Treatise on Invertebrate Paleontology, and adopted by Buckman for ammonite superfamilies many years ago (e.g., Type Ammonites, 1926, vol. vi, pp. 20 ff.), though the form *-acea* is more usual.

I have attributed the name of a superfamily to the first author by whom that name was so published, whereas in the case of families and subfamilies I have attributed the name to the first author to introduce the group name as the name of either a family or a subfamily. Provided the groupings proposed by an author are of higher order than families, they need not have been called by him superfamilies; for such details of terminology have varied from time to time. For instance Wedekind (1917, Palaeontographica, vol. lxii, p. 103) grouped his families in a number of larger units which he called Suborders and Sections, using the terminations *-acea* and *-oidea* respectively. From their form and manner of presentation these are valid groupings of higher-than-family status and are here adopted as superfamilies.

It follows, by analogy, from Opinions 133

and 141 that the superfamily Harpoceratataceae Wedekind 1917 is not invalidated because Harpoceratidae Neumayr 1875 is not the oldest family included in it but has to be subordinated as a subfamily to Hildoceratidae Hyatt 1867; and that the superfamily Perisphinctaceae Wedekind 1917 is not invalidated because Aspidoceratidae Zittel 1895 is an older-established family than Perisphinctidae Hyatt 1900.

By analogy from the rules governing the names of families I have adopted as superfamily name Eoderoceratataceae nov., on the assumption that when Spath in 1929 emended the family Deroceratidae Hyatt 1867 (on account of *Deroceras* having been preoccupied) to Eoderoceratidae Spath 1929, this automatically emended the superfamily Deroceratida Spath 1926; and consequently I have not adopted instead the unfamiliar superfamily name Xipheroceratida Spath 1929.

THE PROPOSED CLASSIFICATION

(Numbers refer to explanatory notes on pp. 359–364)

ORDER AMMONOIDEA

Suborder Phylloceratina Hyatt 1900 (as superfamily)

Superfamily Phylloceratataceae Hyatt 1900
- Family Phylloceratidae Zittel 1884
  - Subfamily Phylloceratinae Zittel 1884
  - Subfamily Calliphylloceratinae Spath 1927
- Family Juraphyllitidae[1] (Spath 1927) nov. (=Rhacophyllitinae Spath 1927)

Suborder Lytoceratina Hyatt 1889

Superfamily Lytoceratataceae Buckman 1894
- Family Pleuroacanthitidae[2] Hyatt 1900
  - Subfamily Pleuroacanthitinae Hyatt 1900
  - Subfamily Analytoceratinae Spath 1927
- Family Ectocentritidae Spath 1926
- Family Derolytoceratidae Spath 1927
- Family Lytoceratidae Neumayr 1875 (Syn. Thysanoidae[3] Hyatt 1867)
  - Subfamily Lytoceratinae Neumayr 1875
  - Subfamily Hemilytoceratinae Spath 1927
  - Subfamily Megalytoceratinae Spath 1927
  - Subfamily Alocolytoceratinae Spath 1927
- Family Nannolytoceratidae Spath 1927

Superfamily Spiroceratataceae[4] nov.
- Family Spiroceratidae Hyatt 1900
- Family Arcuceratidae nov.

Suborder Ammonitina Hyatt 1889

Superfamily Arietitataceae (Buckman, 1905) nov. (Ammonitacea Buckman 1905; including Psiloceratoidea Wedekind 1917)
- Family Psiloceratidae Hyatt 1867 (syn. Caloceratidae[5] Buckman 1906)
  - Subfamily Psiloceratinae Hyatt 1867
  - Subfamily Alsatitinae Spath 1924 (syn. Proarietitinae Lange 1941)

[1] *Juraphyllites* Muller (1939, Jour. Paleontology, vol. 13, p. 537) replaces the Liassic *Rhacophyllites* auct., the type species of *Rhacophyllites* being the Triassic *Am. neojurensis* Quenstedt, desig. J. Perrin Smith, 1927. Juraphyllitinae includes *Tragophylloceras* Hyatt, the systematic position of which has been so much debated (see Spath, 1936, Quart. Journ. Geol. Soc. London, vol. 92, p. 439).

[2] Pleuracanthitidae Hyatt, but the type genus is *Pleuroacanthites* Canavari 1883.

[3] Thysanoidae Hyatt (1867) is based on *Thysanoceras* Hyatt (1867) (type species *T. orbignyi* Buckman, desig. Buckman 1905), which is a subjective synonym of *Lytoceras* Suess 1865 (type by orig. desig. *Am. fimbriatus* J. Sowerby; see Int. Com. Opinion 130).

[4] Spiroceratids (uncoiled ammonoids) occur in the Middle Bajocian in Sinai and the Aalenian in Switzerland and therefore cannot be, as usually supposed, uncoiled parkinsonids. They and *Arcuceras* Potonié (1929, Jahrb. Preuss. Geol. Landesanst. 50, p. 225) from the Middle Lias are here provisionally regarded as independent offshoots from Lytoceratina, analogous with the uncoiled Cretaceous forms. Spiroceratids persist with little change from Middle Bajocian to Callovian and the idea that the Callovian forms (*Parapatoceras*) originated independently from other Ammonitina has been disproved by Potonié. *Strenoceras* may be a coiled spiroceratid.

[5] Caloceratidae was proposed by Buckman on the mistaken assumption that *Psiloceras* was preoccupied.

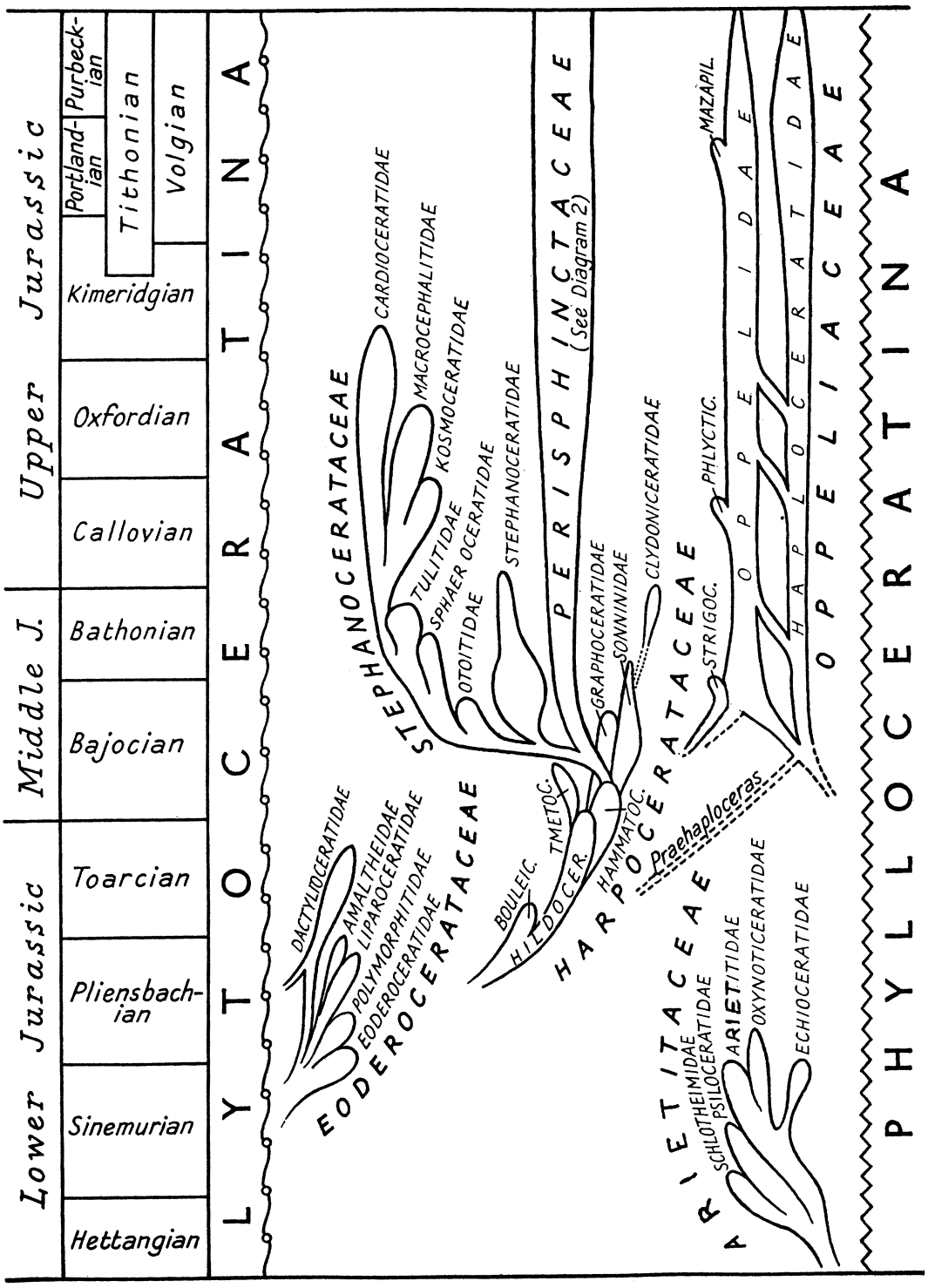

FIG. 1—Illustrating the supposed relationships of the Jurassic Ammonitina to the Lytoceratina and the Phylloceratina and to one another, in explanation of the classification here proposed.

Family Schlotheimidae Spath 1923 (syn. Angulatidae[6] Hyatt 1874)
Family Arietitidae Hyatt 1874 (syn. Discoceratidae[7] Hyatt 1867)
Subfamily Arietitinae[8] Hyatt 1874
Subfamily Asteroceratinae Spath 1946
Subfamily Arnioceratinae Spath 1924
Subfamily Agassiceratinae Spath 1924
Subfamily Cymbitinae Buckman 1919
Family Oxynoticeratidae[9] Hyatt 1874
Family Echioceratidae Buckman 1913
Superfamily Eoderocerataceae nov. [Spath 1926] (=Deroceratida[10] Spath 1926)
Family Eoderoceratidae Spath 1929 [Hyatt 1867]
Subfamily Eoderoceratinae Spath 1929 (Syn. Deroceratidae[10] Hyatt 1867)
Subfamily Xipheroceratinae Spath 1925
Subfamily Hemimicroceratinae Spath 1929 (Syn. Microceratidae Spath 1926)
Subfamily Phricodoceratinae Spath 1928
Family Polymorphitidae Haug 1887
Subfamily Polymorphitinae Haug 1887
Subfamily Acanthopleuroceratinae[11] nov. [Hyatt 1867] (Syns. Cycloceratidae Hyatt 1867, Tropidoceratidae Hyatt 1900)
Family Liparoceratidae Hyatt 1867 (Syn. Aegoceratidae Neumayr 1875)
Family Amaltheidae[12] Hyatt 1867
Family Dactylioceratidae[12] Hyatt 1867
Superfamily Harpocerataceae Wedekind 1917
Family Hildoceratidae Hyatt 1867
Subfamily Seguenziceratinae Spath 1924
Subfamily Hildoceratinae Hyatt 1867
Subfamily Harpoceratinae Neumayr 1875
Subfamily Grammoceratinae Buckman 1904
Family Tmetoceratidae[13] Spath 1936
Family Bouleiceratidae[14] nov.
Family Hammatoceratidae Buckman 1887
Subfamily Hammatoceratinae Buckman 1887
Subfamily Phymatoceratinae Hyatt 1900 (Syn. Hauginae Buckman 1905)
Family Sonninidae[15] Buckman 1892

[6] Angulatidae Hyatt is invalid because it has no type genus, being formed on the species *Ammonites angulatus* Schlotheim.

[7] *Discoceras* Hyatt 1867, preoccupied. Hyatt substituted Arietidae for Discoceratidae.

[8] Type species of *Arietites* Waagen 1869 by monotypy is *A. bucklandi* J. Sowerby (refigured Buckman, 1919, Type Ammonites, vol. iii, pl. CXXXI), but it is not a synonym of *Coroniceras* Hyatt 1867, of which the lectotype species is *A. kridion* Hehl in Zieten, designated Bonarelli, 1900 (Pal. Italica, V, p. 58) (objective synonym *Arnioceratoides* Spath 1922). Arietitinae as here restricted is the same as Ammonitidae Spath (1924, Proc. Geol. Assoc., vol. 35, p. 202), and Arietitidae as here used is the same as Ammonitidae Buckman (1919, Type Ammonites, vol. ii, p. B, and 1920, vol. iii, p. 13). These were artificial "revivals" entirely different from the family Ammonitidae Owen 1836, a group almost coincident with the present order Ammonoidea (family Ammonitea de Haan 1825). The type species of *Ammonites* Bruguière 1789 is *A. bisulcatus* Bruguière, designated Meek 1876 (U. S. Geol. Survey Territories, vol. 9, p. 446), and the lectotype of *A. bisulcatus* is a figure in Lister (1678, Cochlitarum Angliae, pl. vi, fig. 3), designated Buckman 1923 (Type Ammonites, vol. iv, pp. 56–57). This is probably a Lower Sinemurian Arietitid from Bugthorpe Beck, Yorkshire, but it is generically unidentifiable. Accordingly an application has been made by the writer to the International Commission on Zoological Nomenclature to place *Ammonites* Bruguière on the Official Index of Suppressed and Invalid Generic Names. Attempts by Buckman to reintroduce it in a restricted sense, after its universal abandonment as the generic name for all ammonites, have led to much confusion.

[9] Oxynotidae Hyatt 1874, which according to the Rules automatically becomes Oxynoticeratidae, from the type genus *Oxynoticeras* Hyatt 1874.

[10] *Deroceras* Hyatt 1867, preoccupied, was replaced by *Eoderoceras* Spath 1925.

[11] *Cycloceras* Hyatt 1867, preoccupied, was replaced by *Acanthopleuroceras* Hyatt 1900.

[12] Amaltheoidae, Dactyloidae Hyatt, 1867, first rectified to Amaltheidae by Fischer 1882, and Dactylioceratinae by J. P. Smith, 1913. Dactylioceratidae includes (as a genus) Coeloceratidae Haug 1910.

[13] Vacek's comparison of *Tmetoceras* with *Catulloceras dumortieri* (Thiollière) and Haug's comparison of that with *Dumortieria levesquei* (d'Orbigny) lead to the conclusion that *Tmetoceras* is of Hildoceratid descent, and Spath placed it as a subfamily of Hildoceratidae.

[14] Bouleiceratidae nov. for *Bouleiceras* Thevenin 1906, and *Paroniceras* Bonarelli 1893, with ceratitic sutures.

[15] Sonninidae includes Poecilomorphidae and Zurcherinae Hyatt 1900.

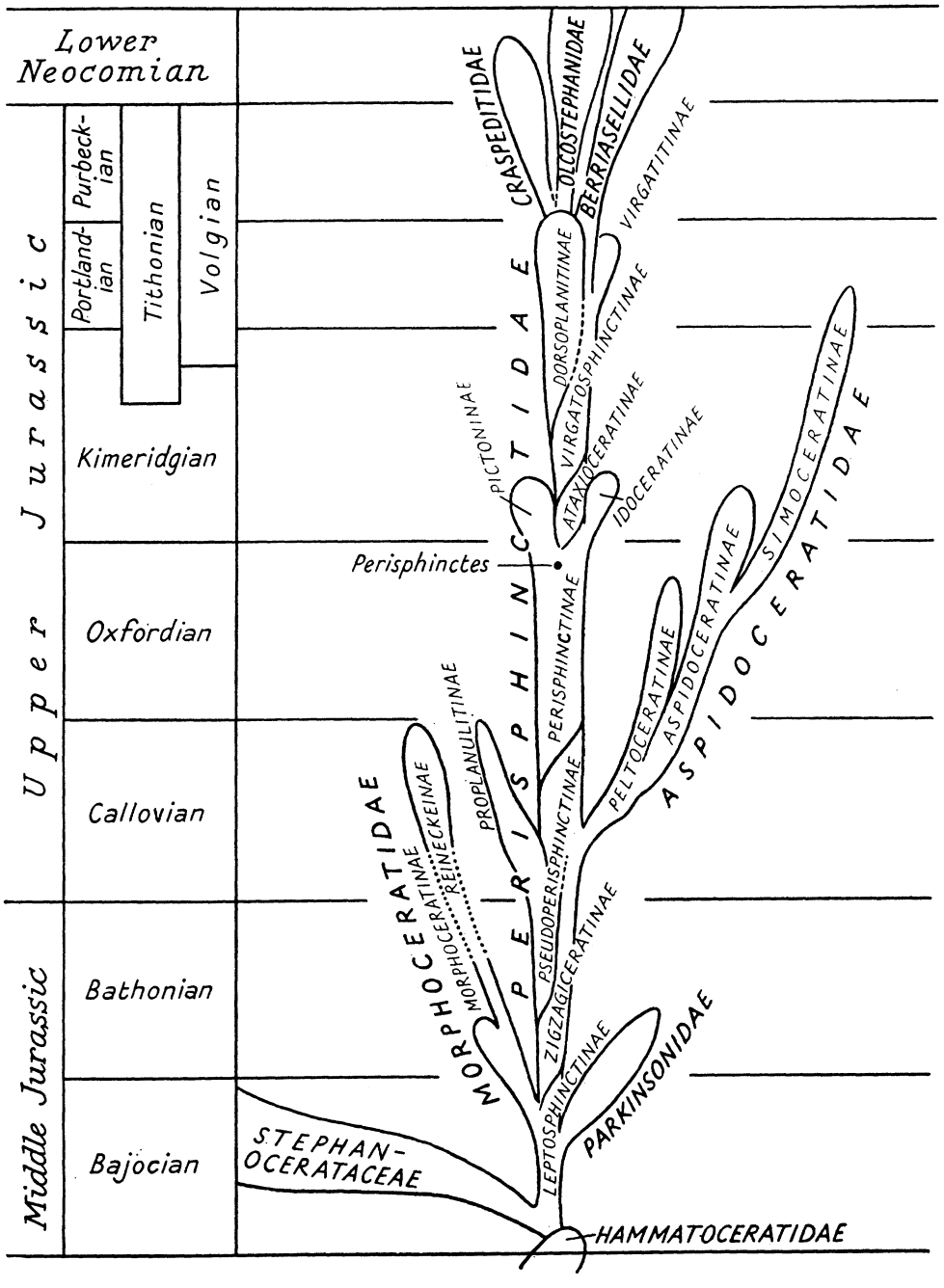

FIG. 2—Enlarged view of the Perisphinctaceae.

Family Graphoceratidae Buckman 1905
Subfamily Graphoceratinae[16] Buckman 1905
Subfamily Darelleinae Buckman 1905
Subfamily Leioceratinae Spath 1936
Family Clydoniceratidae Buckman 1924
Superfamily Oppeliaceae Buckman 1924
Family Strigoceratidae Buckman 1924
Family Haploceratidae Zittel 1884 (Syn. Lissoceratidae Douvillé 1884)
Family Oppelidae Bonarelli 1893
Subfamily Oppelinae[17] Bonarelli 1893
Subfamily Hecticoceratinae Spath 1925
Subfamily Ochetoceratinae Spath 1928
Subfamily Distichoceratinae Hyatt 1900 (Syn. Bonarellinae[18] Spath 1925)
Subfamily Taramelliceratinae Spath 1928
Subfamily Streblitinae Spath 1925
Family Phlycticeratidae[19] Spath 1928
Family Mazapilitidae Spath 1928
Superfamily Stephanocerataceae Wedekind 1917 (Syn. Stepheoceratacea Buckman 1919)
Family Stephanoceratidae Neumayr 1875 (Syn. Stepheoceratidae[20] Buckman 1898)
Family Otoitidae Mascke 1907
Family Sphaeroceratidae[21] Buckman 1920
Family Tulitidae Buckman 1921
Family Macrocephalitidae[22] Buckman 1922
Family Kosmoceratidae Haug 1887
Family Cardioceratidae Hyatt 1892
Subfamily Cadoceratinae Hyatt 1900
Subfamily Pachyceratinae Buckman 1918
Subfamily Cardioceratinae Hyatt 1892
Superfamily Perisphinctaceae Wedekind 1917
Family Perisphinctidae Hyatt 1900
Main Stock:
Subfamily Leptosphinctinae[23] nov
Subfamily Zigzagiceratinae Buckman 1920
Subfamily Pseudoperisphinctinae[24] Schindewolf 1925
Subfamily Perisphinctinae Hyatt 1900
Subfamily Ataxioceratinae Buckman 1921
Subfamily Virgatosphinctinae[25] Spath 1923
Subfamily Dorsoplanitinae nov.[26] [Schindewolf 1925] (Syn. Pavlovinae Spath 1931)

[16] Graphoceratinae includes Hyatteinae and Lucyinae Buckman 1905 and Ludwigellidae Spath 1928.

[17] Oppelinae includes Hebetoxyitidae Buckman 1924?

[18] *Bonarellia* Cossmann 1898 was proposed as substitute for *Distichoceras* Munier-Chalmas 1892, on the mistaken assumption that the latter was preoccupied.

[19] *Phlycticeras* Hyatt 1900, Callovian, is a remarkable homoeomorph of *Strigoceras* Quenstedt 1886, Bajocian, but can hardly be directly related. The somewhat similar *Micromphalites* Buckman 1923, Bathonian, is now classed in Clydoniceratidae, Harpoceratacеae.

[20] *Stepheoceras* Buckman 1898, proposed as substitute for *Stephanoceras* Waagen 1869, on the mistaken assumption that the latter was preoccupied. See Spath 1944, Geol. Mag., vol. 81, p. 230.

[21] *Sphaeroceras* Bayle 1878, is preoccupied by *Sphaeroceras* Hope 1840, for a beetle, but since coleopterists inform me that *Sphaeroceras* Hope is an objective synonym of *Globicornis* Latreille 1829, and has hardly ever been used, and cannot be used again, I have applied to the International Commission on Zoological Nomenclature to have it placed on the Official Index of Rejected and Invalid Generic Names, and *Sphaeroceras* Bayle 1878, placed on the List of Valid Generic Names.

[22] Macrocephalitidae includes Mayaitidae and Eucycloceratidae Spath 1928, and Grayiceratidae Spath 1925.

[23] Leptosphinctinae nov. for the Middle and Upper Bajocian Perisphinctids, *Leptosphinctes* Buckman and its allies, often with coronate (tuberculate) nuclei, queried by Buckman as Parkinsonidae.

[24] Pseudoperisphinctinae Schindewolf, based on *Pseudoperisphinctes* Schindewolf 1923, of which the type species by monotypy is *Per. rotundatus* Roemer (1911, pl. 8, fig. 2 lectotype), includes Grossouvrinae Spath 1930.

[25] Virgatosphinctinae is here considered to include Pseudovirgatitinae Spath 1931 as indistinguishable.

[26] *Polytosphinctes* Schindewolf 1925 is an objective synonym of *Dorsoplanites* Semenow 1897; therefore Polytosphinctinae Schindewolf 1925 becomes automatically Dorsoplanitinae nov.

Offshoots	Subfamily Proplanulitinae Buckman 1921
	Subfamily Pictoninae[27] Spath 1924
	Subfamily Idoceratinae Spath 1924
	Subfamily Virgatitinae Spath 1923
	Family Parkinsonidae Buckman 1920
	Family Morphoceratidae[28] Hyatt 1900
	Subfamily Morphoceratinae Hyatt 1900
	Subfamily Reineckeinae[29] Hyatt 1900
	Family Aspidoceratidae[30] Zittel 1895
	Subfamily Aspidoceratinae Zittel 1895
	Subfamily Peltoceratinae Spath 1924
	Subfamily Simoceratinae Spath 1924
Terminal forks	Family Berriasellidae[31] Spath 1922
	Subfamily Berriasellinae Spath 1922
	Subfamily Himalayitinae Spath 1925
	Subfamily Paraboliceratinae Spath 1928
	Subfamily Neocomitinae Spath 1924 (Cretaceous)
	Family Craspeditidae Spath 1924
	Family Olcostephanidae[32] Haug 1910
	Subfamily Olcostephaninae Haug 1910 (Cretaceous)
	Subfamily Spiticeratinae Spath 1925
	Subfamily Polyptychitinae Spath 1924 (Cretaceous)

[27] Pictoninae Spath 1924 includes Raseninae Schindewolf 1925 and Aulacostephaninae Spath 1924 (the closely interlinked genera *Ringsteadia*, *Pictonia*, *Rasenia*, *Aulacostephanus* etc. and their subgenera).

[28,29] The likeness between the Lower Bathonian Morphoceratid *Ebrayiceras pseudo-anceps* and the Callovian *Reineckeia anceps* (pointed out by Ebray in 1864) is so close that there is little doubt that Reineckeidae are derived from *Ebrayiceras*. An example of how such gaps are always liable to be bridged is the finding by Guillaume (1927, C. R. Soc. géol. France, no. 17, p. 217) of an *Ebrayiceras* in the Middle Bathonian of Normandy. The earliest known Morphoceratid is the Bajocian *Dimorphinites*, of which the venter has no furrow or smooth band, and the prevalent constrictions of this and *Morphoceras* point to their Perisphinctacean origin; but all forms show points of convergence to Stephanocerataceae.

[30] The possibility that Peltoceratinae originated from Reineckeinae requires further investigation.

[31] Berriasellidae Spath 1922 is included by Roman in an invalid family Palaeohoplitidae Roman 1938, which has no status in nomenclature because there is no type genus.

[32] Misspelt Holcostephanidae by Haug (1910, Traité, ii, pp. 1166, 1167), but the genus is *Olcostephanus* Neumayr 1875. First rectified to Olcostephanidae by Pavlow 1913.