

Fossils of Dorset

Inferior Oolite ammonites

Lower Bajocian



Robert Chandler & John Whicher

Commemorative issue celebrating the work of John Callomon
and the 200th year since the production of William Smith's
geological map of England and Wales



Wessex Cephalopod Club

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Introduction

This book, produced by subscription in 2015, celebrates the geological work of John Hannes Callomon (1928-2010) through the commemoration of the 200th anniversary of William Smith's ground breaking geological map of England and Wales. The Dorset Geologists' Association Group marked the event with a special meeting at Sherborne Castle between September 29th and October 3rd 2015, attended by authorities on Jurassic geology from around the globe whose work has in some way been influenced by John Callomon. We were fortunate to have the support of Sherborne Castle Estates who kindly provided the venue for the meeting in an area of some of the world's most fossil-rich Jurassic rocks that have been subjected to intensive study since Smith's time.



Sherborne Castle

John Cope, a long-time friend and collaborator, says of Callomon "He was certainly the foremost Jurassic ammonite expert of his day. He totally revolutionised the whole of ammonite taxonomy by realising that ammonites exhibited sexual dimorphism and his hypothesis is now accepted world-wide and embraces ammonoids from the Devonian through to the Upper Cretaceous. He had a great influence on many people throughout the world and encouraged a group of amateurs, amongst them Robert Chandler, to form the Wessex Cephalopod Club. With Robert Chandler he proposed ammonite biohorizons as the smallest unit of the biochronological time-scale, producing divisions which are in some cases shorter than 30 ka and which can be traced across continents". In this booklet we review aspects of John Callomon's palaeontological legacy.

The idea of remembering John in this way was conceived by Robert Chandler and John Whicher when they became involved in the William Smith bicentenary celebrations for 2015. Much of Callomon's work expanded on, and significantly advanced, our understanding of the strata

displayed on Smith's map of England and Wales of 1815. This year is therefore an ideal opportunity to reward the labours of both Smith and Callomon.

We have reviewed key aspects of the work of the Wessex Cephalopod Club (WCC) of which John was a founder member and firm supporter of its objectives described herein. We have used the medium of short written texts and extensive illustrations of specimens in the WCC collections housed in London and Somerset. Our coverage includes sexual dimorphism, biochronology and variability in ammonite assemblages.

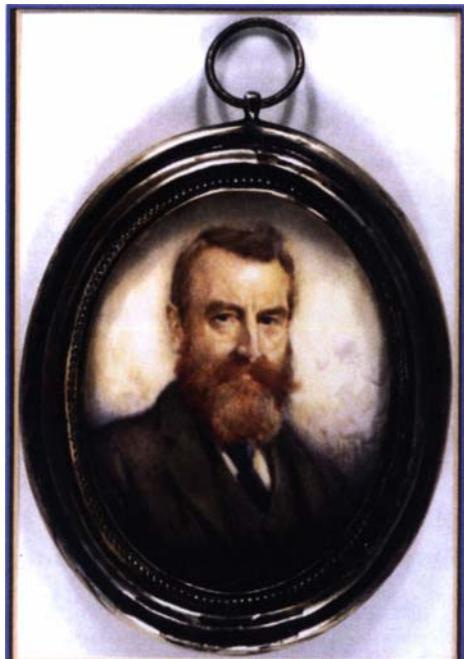
The WCC collection, comprising the collections of Robert Chandler and John Whicher, is a unique assemblage of several thousand specimens of ammonites and other invertebrate fossils from the Middle Jurassic, Inferior Oolite Formation of Dorset and Somerset. The specimens have been collected with accurate stratigraphical information and precise locations and thus form an important scientific resource allowing the many specimens, including type specimens, collected in the last century, now housed in museums without such information, to be re-evaluated.

John Callomon used the term 'potatoes' to describe the majority of museum specimens, which tend to be incompletely documented and lack context. He considered re-collection from the original sites, where possible, as essential to understanding the nature of such collections, the types and their ranges through time. Unlike the existing material in museum collections, most of the WCC collection has been prepared using state of the art techniques and most of the specimens are superbly preserved and prepared. These collections, which John Callomon encouraged, are already the basis of several scientific publications and will be a great resource for the future.

A brief history of biostratigraphical exploration in Southwest England.

The use of ammonites as high resolution tools for biostratigraphy in Dorset and Somerset is largely due to the work of Sydney Savory Buckman (1860-1929). Buckman spent his early years living at Coombe in Bradford Abbas on his father's farm. He attended Sherborne School and gained there a strong grounding in classical languages. His father James Buckman had been Professor of Geology at Royal Agricultural College, Cirencester, and the young Sydney was

encouraged from his early years to take an interest in geology. In much of the area around Sherborne and south to the coast near Bridport, there outcrops a thin band of limestone, the Inferior Oolite Formation. In Buckman's day, many quarries were in work for building stone and lime burning. These rocks are immensely rich in fossils and are amongst the most richly fossiliferous developments of lower Middle Jurassic rocks in the world.



Portrait of S. S. Buckman painted in a locket by his brother Percy Buckman. This is the only image of Buckman that shows his red hair and complexion. Image by kind permission of Hugh Torrens.

Sydney Buckman devoted much of his time to palaeontology and stratigraphy. Two Buckman contributions stand apart; his *Monograph of the Inferior Oolite Ammonites* (1887-1907) and *Type Ammonites* (1909-1930), but his *Bajocian of the Sherborne District* (1893) set the scene for the work that followed, using biostratigraphical methods to achieve the highest precision possible to place assemblages of ammonites into age order. Buckman observed that there were far more distinguishable ammonite faunas than there were zones then described; the strata of the Inferior Oolite is thin and separated by non-sequences and parts of the succession of ammonites were not present everywhere, but varied over very short distances from one place to another. This directed Buckman's

thinking towards a clear distinction between lithostratigraphy, biostratigraphy and chronostratigraphy. He understood that the succession in Dorset was very incomplete and wrote "A schoolboy once defined a net as a series of holes strung together, and the Dorset Inferior Oolite might be defined as a series of gaps united by thin strands of deposit" (Buckman, S.S.,

1910. Certain Jurassic ('Inferior Oolite') species of ammonites and Brachiopoda. Journal of the Geological Society 66, 90-110). He erected a time term, 'hemera' to indicate the acme of taxa and pointed out that while time passes, the rate of sediment deposition and erosion is highly variable. Having initially embraced biogenetic laws as a basis for classification, he later devised his own system, unfortunately based on minute differences of morphology such as the details of the suture line. This resulted in a plethora of new taxa, based in many cases on very slight differences and limited explanation, as displayed in *Type Ammonites* (Buckman, S.S., 1909-1930. Type Ammonites. Weldon and Wesley, Thame and London).

Our methods of classification are shifting progressively towards descriptions of faunas, horizon by horizon and to the limit of resolution. To this end Buckman's nominal species are being given renewed life as characteristic markers, with his names being employed to denote horizons in a succession.

Following Buckman, the entire Inferior Oolite was re-examined by Richardson between 1907 and 1932. Revival of interest in British Jurassic stratigraphy, in particular by Colin Parsons and Hugh Torrens in the 1960s, led to a modified usage of Buckman's hemeral system. The main differences are that the principal units of classification are rocks rather than time units. The equivalents of the hemerae are now biohorizons, rock units containing horizons of fossils removed of any reference to time or peak of development.

John Callomon was next to continue the work, and with Robert Chandler, from the 1970s until just weeks before he died, he continued with field work. John was born in Germany, but considered himself a true Englishman. In 1946, John won an Open Scholarship to St John's College, Oxford. By chance he encountered William Joscelyn Arkell (1904-1958) when he arrived there as an undergraduate Chemistry student, just before Arkell departed for the Sedgwick Museum in Cambridge. John was introduced to Arkell by the curator, James Edmonds. There followed a gift to John of various publications from Arkell, one of which was on the Oxford Clay at Woodham. It was this that set John's course and interest in the Jurassic. In the following years, John sent Arkell updates of his findings refining some of Arkell's identifications. In 1955 John stayed at Ringstead, in Arkell's holiday home 'Faraway', where they proof-read *Jurassic Geology of the World*. We understand that John also spent time at Arkell's bedside shortly before he died in 1958 contributing to the *Ammonites of the English Corallian Beds*. John often spoke of a rather fine photograph of Arkell (reproduced here) and thought that a later painting of a more mature man did not do his likeness justice.

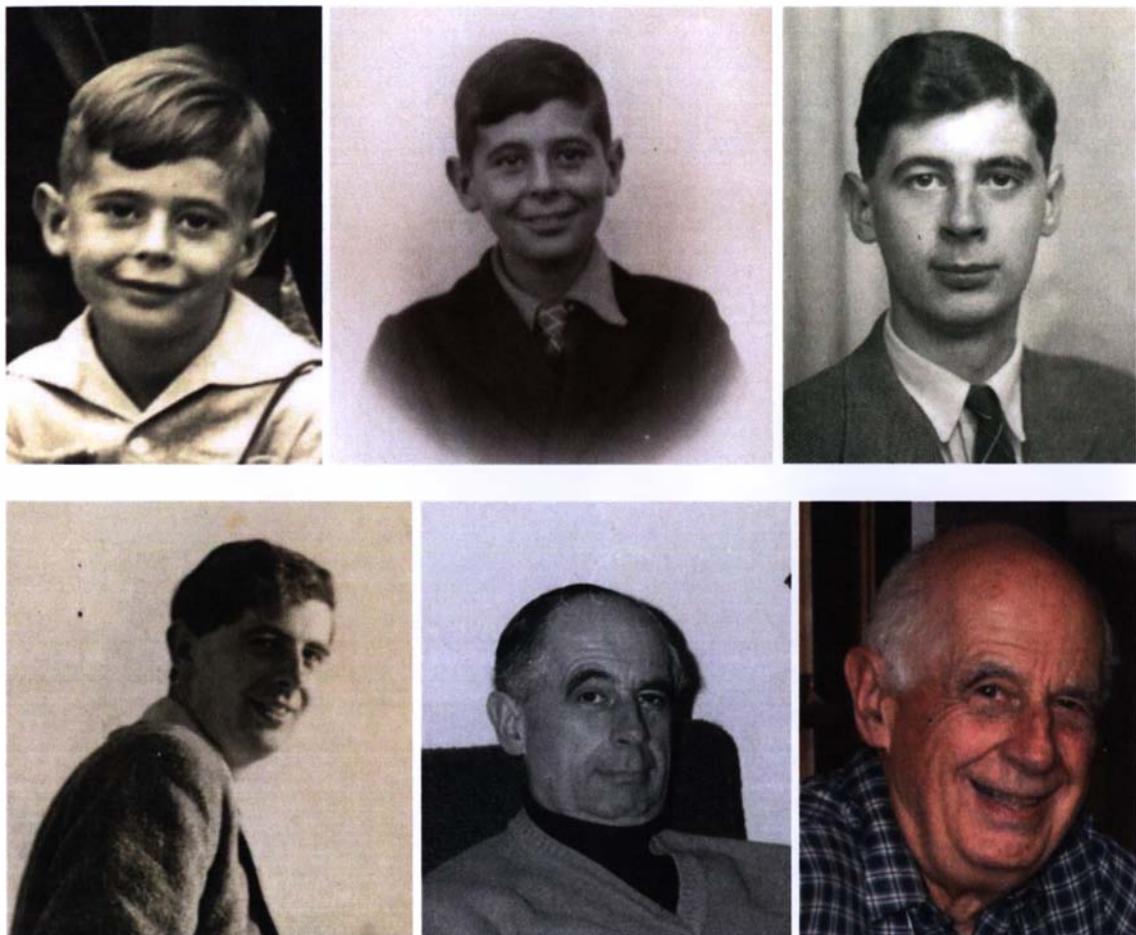


Photographic portrait of W. J. Arkell as a young man (left) by kind permission of M & R. Arkell. A painting of Arkell in later life was in the opinion of Callomon not a likeness that truly reflected his appearance at the time (right). Original in the Geological Society of London portrait collection.

From the ammonite collections he made, John developed theories on dimorphism in ammonites, but throughout his later life he was grieved that his paper on sexual dimorphism had been delayed in its publication by matters outside his control. In 1955 his idea was made known by Arkell, and in 1957 by John himself, and his work was ready for publication in 1958 but did not appear in print until 1963. However in 1962 Makowski published his own work on dimorphism, but it is generally accepted that John was truly the founder of the concept in its modern form.

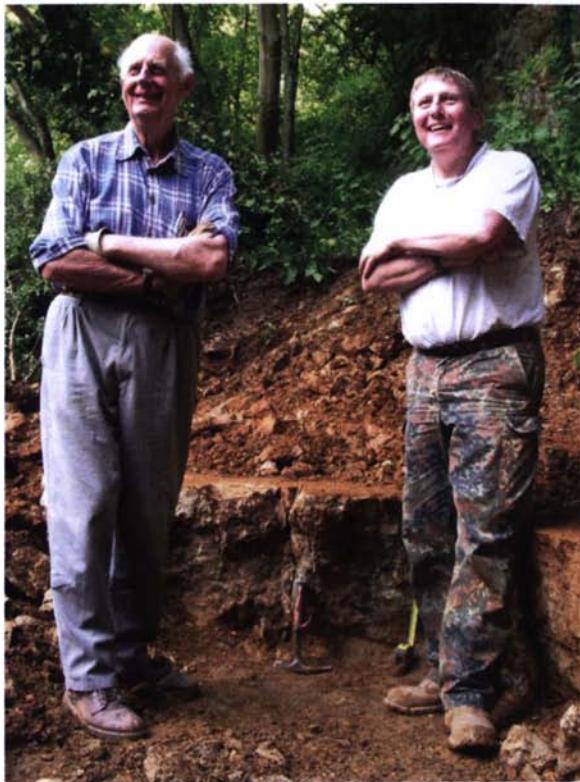
John was also interested in intraspecific variability in ammonite shells. His paper on Cardioceratids (Callomon, J., 1985. The Evolution of the Jurassic ammonite family Cardioceratidae. In: Cope, J.C.W. & Skelton P. W. (Eds.), Special Papers in Palaeontology.

pp. 49-90) gives excellent illustrations of a fauna from successive horizons with the variability at each level depicted. John was well known for his quote ‘You can identify your mother amidst a crowd of thousands’ demonstrating the precision of the human eye over mathematical methods of morphological discrimination.



John Callomon [m] Chronological development from age 5 to 80 years.

John was meticulous with his stratigraphical control, always ensuring that specimens were correctly marked with the beds from which they came. Each horizon could then be assembled into its relative order, providing a time scale based on ammonite evolution capable, in John’s view, of discriminating with a mean resolution of about a hundred thousand years (recently John Cope suggests that this may be closer to thirty thousand years!).



John with Robert Chandler standing on the top of bed 6d, Sandford Lane, Dorset.



John with John Whicher contemplating the stratigraphy on a cold, damp day.

Faunal Horizons

One of the main research objectives of the Wessex Cephalopod Club is to collect carefully fossils from rocks bed by bed and to subdivide rock beds on the basis of their fossil content into horizons characterised by typical assemblages of fossils, principally ammonites. A single bed of rock may contain an assemblage that is consistent throughout its thickness, in which case it belongs to one ammonite faunal horizon, or it may be possible to identify discrete levels within a single bed that are characterised by different ammonite assemblages, in which case a number of faunal horizons may be recognised. Faunal horizons are rock units, they have a thickness determined by the presence of the characteristic assemblage, but there may be gaps between them. Therefore unlike standard chronozones they may not be contiguous. Indeed, further discoveries at other locations may result in new horizons being inserted between them. This

methodology has in the past caused misunderstanding based on the interpretation of the term ‘condensation’. Callomon pointed out that two types of condensation should be considered; the first, homogeneous condensation is due to slow or absent sediment supply rates, resulting in an accumulation of fossil remains over periods of time that may be geologically significant and in which fossils of different ages are mixed up together. The second, heterogeneous condensation results from accumulations of sediment separated by gaps during which there was either no deposition or there was net erosion.

One aim of biostratigraphy is to determine the finest resolution possible between fossil assemblages. Clearly there is ‘duration’ over which a body of sediment is deposited, be it days between the time when two shells fall one upon the other on the sea bed or a thousand years! The point is whether this is discernible from the geological record. Fernandez-Lopez has carefully demonstrated various taphonomic (post-mortem) criteria that allow us to recognise, in an assemblage, those fossils which are not contemporary with the sediment and should not therefore be included in the composition of an assemblage described as a fauna that lived together. Having eliminated fossils that are re-deposited, what is left is a collection of specimens that, in geological terms, were deposited at the same time. Callomon used the term isochronous. He went on to say that a population of specimens of a single fossil type found within a faunal horizon is likely to be the closest that we can get to a biospecies in geology.

It can be argued that the term ‘isochronous’ is inappropriate as the ammonites in a faunal horizon cannot be proven to have exactly the same age of deposition. In reality only a single event of instantaneous duration can truly be isochronous as two shells falling one upon the other days apart are not isochronous. An assemblage from a single horizon must therefore be examined taphonomically to ensure that the individual components of slightly different ages lie within a time duration that is regarded as negligible compared with the rate of evolution of the organisms preserved within the sediment. For such fossil accumulations deposited over a time range of negligible duration we suggest the term circachronous (of around the same time).

There are examples of ‘so-called’ expanded successions that appear to show continuous thick sediment accumulations with fossils distributed sporadically or concentrated at specific levels. There is an unfortunate tendency in the literature for palaeontologists to assume that such successions are ‘complete’ and contain no gaps, which is almost certainly not the case. Due to the large intraspecific variability of most ammonites, many ‘expanded’ sections tell us little about biology at an instant in time, as the paucity of specimens means we are seeing a very limited random sample of the morphologies that may be present. In geological terms the time duration over which faunal horizons in the Inferior Oolite of Dorset and Somerset are deposited

must be very short with bedding planes representing gaps of unknown, sometimes geologically long, duration. Taken as an average, horizons in the Inferior Oolite may each have resolutions in the order of thirty thousand years (see Cope's latest note). Other criteria support this assumption. Specimens are common in perfect preservation with delicate spines, ornament and lappets, which together with the lithology suggests that in many cases the content of a single horizon may have been deposited in an interval as short as a few months or less, prior to final burial. Identical assemblages occur in distant locations, both in England and abroad, and appear to match over their time of existence.

LOWER BAJOCIAN		Zone	Subzone
Bj-19	<i>Teloceras coronatum</i>	Humphriesianum	Blagdeni
Bj-18	<i>Teloceras blagdeni</i>		
Bj-17	<i>Stephanoceras blagdeniforme</i>		
Bj-16	<i>Stephanoceras gibbosum</i>		Humphriesianum
Bj-15	<i>Stephanoceras humphriesianum</i>		
Bj-14b	<i>Chondroceras wrighti</i>		
Bj-14a	<i>Chondroceras delphinum</i>		Romani
Bj-13	<i>Stephanoceras umbilicum</i>		
Bj-12	<i>Stephanoceras rhytum</i>		Hebridica
Bj-11b	<i>Nannina evoluta</i>		
Bj-11a	<i>Stephanoceras kalum</i>	Sauzei	Patella
Bj-10b	<i>Sonninia micracanthica</i>		
Bj- 10a	<i>Witchellia spinifera</i>		
Bj-9	<i>Witchellia ruber</i>	Laeviuscula	Laeviuscula

Bj-8b	<i>Shirbuirnia trigonalis</i>	Laeviuscula	Trigonalis Sayni
Bj-8a	<i>Sonninia nodatipinguis</i>		
Bj-7b	<i>Witchellia connata</i>		
Bj-7a	<i>Witchellia gelasina</i>		
Bj-6c	<i>Witchellia "pseudoromani" MS</i>	Discites	Ovale Subsectum Walkeri
Bj-6b	<i>Fissilobiceras gingense</i>		
Bj-6a	<i>Euhoploceras zugophorum</i>		
Bj-5	<i>Witchellia romanoides</i>		
Bj-4	<i>Bradfordia inclusa</i>		
Bj-3	<i>Hyperlioceras subsectum</i>		
Bj 2b	<i>Hyperlioceras ruditiscites</i>		
Bj-2a	<i>Hyperlioceras walkeri</i>		
Bj-1	<i>Hyperlioceras politum</i>		

Callomon and Chandler (1990) introduced a scheme of ammonite faunal horizons for the Inferior Oolite Formation (Aalenian and Lower Bajocian) of Dorset and Somerset, UK. The labelling of each horizon consists of a letter code: Aa for Aalenian and Bj for Bajocian followed by a number based on the horizons identified at the time, '1' being the lowest identified in the sequence of strata for that Stage. Thus Bj-1 is the first horizon of the Bajocian identified at that time. Improvements on the scheme have led to the insertion of further horizons between those known in 1990. For these additional letters (a, b, c) are inserted but do not denote any reduction of rank or importance. MS;in manuscript.

It was fortuitous that most of the collecting that resulted in the Wessex Cephalopod Club collection occurred between 1970 and the present, a time when sea defence, road widening schemes and renewed quarrying made available again some of the classical sites studied by

Buckman, Richardson and Parsons. In 1990 Callomon & Chandler produced their first scheme of ammonite faunal horizons for the Aalenian to Lower Bajocian of South West England. The horizons presented were the result of numerous visits to each site and meticulous recording. A first testing ground was at Horn Park Quarry (now a National Nature Reserve) where the sixteen horizons reported for the Aalenian Stage have since only necessitated one new English addition.

A major failing of the scheme has been that in most cases the (morpho) species contained in each horizon were presented in the literature only as lists without illustrations of the entire assemblage. The aim of this book, and others that will follow, is to remedy that, however to depict every variant of every genus is beyond our scope here, so we will focus on high quality illustrations of the principle components of each horizon starting with the Lower Bajocian.

Dimorphism

The study of ammonoids has shown that from the Devonian Period onwards, in many genera, if a large enough collection of mature individuals is made from the same horizon, it is apparent that they fall into two size groups. There are separate groups of larger and smaller specimens, sometimes with a small degree of overlap in size. From the Lias, Toarcian rocks of Jurassic age onwards, the small forms often have an aperture ornamented with lateral protrusions known as lappets while the large forms have a simple termination. Presently it is generally accepted that this represents sexual dimorphism, with the large forms, macroconchs [M], being the putative females and the smaller microconchs [m] being presumed males. This assumption is however rather extraordinary in view of the fact that the reverse is true in modern Nautilus. It may date back to de Blainville (1840) who is generally credited with being the first to suggest sexual dimorphism in ammonite shells. He thought that by analogy with living Nautilus, ammonites probably had two separate sexes and that the ovaries resulted in the females being larger, a concept that seems to have stuck to this day. However it is doubtful that he would have had the opportunity to examine a live example as it was only 8 years earlier in 1832 that Richard Owen described the anatomy of a nautilus for the first time.

In 1962 and 1963 two reviews were published that independently reached the identical conclusion that Jurassic ammonites exhibited dimorphism, presumed to be sexual in origin. Though this was not a new idea, having been popular particularly amongst French palaeontologists at the beginning of the 20th century (see above), it had gained little acceptance amongst ammonitologists in the ensuing 50 years. John Callomon was one of the leading

protagonists, resurrecting these ideas, and by 1969 no one seemed to doubt the reality of dimorphism, certainly in many groups of Middle and Upper Jurassic ammonites. Despite this, immense problems for taxonomy remain on which no one seems to agree.

Are *Nautilus* Sexually Dimorphic?

Saunders, W.B., Spinosa, C., 1978.

Shells of 375 sexed specimens of *Nautilus pompilius* trapped off Palau, exhibit distinctive dimorphism in shell proportion and overall size. Males have larger shells, a broader aperture and greater weight. Female shells are smaller, narrower and the overall weight is less. Dimorphic differences are not apparent in young shells but develop during the final 1/2 to 1/4 whorl. This is accompanied by development of the spadix in males, indicating that shell dimorphism reflects sexual maturity. Of the animals trapped, 28% were female; no depth segregation was apparent. The authors suggest that the traditional identification of larger fossil dimorphic cephalopods as females and smaller forms as males is the reverse of observed dimorphism in *Nautilus* and should be discontinued in favour of macroconch and microconch designations.

Callomon summarised the situation then, as now, as follows.

Ammonites do not go on growing until death but reach maturity, which manifests itself in various morphological changes.

- Uncoiling of the umbilical seam, sometimes with contraction of the body chamber.
- Modification of the shell surrounding the aperture with flares, constrictions, collars and lappets.
- Approximation and degeneration of the last few sutures.

Using these characters it is clear that in any bed of rock most shells are adults, in fact juveniles are rather the exception, and the size of the mature shells often falls into two quite distinct groups, which in themselves have a low variability (coefficient of variation of less than 10%). Within each group, which may differ from the other by as much as four-fold in size, the length of the body chamber is also rather constant. Lappets are always associated with the smaller sized group and the body chamber is usually shorter than in the larger shells.

Dimorphism within a lineage may be proposed if the two groups can be shown to be ontogenically (genetically) linked. This appears to be the case if:

- The inner whorls are indistinguishable. The distinctions arise in maturity.
- New characters, e.g. of ornament, appear in both groups of a genus more or less simultaneously as evolving lineages are followed.
- The putative dimorphs have the same stratigraphical and geographical distribution.

It is common in a bed of rock for the ratio of dimorphs to be heavily biased in one or the other direction as may be seen in shoals of squid today.

Despite the general acceptance of these concepts they have not generally been incorporated into taxonomy, perhaps because of the difficulty of allocating dimorphs at the species level. One of the reasons for this is the morphological conservatism of the microconchs, which may all look pretty much the same in a genus of dissimilar macroconchs.

Polymorphism

It is well known that adult ammonites display a considerable range of size in both the macroconchs and microconchs. At almost all levels in the Lower Bajocian of Southwest England we also encounter adult macroconch specimens (confirmed by their approximated sutures, modified mouth-border and eccentric coiling of the last whorl), that stand apart in their diminutive size. These small macroconchs have, in most cases, morphology that is very close to that of the corresponding larger specimens, but sometimes they extend over different ranges of strata. A number of them are placed in separate genera on the grounds of having consistently different characteristics from larger specimens at comparable levels. One such example is *Mollistephanus*, a miniature adult genus resembling, but not identical to, contemporary *Stephanoceras* [*Skirroceras*].

Another example is in the Sonniniidae. In his Monograph, S. Buckman depicts numerous specimens of *Sonninia* [*Euhoploceras*]. In Dorset these ammonites have their origins in the Concavum-Discites zone rocks of the Inferior Oolite, such as seen at Bradford Abbas. Sandoval and Chandler showed that they occur at a number of discrete horizons between which shifts in morphology are discernible. One view is that the microconchs of this plethora of *Euhoploceras* belong to the small adult *E. decoratum* group. Rather than this being the case, we suggest that *E. decoratum* is a small macroconch and that the corresponding microconchs remain to be

definitively identified. However, small spinose ammonites with lappets, in every way identical to *Euhoploceras*, do occur in the Concavum and Discites zones of Dorset, but they are very rare. These have a range of morphological variability that encompasses a number of species placed in the genera *Pelekodites* and *Nanninia*, particularly evident later on in the Ovale to Sauzei zones. These are presumed to be the microconchs of *Witchellia*, however they first arise in the Concavum Zone alongside *Euhoploceras* and far earlier than the first *Witchellia*. They have a conservative morphology compared to macroconchs and it is not unreasonable to suspect that a ‘common microconch morphology’ may be shared by sonninids, hammatoceratids and *Witchellinae*.

Thus in samples where large numbers of specimens are available, it appears that some ammonite size distributions are trimodal rather than just the two dimorphic partners. In plate 25 we figure some examples. We suggest the term mesoconchs for these small macroconchs.

Nomenclature and the species concept

The species concept in palaeontology is a complex issue. There is general agreement in biology that a species is a group of organisms that is genetically distinct, and does not interbreed with those around it. It must be reproductively separated for speciation to occur. Such separation is usually geographical (allopatric) but maybe behavioural. This is the ‘biospecies’ and in fossils is very hard to define. This implies that multiple species of closely related ammonites (e.g. of the same genus) probably arose by allopatric speciation. Therefore, to find several different species together at the same time (circachronous as we define it) they must have migrated together and quite probably need to occupy different ecological niches in order to avoid one species out competing the other. In the case of benthic organisms, such as gastropods, this is common enough, but in the case of ammonites, with a supposedly nektonic lifestyle, it is more difficult to envisage. So when we find a population of closely related ammonites that are truly contemporaneous it seems unlikely that they are different biospecies. However if we can demonstrate that there are morphologically separate groups in the population which do not overlap (using adequate statistical tests) then we can erect a separate species. This requires a large number of specimens, collected accurately from a single horizon and is rarely possible, not least because it is difficult to be sure that a bed of rock has been deposited over a short enough period of time not to allow ammonite evolution or migration. We must also remember that we only have the shell!

This brings us to the other problem, change over time. In an evolving lineage where do you draw the line between ‘species’? In the Inferior Oolite we see a series of related forms changing over time but usually in a punctuated manner because of the gaps in the stratigraphical record which abound in the Inferior Oolite of Dorset and Somerset.

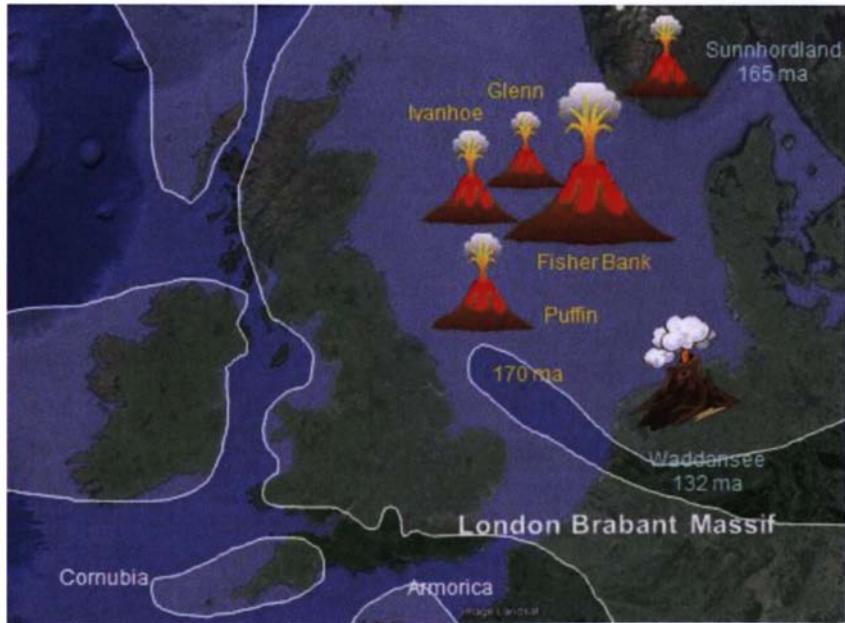
For all these reasons the species defined by ammonite palaeontologists are generally morphospecies. Often the erection of a new species is based on one or a few incomplete specimens. While this may seem to be ‘stamp collecting’ it does document the range of forms observed and preserves information which may be lost if the forms were ‘lumped’ together. A genus should represent a group of phylogenetically related species in time or space. This may be difficult owing to the marked homeomorphy of ammonites. Thus *Fissilobiceras*, a hammatoceratid, has spent much of its existence being classified as a sonninid owing to the homeomorphic appearance of the contemporaneous sonninids.

Most morphospecies depicted in the literature persist over a range of strata and therefore time, so a particular morphology may exist at several levels; it has a range. This is problematic as it raises the question of what to call a specimen, as the type horizon may not be known and homeomorphy is common. To side step such issues we have adopted a rather coarse standard. We have not used a number of generic names for transients of what are in many cases long lineages, if a more general term is available. So, for example, *Skirroceras* and *Riccardiceras* are listed under *Stephanoceras* with any varietal names given in square brackets, thus *Stephanoceras* [*Skirroceras*] *kalum* (Buckman). The microconchs have, as far as possible, been treated in the same way.

The geological background of the Middle Jurassic of Dorset and Somerset

In the Middle Jurassic Dorset was at the western end of a shallow marine basin, the Wessex basin, which extended from the land mases of Cornubia in the west to the London Brabant Massif to the east. The sea floor of this basin was slowly subsiding throughout the Mesozoic and the stretching of the underlying sediments induced a network of faults and the formation of sub-basins.

The Inferior Oolite Formation of Dorset was deposited in this basin, which was undergoing active faulting during the period of deposition, so called synsedimentary faulting. This resulted in the formation of hollows and fissures in the sea floor. The sediments that filled these were given a degree of protection from the intermittent erosion of the sea floor that was disturbing or removing part or all of the more vulnerable neighbouring deposits. These processes resulted in variations in thickness of the remaining strata on a very local scale, together with the formation of conglomerates and hardgrounds. The development of high resolution biostratigraphy for the Inferior Oolite (Callomon & Chandler, 1990) has led to the recognition that some of these localised deposits preserve fossil assemblages representing periods of time that differ from those of the adjacent rocks.



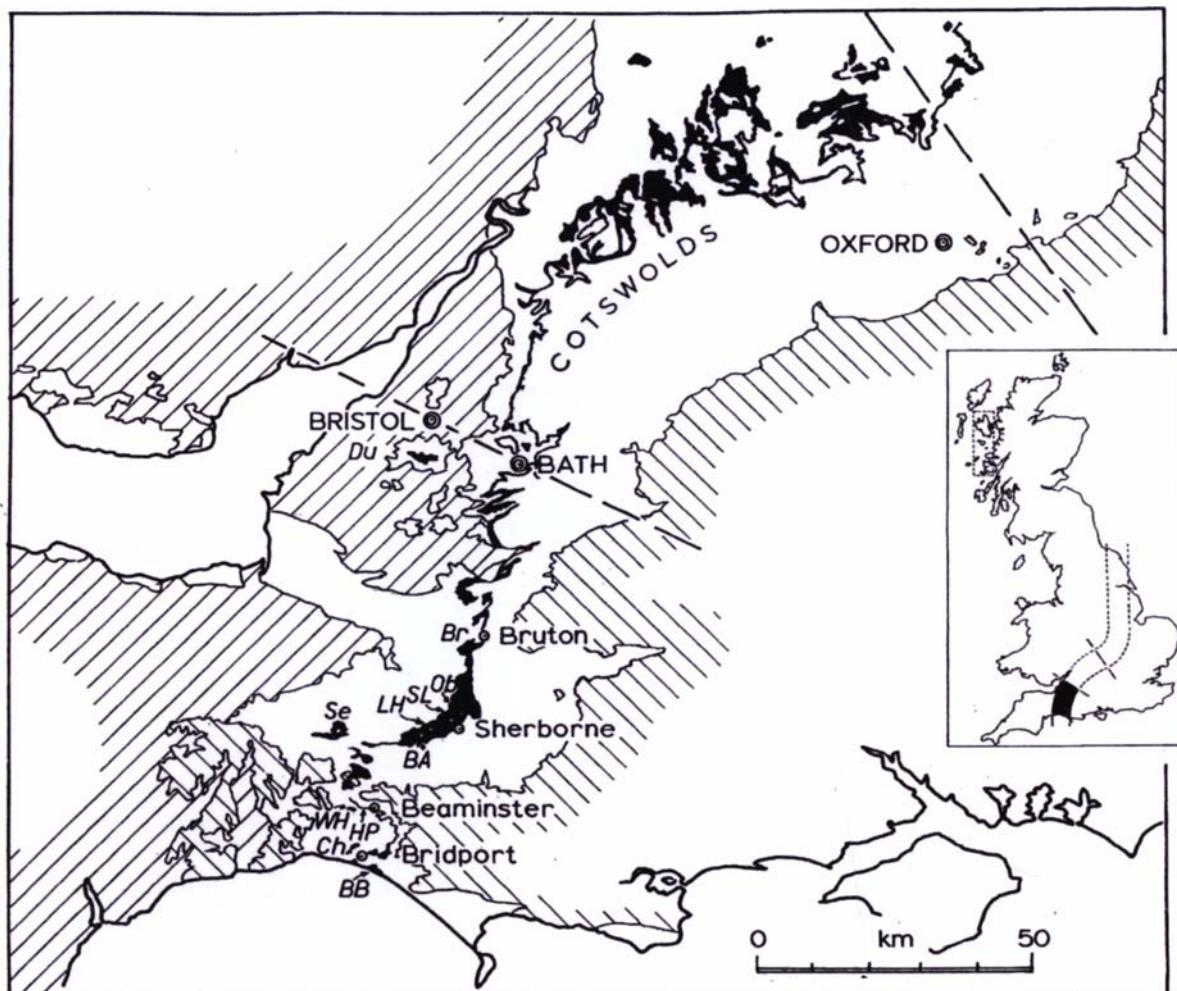
The palaeogeography of the Middle Jurassic of Europe.

North Sea Oil exploration has revealed the presence of a number of volcanoes in the Jurassic, active at different times. These may be the source of bentonites (fossilised ash deposits) such as the famous Fullers Earth of the Bath area.

As discussed above, Sydney Buckman (1893) was the first to realise that different localities thus record different successions deposited over slightly different intervals of time which are recognisable from the ammonite content and that by piecing together these records a more complete picture can be obtained.

As a result of these processes the Inferior Oolite varies enormously in thickness in Dorset. In the cliffs at Burton Bradstock it is about 4m thick but around Oborne it is 40m. As the formation is traced to the north, the Middle Inferior Oolite wedges out against the old massif of the Mendips over which the Upper Inferior Oolite continues. Further north the Lower Inferior Oolite

reappears and the formation reaches a thickness of about 125m in the Cotswolds. The palaeoenvironment and thus the facies are very different, however, ammonites being largely absent.



The Inferior Oolite formation (in black) can be seen passing from Burton Bradstock in Dorset to The Cotswolds north of Oxford. Letter codes indicate important localities: BB, Burton Bradstock; Ch, Chideock; HP, Horn Park; WH, Waddon Hill; BA, Bradford Abbas; Se, Seavington; LH, Louse Hill; SL, Sandford Lane; Ob, Oborne; Br, Bruton; Du, Dundry. Reproduced from Callomon and Chandler, 1990.

Codes and nomenclature

In order to identify locations we use abbreviated locality codes as given below.

Locality	Code	Sub-code
Beaminster	Be	
Beaminster, Cockroad Farm		Be-CF
Beaminster, Horn Park		Be-HP
Bradford Abbas	BA	
Bradford Abbas, Baggerbush Lane		BA-BL
Bradford Abbas, East Hill		BA-EH
Bradford Abbas, Kings Quarry		BA-KQ
Bradford Abbas, Three acre field		BA-TwA
Bruton	Br	
Bruton, Lusty Cutting		Br-LC
Dundry	Du	
Dundry, Little Down Wood		D-LDW
Dundry, South Main Road		D-SMR
Mapperton	Mp	
Mapperton, Coombe Quarry		Mp-CQ
Milborne Wick	MW	
Milborne Wick, Millers Hill		MW-MH
Oborne	Ob	
Oborne, Frogden Quarry		Ob-FQ
Oborne, Mill Close Farm		Ob-MCF
Oborne, Oborne Wood		Ob-OW
Sherborne	Sh	
Sherborne, Halfway House		Sh-HH
Sherborne, Clatcombe, Redhole Lane		Sh-RL
Sherborne, Sandford Lane		Sh-SL
Stoke Knap	SK	
Waddon Hill, Stoke Knap		WH-SK

Nomenclature.

In many parts of this book we have used ‘qualifiers’ when the identity of a specimen cannot be securely determined. We have followed prevailing fashion in using **cf.** preceding a species group name to indicate that the determination is uncertain. **aff.** indicates affinity of a new as yet

undescribed species with a known species. **sp.** indicates that the specimen cannot be related to any known species. **LT** denotes lectotype, **HT** holotype.

Author names.

We have included the name of the author who described the species. We have not included the year of the relevant publication or its reference in the interests of simplicity. The author name in brackets indicates that the species was originally placed in a different genus.

Order of presentation of plates

We have organised the subject matter of the plates in this work to follow the scheme of classification used in the Treatise on Invertebrate Palaeontology (1957). Plates are organized into superfamilies and families, which also has the effect of placing taxa in the approximate order of their appearance in time. As this work deals with Lower Bajocian ammonites we have omitted examples of species belonging to families that are prominent in the Aalenian or Upper Bajocian and have only figured those that occur in the Lower Bajocian. For example, we have figured Graphoceratidae including *Hyperlioceras* and some *Graphoceras* but excluded *Leioceras*, *Ludwigia* and *Brasilia* of the Aalenian.

The intention is to present high quality images of a selection of well preserved, typical specimens in the collection of the Wessex Cephalopod Club with some additions from the literature (shown in black and white). It is not an exhaustive account of each Family as this is beyond the scope of this work; however, a brief summary of each Family is given.

Superfamily HILDOCERATOIDEA

Family GRAPHOCERATIDAE

A Family arising in the Aalenian Stage from Toarcian ancestors. The entire group is represented by planulate to discoidal ammonites that are ornamented by weak to strong ribbing and a keel. A number of the older species (*Ludwigia*) possess strong tubercles. The genera *Leioceras*-*Ludwigia*-*Brasilia*-*Graphoceras* and *Hyperlioceras* form a continuum through time with *Staufenia* branching-off in the Lower Aalenian. The group is dimorphic, microconchs possessing slender lappets at mid flank position. The suture line is relatively simple. Most specimens are of small to medium size with large (0.5 m) examples occurring in the genus

Brasilia. The graphoceratids become less common at the end of the Discites Zone with very rare specimens persisting into the lowest Ovale Zone.

Family HAMMATOCERATIDAE.

This Family persists through from the Toarcian, where most of the morphologies seen in the group are already present. Aalenian species commonly have fine or coarse spines. The whorl section is ovoid to quadrate and there are regular well-defined ribs that persist across the flanks to a keel that is high and well defined. The suture is complex, particularly in Late Aalenian and Lower Bajocian species. Some species attain a large size (0.5 m) and the group is dimorphic, microconchs resembling the inner whorls of the macroconchs but being evolute with medial lappets. The Family persists into the Lower Bajocian as *Fissilobiceras* and appears to become extinct at this time, but is accompanied by homoeomorphic sonniniids that display equally complex sutures.

Family SONNINIIDAE

The first members of the Sonniniidae in Southwest England occur in rocks of Upper Aalenian age. They are clearly migrants to the area and have no transitional forms locally in older rocks, although they show some similarities to accompanying hammatoceratids, from which they are thought to have evolved. The early species have relatively simple suture lines and vary in morphology from being medium sized and spinose to plain shells. In later rocks there are a number of different forms, each of which has been allocated a different generic name, however the temporal relationships and branching points remain unclear. Some grow to a large size (0.5 m) and have complex sutures. To circumvent the issue of a specimen being classified as a *Euhoploceras* a *Prepapillites* or a *Shirbuirnia*, we have placed some of the genera in *Sonninia* Bayle, 1879 and indicated suitable varietal genera in square brackets.

Superfamily STEPHANOCERATOIDEA

Family STEPHANOCERATIDAE

The earliest coiled ammonites considered by us as stephanoceratids occur as extreme rarities in rocks of the Bradfordensis and Concavum zones. They are migratory and occur at certain levels, becoming more common in the Ovale Zone after which they increase in abundance and variety. There are numerous generic terms for the various morphologies and geographical variants, so for brevity we have again called them all *Stephanoceras*, unless there is a clear and well-established distinction e.g. *Teloceras*, but even here the transitional forms are difficult to assign! The

dominant morphological feature is that most are ‘snake-stones’ resembling a coiled rope, the rope varying in width and height throughout development.

Family OTOITIDAE

This group occurs at the Aalenian-Lower Bajocian transition and is characterised by stout, mostly moderately involute ammonites, some with a deep, circular ‘crater-like’ umbilicus, often with a pre-constriction before the mouth border and a prominent modified lip. The family name derives from otid or ear, in recognition of the lateral projections or lappets that typically ornament the termination of the microconchs. The best known form is *Emileia* and its partner microconch *Otoites*.

Family SPHAEROCERATIDAE

The early forms are diminutive and have a globose morphology and tendency for the umbilicus to become constricted and oval. The largest forms in the Lower Bajocian are *Labyrinthoceras* with a globose, spherical morphology and delicate, fine ribbing that persists across the venter. There are no tubercles or spines. The termination is highly modified and is preceded by a deep constriction.

Superfamily HAPLOCERATOIDEA

For convenience, we have organised the plates to include three families together based on their subdivision used in the Treatise (1957):

Family HAPLOCERATIDAE

Small, generally smooth ammonites with a rounded venter and lacking a keel. The only genus of significance in the Lower Bajocian is *Lissoceras*.

Family STRIGOCERATIDAE

Discoid, involute ammonites decorated by bi-concave growth lines or ribbing. In the Lower Bajocian the prominent strigation seen in later forms is absent. A strong high keel is present.

Family OPPELIIDAE

Small ammonites with a rounded venter and marked ventral ribbing that fades dorsally on the flanks. As *Bradfordia* the group occurs first in the late Concavum Zone.

Superfamily PHYLLOCERATOIDEA

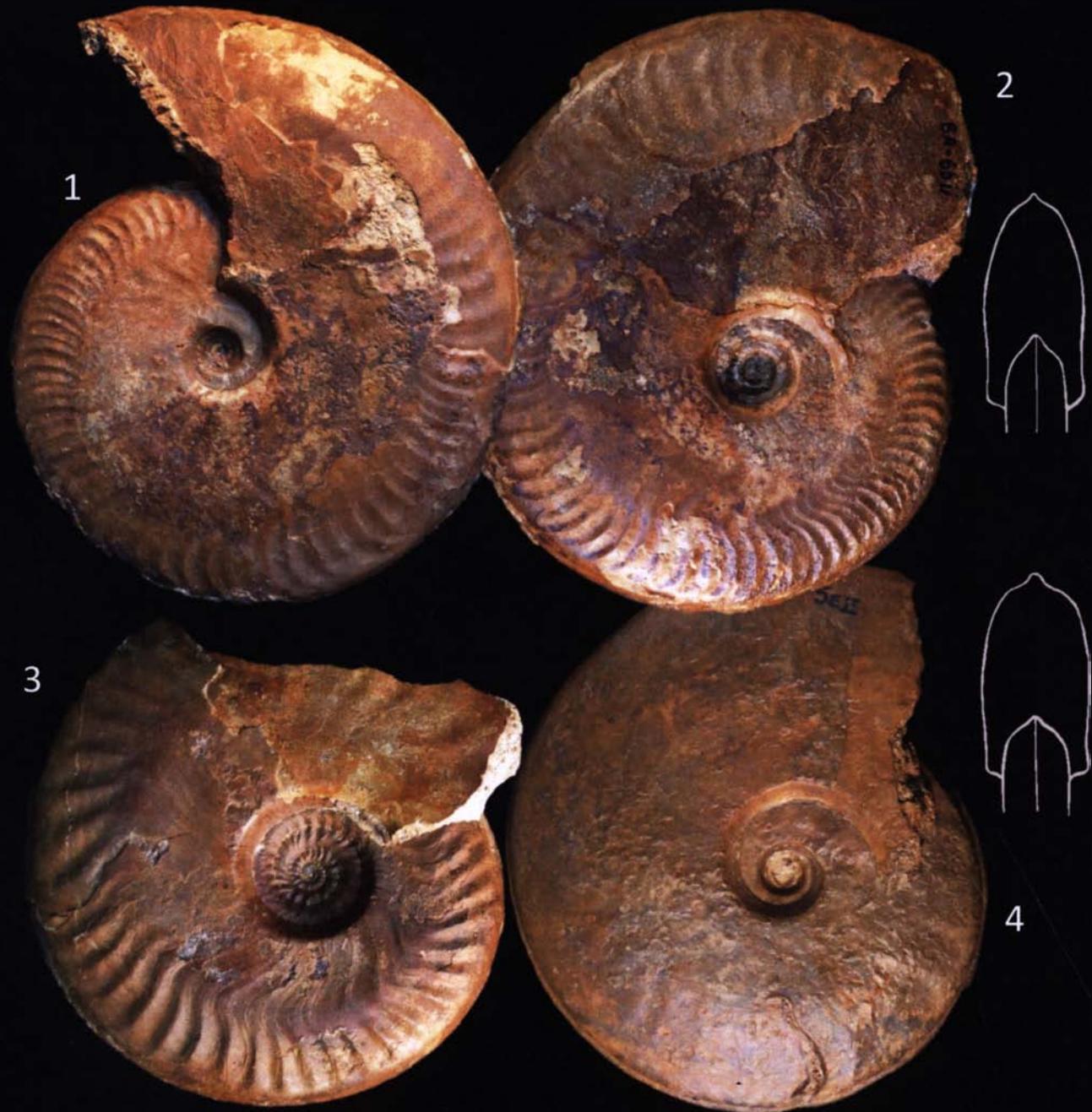
Family PHYLLOCERATIDAE

In the Lower Bajocian of southwest England, phyloceratids are extremely rare. Specimens are known from the Sauzei Zone and one example of *Holcophylloceras* is recorded from the Humphriesianum Zone.

Superfamily LYTOCERATOIDEA

Family LYTOCERATIDAE

Large trumpet like shells often smooth on later whorls, sometimes with constrictions and fimbriae. Shells are often very large (0.75 m) and occur in specific horizons presumably as migration events?



Family GRAPHOCERATIDAE. Genus *Graphoceras* and *Hyperlioceras*. Discites Zone, Walkeri Subzone, Bj-1.

1. *G. limitatum* S. Buckman, Bj-1, BA-EH. ($d=125\text{mm}$).
2. *G. formosum* S. Buckman, Bj-1, BA-EH. ($d=135\text{mm}$).
3. *G. stigmosum* S. Buckman, Bj-1, BA-EH. ($d=90\text{mm}$).
4. *H. politum* S. Buckman, Bj-1, BA-EH. ($d=160\text{mm}$).

The distinction between *Graphoceras* and *Hyperlioceras* is arbitrary. Specimens transitional to *Hyperlioceras* are already present in the Late Concavum Zone.



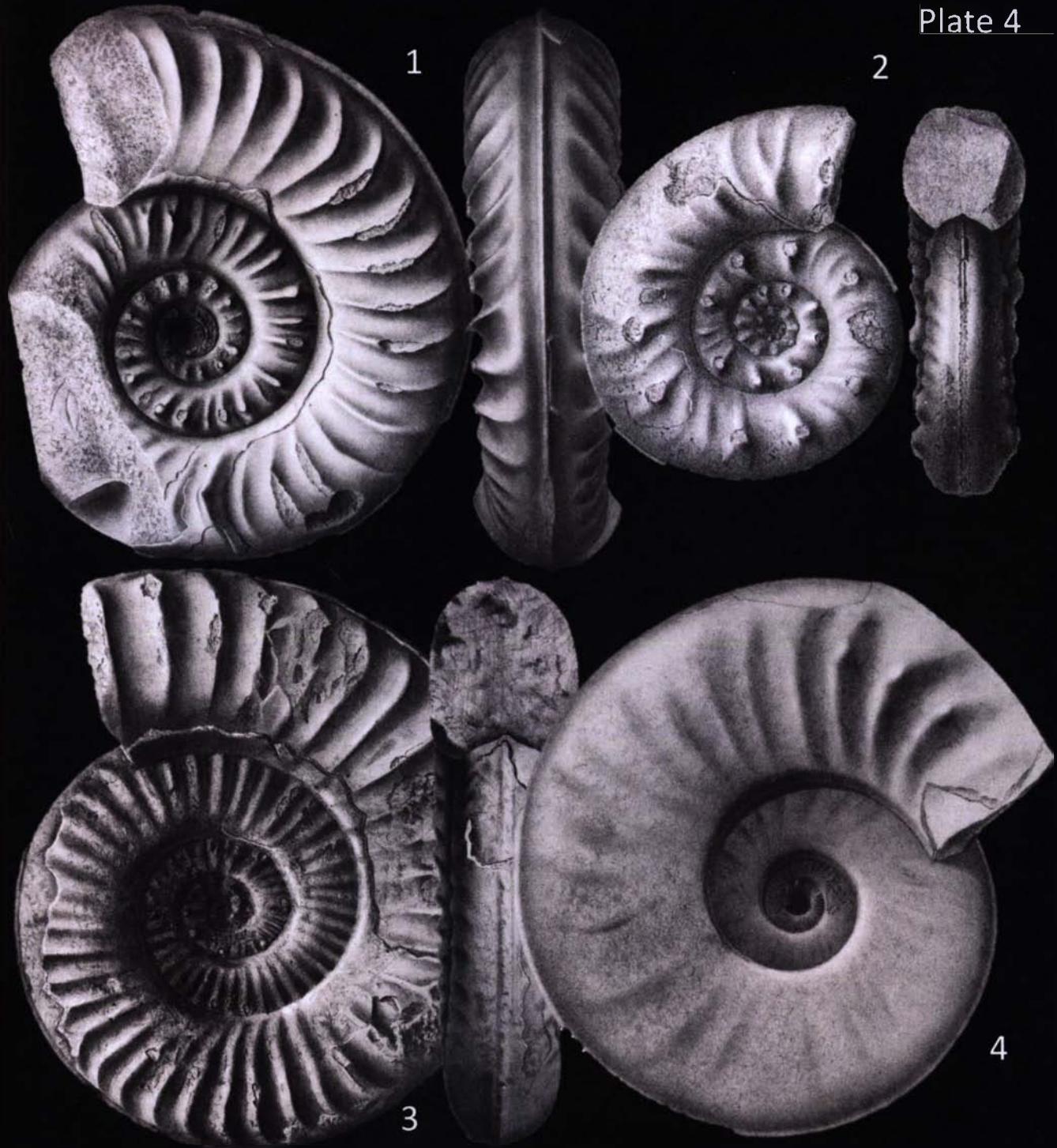
Family GRAPHOCERATIDAE. Genus *Hyperlioceras*. Discites Zone,
Walkeri & Subsectum subzones, Bj-2&3.

1. *H. walkeri* S. Buckman, Bj-2, Be-CF. ($d=120\text{mm}$).
2. *H. liodiscites* S. Buckman, Bj-3, Mp-CQ. ($d=160\text{mm}$).
3. *H. cuneatum* S. Buckman, Bj-3, BA-EH. ($d=220\text{mm}$).
4. *H. subsectum* S. Buckman, Bj-3, Br-LC. ($d=150\text{mm}$).



Family HAMMATOCARATIDAE. Genera *Eudmetoceras* and *Fissilobiceras*. Discites Zone, Walkeri Subzone and Laeviuscula Zone, Trigonalis Subzone.

1. *E. amplexens* S. Buckman, Bj-1, BA-EH. ($d=115\text{mm}$).
2. *F. cf. fissilobatum* (Waagen), Bj-8, Sh-SL. ($d=270\text{mm}$).
3. *F. cf. ovale* (Quenstedt), Bj-1, Br-LC. ($d=221\text{mm}$).



Family SONNINIIDAE. Genus *Sonninia* including *Euhoploceras*. Concavum Zone, Formosum Subzone, Aa-16 to Walkeri Subzone Bj-1. Buckman, S.S., 1887-1907. A monograph of the ammonites of the Inferior Oolite Series. Palaeontographical Society, London.

1. S. [E.] *acanthodes* S. Buckman, Plate 58. Concavum Zone, BA. (d=250mm).
2. S. [E.] *acanthodes* S. Buckman, Plate 59. Concavum Zone, BA. (d=100mm).
3. S. [E.] *marginatum* S. Buckman, Plate 62. Concavum Zone, BA. (d=230mm).
4. S. [E.] *modestum* S. Buckman, Plate 68. Concavum Zone, BA. (d=180mm).



Family SONNINIIDAE. Genus *Sonninia* including *Euhoploceras*. Concavum Zone, Formosum Subzone, Aa-16 to Walkeri Subzone Bj-1.

1. S. [E.] *acanthodes* S. Buckman, Aa-16, BA-EH. (d=260mm).
2. S. [E.] *acanthodes* S. Buckman, Aa-16, BA-EH. (d=200mm).
3. S. [E.] *acanthodes* [syn. *crassispinata*] S. Buckman, Aa-16, BA-EH. (d=200mm).
4. S. [E.] *acanthodes* [syn. *locuples*] S. Buckman, Bj-1 or 2, Sh-HH. (d=150mm).



Family SONNINIIDAE. Genus *Sonninia* including *Euhoploceras*. Discites Zone, Bj-1 to 3.

1. *S. [E.] acanthodes* [syn. *nodata*] S. Buckman, Bj-2 or 3, BA-TwA. (d=200mm).
2. *S. [E.] acanthodes* [syn. *irregularis*] S. Buckman, Bj-2, BA-EH. (d=150mm).
3. *S. [E.] marginatum* S. Buckman, Bj-1 or 2, BA-EH. (d=130mm).
4. *S. [E.] marginatum* [syn. *diversa*] S. Buckman, Bj-1, BA-EH. (d=200mm).



Family SONNINIIDAE. Genus *Sonninia* including *Euhoploceras*. Discites Zone, Bj-1 to 3.

1. *S. [E.] marginatum* S. Buckman, Bj-1, Mp-CQ. ($d=150\text{mm}$).
2. *S. [E.] marginatum* [syn. *dominica*] S. Buckman, Bj-1, BA-EH. ($d=210\text{mm}$).
3. *S. [E.] modestum* [syn. *parvicostata*] S. Buckman, Bj-3, Mp-CQ. ($d=170\text{mm}$).
4. *S. [E.] modestum* S. Buckman, Bj-1, BA-EH. ($d=220\text{mm}$).



Family SONNINIIDAE. Genus *Sonninia* including *Euhoploceras*. Ovale Zone, Bj-6.

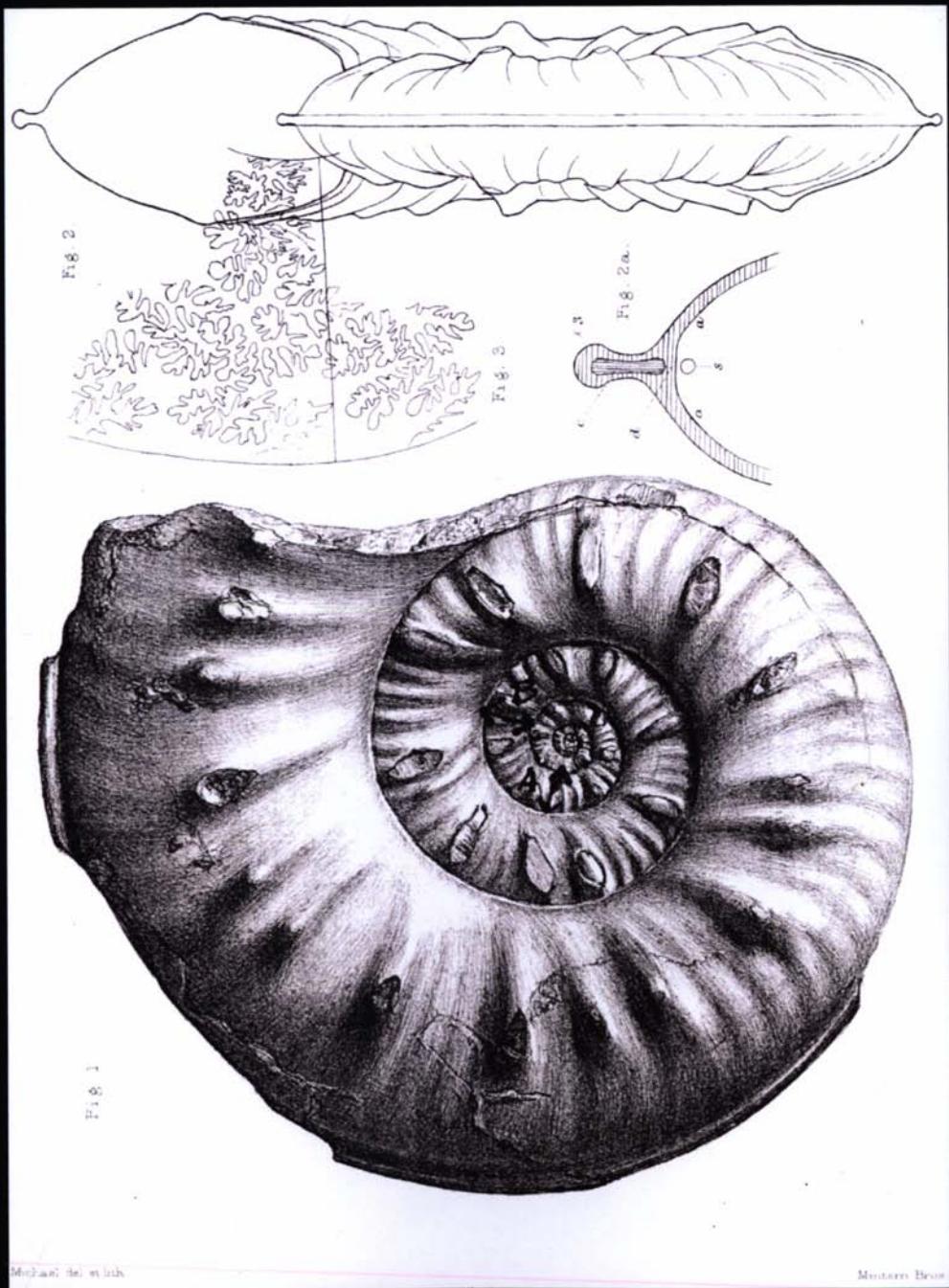
1. S. [E.] *adicra* (Waagen), Bj-5, Mp-CQ. ($d=180\text{mm}$).
2. S. cf. *corrugata* (J. de. C. Sowerby), Bj-6, Sh-SL. ($d=240\text{mm}$).
3. S. cf. *corrugata* (J. de. C. Sowerby), evolute variant. Bj-6, Sh-SL. ($d=130\text{mm}$).
4. S. [E.] cf. *modestum* var. *contusa* S. Buckman, Bj-6, Sh-SL. ($d=130\text{mm}$).

These ammonites have morphologies that first appear in earlier strata but persist to the Ovale Zone and later with modifications.



Family SONNINIIDAE. Genera *Witchellia* and *Sonninia* including *Euhoploceras*.
Laeviuscula Zone, Trigonalis and Laeviuscula subzones.

1. S. [*E.*] *nodatipinguis* (S. Buckman), Bj-8a, Sh-RL. (d=110).
2. S. [*E.*] *omphalica* (S. Buckman), Bj-7, Sh-SL. (d=105mm).
3. *W. gelasina* (S. Buckman), Bj-7, Sh-SL. (d=80mm).
4. *W. cf. laeviuscula* (J. de C. Sowerby), Bj-10b, Topotype. D-SMR. (d=76mm).

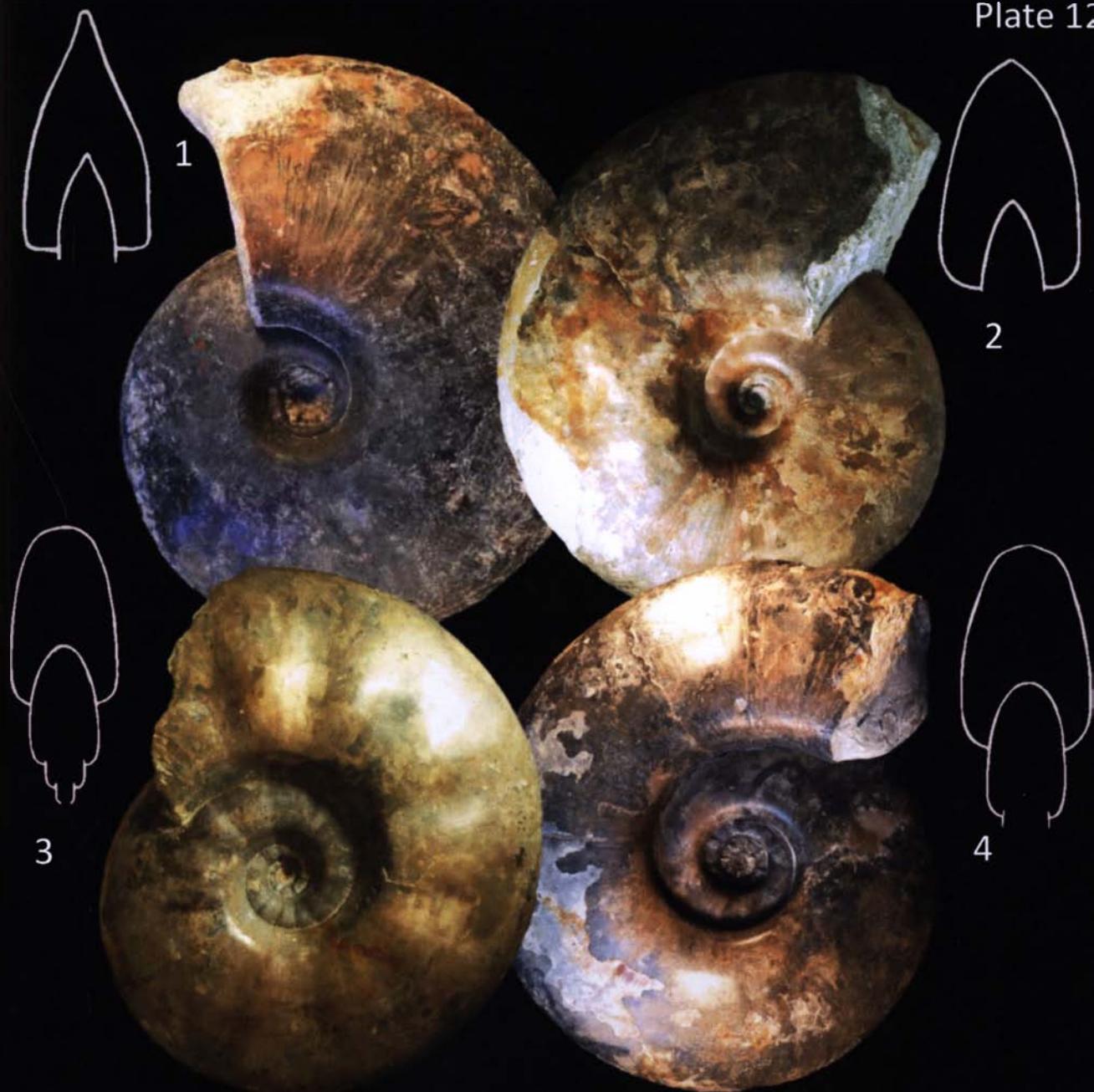


Family SONNINIIDAE. Genus *Sonninia* including *Papilliceras*. This plate depicts a specimen intended for inclusion in a later part of Buckman's *Monograph* (1887-1907). It was never published. The specimen is probably intended to demonstrate the un-named coarsest member of the variability of the group *S. [P.] micracanthicum* (Buckman, 1925), *S. [P.] mesacanthum* (Waagen, 1867) from the Laeviuscula Zone of Dundry or Oborne? Image courtesy of H. Torrens.



Family SONNINIIDAE. Genus *Sonninia* including *Papilliceras*. Laeviuscula Zone, Trigonalis and Laeviuscula subzones and Sauzei Zone. Patella Subzone, Bj-8 to 10.

1. *S. [P.] mesacanthum* (Waagen), Bj-10b, Sh-SL. ($d=240\text{mm}$).
2. *S. [P.] micracanthicum* (S. Buckman), Bj-10b, D-SMR. ($d=225\text{mm}$).
3. *S. simulans* (S. Buckman), Bj-11, Sh-SL. ($d=250\text{mm}$).
4. *S. [P.] acanthera* (S. Buckman), Bj-8, Sh-SL. ($d=140\text{mm}$).

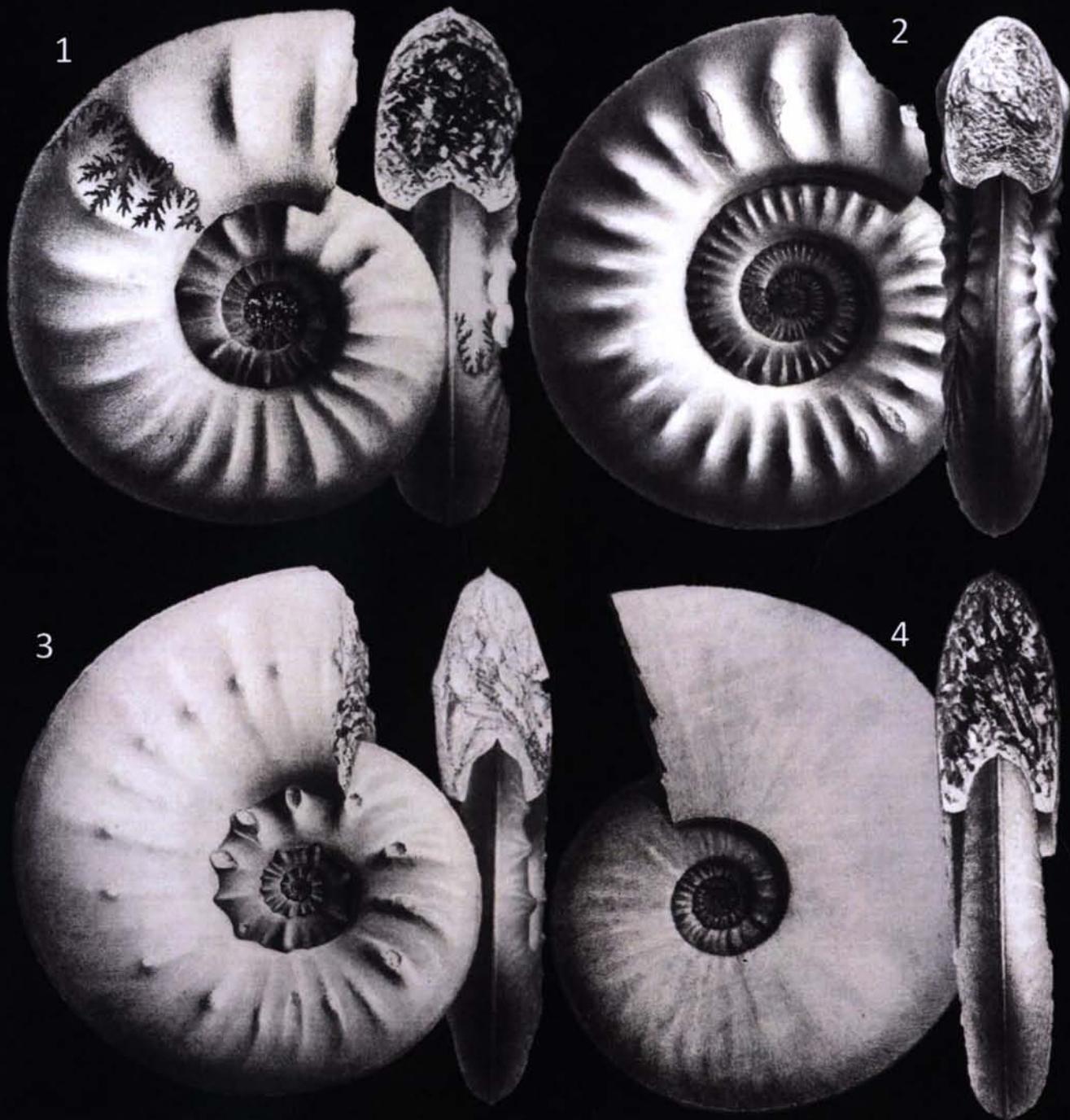


Family SONNINIDAE. Genus *Shirbuirnia* and *Pseudoshirbuirnia*.

Laeviuscula Zone, Trigonalis Subzone, Bj-8.

1. *P. fastigata* (S. Buckman), Bj-8, Sh-SL. ($d=200\text{mm}$).
2. *P. stephani* (S. Buckman), Bj-8, Sh-SL. ($d=240\text{mm}$).
3. *S. undifer* (S. Buckman), Bj-8, Sh-SL. ($d=280\text{mm}$).
4. *S. trigonalis* S. Buckman, Bj-8, Sh-SL. ($d=330\text{mm}$).

Dietze et al. 2005 erected the genus *Pseudoshirbuirnia* Type species: *Amaltheus?* *stephani* BUCKMAN, 1883 to include both *S. stephani* and *S. fastigata* separating it from *S. trigonalis* based principally on the oxyconic morphology and a simple suture. Recently examination of large numbers of specimens demonstrates that variation is continuous with intermediates between all the morphospecies represented.



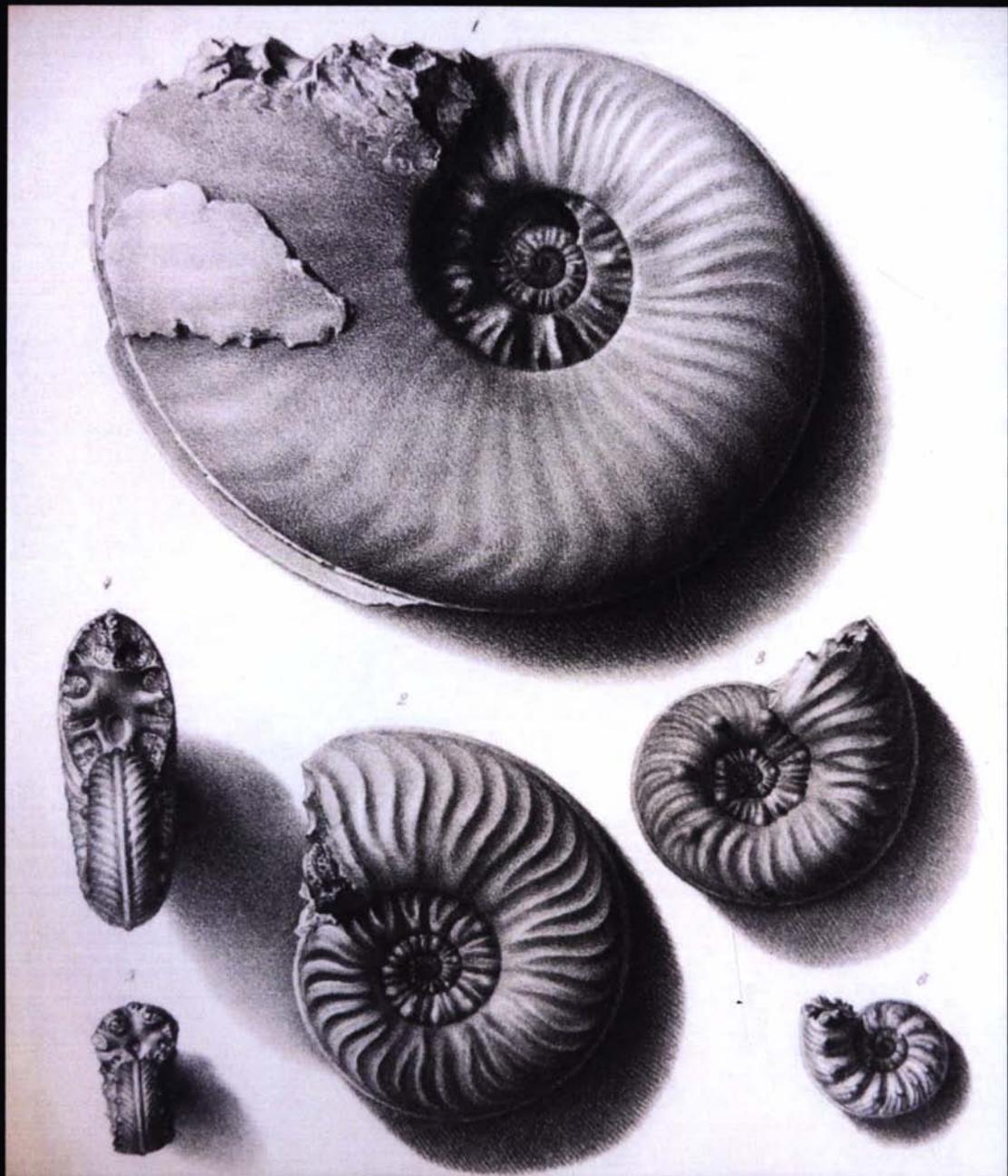
Family SONNINIIDAE. Genus *Sonninia* including *Papilliceras* and *Euhoploceras*.
Laeviuscula Zone and Sauzei Zone. Waagen, W.H., 1867. Über die Zone des Ammonites
Sowerbyi. R. Oldenbourg, München.

1. *S. [E.] adicra* (Waagen), Plate 25, Fig. 1.
2. *S. polyacantha* (Waagen), Plate 29, Fig. 1.
3. *S. [P.] mesacantha* (Waagen), Plate 28, Fig. 1.
4. *S. patella* (Waagen), Plate 25, Fig. 3.



Family SONNINIIDAE. Genus *Sonninia*, including *Papilliceras*. Sauzei Zone, Patella Subzone and Laeviuscula Zone, Trigonalis and Laeviuscula subzones, Bj-8 & 10.

1. *S. propinquans* (Bayle), Bj-11a, Sh-SL. ($d=180\text{mm}$).
2. *S. polyacantha* (Waagen), Bj-8 or 9, Sh-SL. ($d=250\text{mm}$).
- 3, 4. *S. [P.] phlyctenoides* (S. Buckman), Bj-8b, Sh-SL. ($d=190\text{mm}$).



Family SONNINIIDAE. Genus *Sonninia*. Laeviuscula Zone and Sauzei Zone.
Sonninia propinquans (Bayle). Oolite inferior, Les Moutiers, près de Caen, Bayeux,
France. Bayle, E., 1878. Explication de la carte Géologique de la France. Atlas.
Fossiles principaux de Terrains. Tome 1. Imprimerie National, Paris. Plate 84.

Aa-16



Bj-1



Bj-4



Bj-7



Family SONNINIIDAE. Concavum to Laeviuscula zones, Aa-16 to Bj-7.

Range of variability in specimens (not to scale) from selected horizons where specimens are frequent enough to allow a range of morphologies to be collected

Bj-8



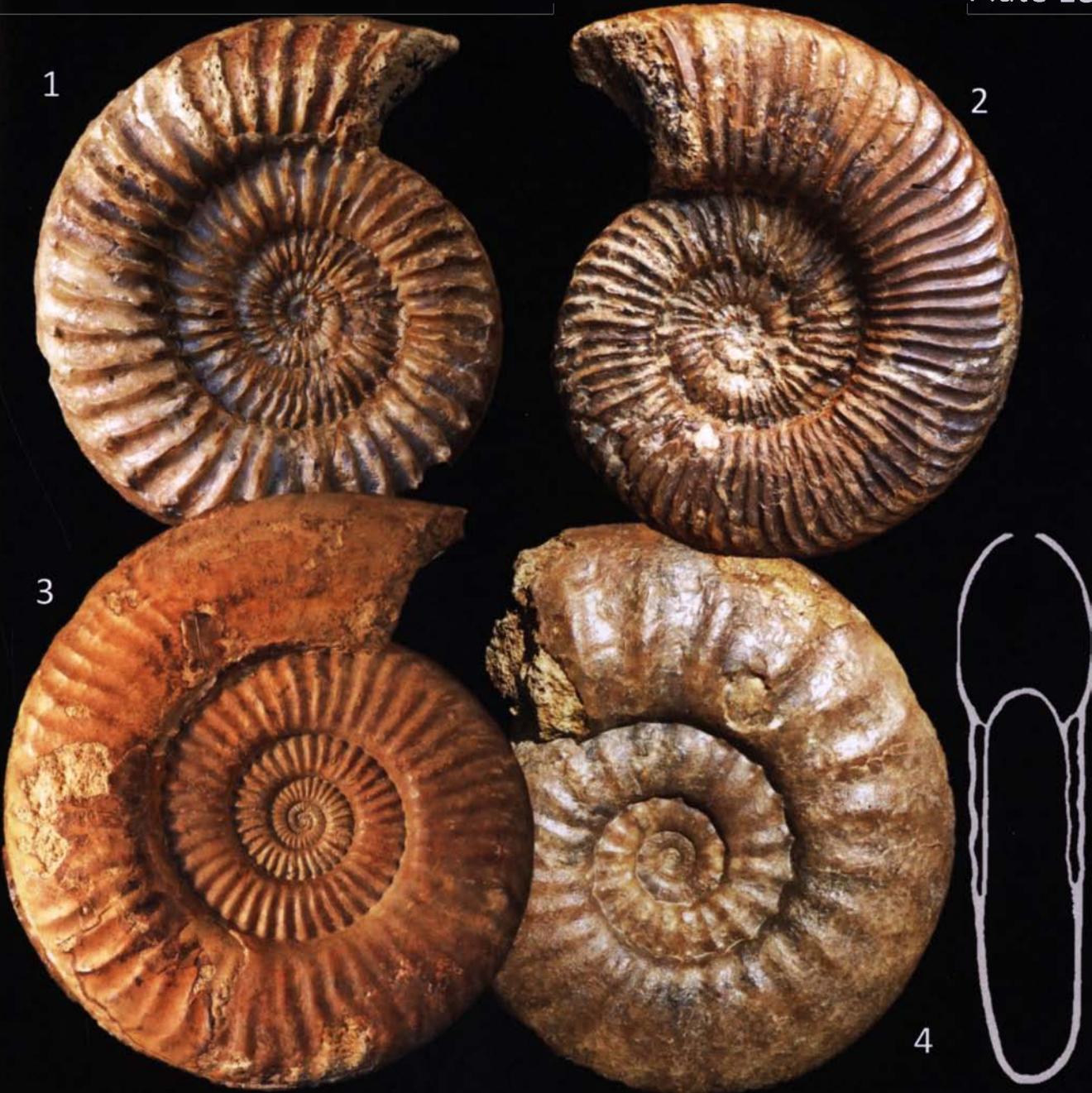
Bj-10



Bj-11



Family SONNINIIDAE. Laeviuscula to Sauzei zones, Bj-8 to 11.
Range of variability in specimens (not to scale) from selected horizons
where specimens are plentiful enough permit adequate sampling.



Family SONNINIIDAE, Subfamily WITCHELLINAE & Family HAMMATOCERATIDAE, Subfamily ZURCHERIINAE. Genus *Haplopleuroceras*, *Zucheria* & *Fontannesia*. Concavum-Discites zones.

1. *H. subspinatum* S. Buckman, Bj-1, BA-BL. ($d=82\text{mm}$).
2. *H. mundum* S. Buckman, Aa-16, Be-HP. ($d=65\text{mm}$).
3. *F. grammaceratoides* S. Buckman, Bj-1, BA-EH. ($d=115\text{mm}$).
4. *Z. inconstans* S. Buckman, Bj-2, BA-KQ. ($d=65\text{mm}$).



Family SONNINIIDAE. Subfamily Witchelliinae Callomon & Chandler. Genus *Witchellia*. Laeviuscula Zone, Trigonalis and Laeviuscula subzones.

1. *W. sayni* (Douvillé), Bj-7, Sh-SL. ($d=111$).
2. *W. albida* (S. Buckman), involute variant, Bj-7, Sh-SL. ($d=113\text{mm}$).
3. *W. albida* (S. Buckman), Bj-7, Sh-SL. ($d=112\text{mm}$).
4. *W. cf. glauca* S. Buckman, Bj-10b, D-SMR. ($d=62\text{mm}$).
5. *W. plena* (S. Buckman), Bj-10a, Ob-OW. ($d=55\text{mm}$).
6. *W. cf. spinifera* S. Buckman, Bj-10a, Ob-FQ. ($d=90\text{mm}$).



Family SONNIIDAE. Genus *Dorsetensis*. Humphriesianum Zone.

1. *D. liostraca* S Buckman, Bj-14, Ob-OW. ($d=210\text{mm}$).
2. *D. subtecta* S. Buckman, Bj-14, Ob-OW. ($d=190\text{mm}$).
3. *D. edouardiana* (d'Orbigny), Bj-14, Ob-OW. ($d=45\text{mm}$).
4. *D. romani* (Oppel), Bj-14, Ob-OW. ($d=90\text{mm}$).



Family SONNIIDAE. Genus *Poecilomorphus*. Humphriesianum Zone.

1. *P. cycloides* (d'Orbigny), Bj-14, Sh-LH. ($d=25\text{mm}$).
2. *P. cycloides* (d'Orbigny), Bj-14, Ob-OW. ($d=30\text{mm}$).
3. *P. angulinus* S. Buckman, Bj-14, Ob-FQ. ($d= 20\text{mm}$).
4. *P. angulinus* S. Buckman, Bj-14, Ob-OW. ($d= 30\text{mm}$).
5. *P. regulatus* S. Buckman, Bj-14, Ob-OW. ($d= 50\text{mm}$).



Superfamily HAPLOCERATOIDEA Zittel, 1884. Genera *Bradfordia*, and *Lissoceras*.
Discites to Sauzei Zone, Bj-1 to 11.

1. *Lissoceras depereti* (Flamand), Bj-8, Sh-SL. (60mm).
2. *B. ambyls* (S.Buckman), Bj-11, Ob-OW. (d=95mm).
3. *B. liomphala* S.Buckman, Bj-1, BA-EH. (d=65mm).
4. *B. inclusa* S.Buckman, Bj-10, Ob-OW. (d=45mm).



Family STRIGOCERATIDAE Genus *Strigoceras*. Ovale to Humphriesianum zones.

1. *S. compressum* S. Buckman, Bj-5, D-SMR. ($d=111\text{mm}$).
2. *S. bessinum* Brasil, Bj-14, Ob-FQ. ($d=75\text{mm}$).
3. *S. cf. strigifer* S. Buckman, Bj-11, D-SMR. ($d= 32\text{mm}$).
4. *S. languidum* (S. Buckman), Bj-11, Sh-SL. ($d=180\text{mm}$).



Family STEPHANOCERATIDAE and OTOITIDAE.

Genus *Docidoceras* & *Stephanoceras* comprising *Riccardiceras*. Concavum - Discites zones.

1. S. [R.] *longlavum* (Vacek), Aa-14, BA-EH. ($d=90$).
2. S. [R.] *perfectum* (S. Buckman), Bj-1, BA-EH. ($d=135$).
3. *D. tolleyi* Sandoval & Chandler, Bj-3, WH-SK. ($d=100\text{mm}$). HT.
4. *D. cylindroides* S. Buckman, Bj-3, WH-SK. ($d=120\text{mm}$).



Family STEPHANOCERATIDAE, Genus *Stephanoceras* including the macroconch micromorphs, *Mollistephanus*, *Phaulostephanus* and *Lokuticeras*. Trigonialis to Humphriesianum zones, Bj-8 to Bj-15.

1. *S. [P.] paululus* S. Buckman, Bj-15, Ob-FQ. ($d=60\text{mm}$).
2. *M. mollis* S. Buckman, Bj-8, Sh-SL. ($d=85\text{mm}$).
3. *S. [L.] cf. rossbrunnense* (Galácz), Bj-15, Sh-RL. ($d=95\text{mm}$).
4. *S. [L.] fredericiromanii* (Roché), Bj-14b, Ob-FQ. ($d=75\text{mm}$).



Family STEPHANOCERATIDAE. Genus *Kumatostephanus*. Laeviuscula to Humphriesianum zones.

1. *K. kumaterus* S. Buckman, [M] Bj-10, Ob-MCF. ($d=190\text{mm}$).
2. *K. perjucundus* S.Buckman, [M] Bj-11, Sh-SL. ($d=220\text{mm}$).
3. *K. cf. perjucundus* S. Buckman, [M] Bj-11, D-SMR. ($d=90\text{mm}$).
4. *K. triplicatus* (Renz), [M] Bj-15, Ob-FQ. ($d=230\text{mm}$).



Family STEPHANOCERATIDAE. Genus *Stephanoceras* including *Skirroceras*. Sauzei Zone.

1. *S. cf. richardsoni* (Dietze et al.), late morph, Bj-11a, Sh-SL. ($d=240\text{mm}$).
2. *S. cf. leptogyrale* (S. Buckman), Bj-11a, Sh-RL. ($d=170\text{mm}$).
3. *S. kalum* (S. Buckman), Bj-11a, Sh-SL. ($d=200\text{mm}$).
4. *S. cf. dolichoecus* (S. Buckman), Bj-11, D-SMR. ($d=220\text{mm}$).



- Family STEPHANOCERATIDAE. Genus *Stephanoceras*. Humphriesianum Zone.
1. *S. humphriesianum* (J. Sowerby), Bj-15, Ob-FQ. ($d=260\text{mm}$).
 2. *S. humphriesianum* (J. Sowerby), Bj-15, Ob-FQ. ($d=160\text{mm}$).
 3. *S. humphriesianum* (J. Sowerby), LT. ($d=100\text{mm}$).
 4. *S. humphriesianum* (J. Sowerby), LT, Buckman, S.S., 1908. Illustrations of type specimens of Inferior Oolite ammonites in the Sowerby collection. Palaeontographical Society.



Family STEPHANOCERATIDAE. Genus *Stephanoceras*. Humphriesianum Zone.

1. *S. rhytum* (S. Buckman), Bj-15, Ob-OW. ($d=240\text{mm}$).
2. *S. freycinetti* (Bayle), Bj-15, Ob-FQ. ($d=160\text{mm}$).
3. *S. humphriesianum* (J. Sowerby), Bj-15, Ob-FQ. ($d=310\text{mm}$).
4. *S. humphriesianum* (J. Sowerby), Bj-15, Ob-FQ. ($d=330\text{mm}$).

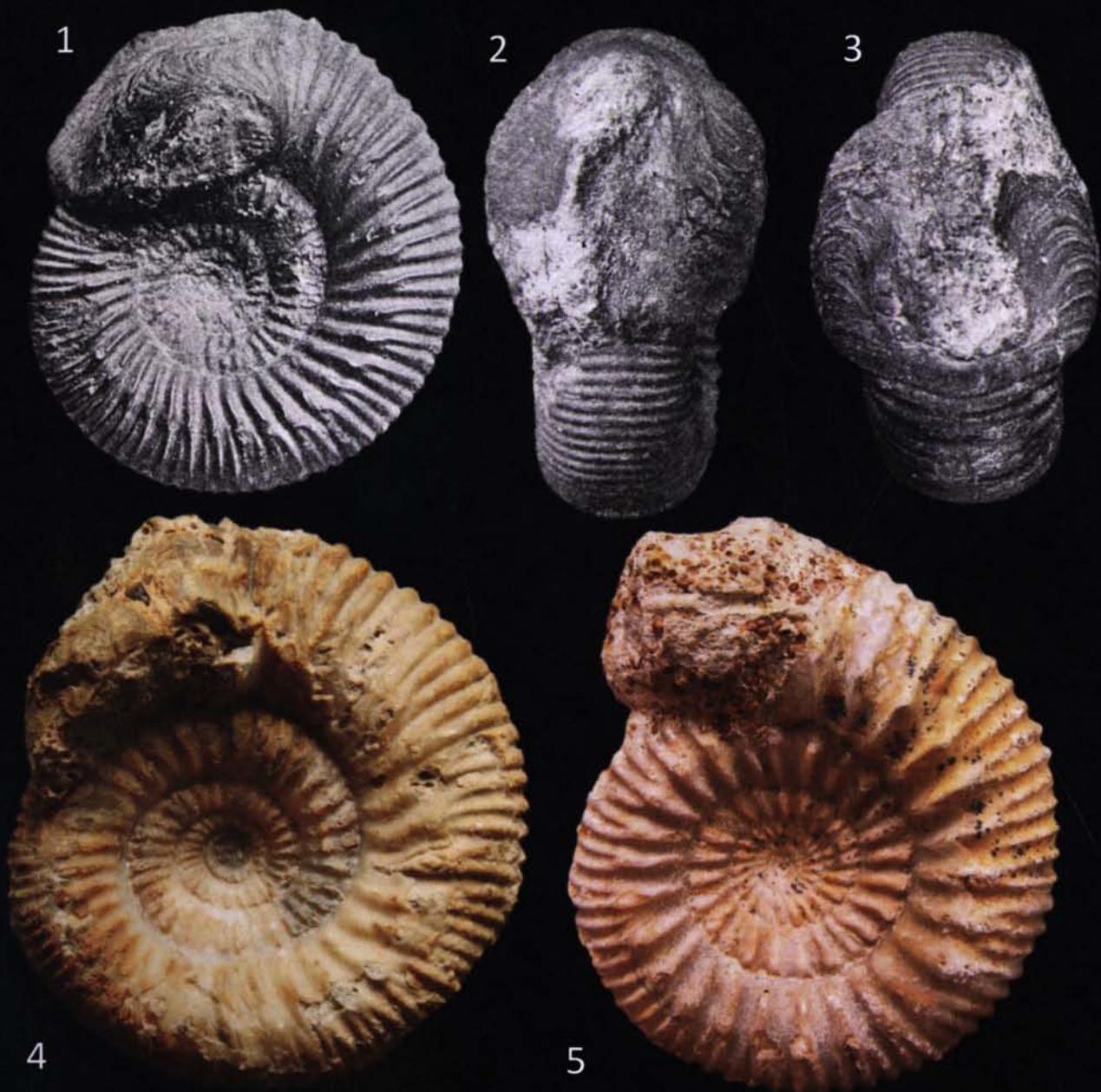
Particular ammonite morphologies range over a number of levels, often earlier or later than their type horizons which often also correspond to their horizons of greatest abundance (locally acme). In this case specimens close to the morphology of *S. rhytum* persist in Bj-15, however the acme of this morphology is in Bj-12.



Family STEPHANOCECERATIDAE. Genus *Stephanoceras*. Humphriesianum Zone.

1. *S. cf. kreter* (S. Buckman), Bj-15, Ob-FQ. ($d=230\text{mm}$).
2. *S. gibbosum* (S. Buckman), Bj-16, Ob-MCF. ($d=190\text{mm}$).
3. *S. cf. hoffmanni* Schmidtill & Krumbeck, Bj-13, Ob-FQ. ($d= 225\text{mm}$).
4. *S. cf. hoffmanni* Schmidtill & Krumbeck, Bj-13, Ob-FQ. ($d= 223\text{mm}$).

Ammonites with similar morphology from different horizons have been given different names. *S. kreter* and *S. gibbosum* are similar and the morphology ranges over much of the Humphriesianum Zone.



Family STEPHANOCERATIDAE Genus *Stephanoceras* [*Normannites*]. Sauzei Zone.

- 1-3. *S. [N.] braikenridgii* (J. Sowerby), Bj-11, "Dundry Ironshott", Sauzei Zone, Dundry. Figured by Buckman, S.S., 1911-1919. Yorkshire Type Ammonites. Weldon and Wesley, Thame and London. Plate 81.
4. *S. [N.] cf. braikenridgii* (J. Sowerby), Bj-11, Sh-SL. ($d=35\text{mm}$).
5. *S. [N.] rugosus* Westermann, Bj-11, D-SMR. ($d=40\text{mm}$).



Family STEPHANOCERATIDAE Genus *Stephanoceras* [*Normannites*].
Humphriesianum Zone.

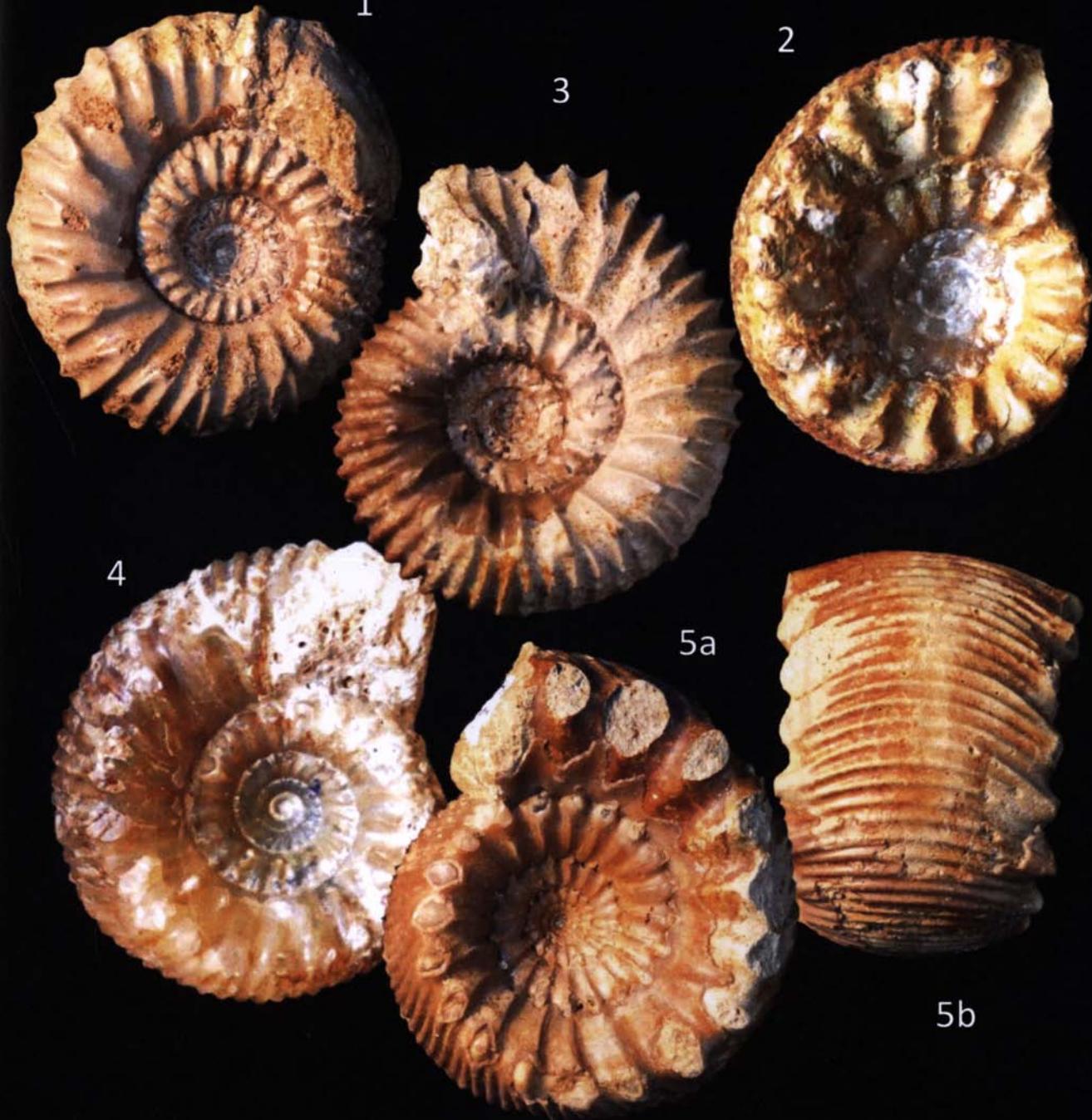
1, 2. S. [N.] *orbignyi* S. Buckman, Oolite Ferrugineuse de Bayeux, France. d'Orbigny, A., 1842-1850. Palaeontologie francale: description des mollusques et rayonnés fossiles. Terrains Jurassiques. Les céphalopodes. Atlas. Vol.1, Masson, Paris. Plate 44, Fig. 3, 4. Specimen now lost.

3, 4. S. [N.] *orbignyi* S. Buckman, Bj-15, Ob-OW. (d=60mm).



Family STEPHANOCERATIDAE Genus *Stephanoceras* [*Normannites*]. Humphriesianum Zone.

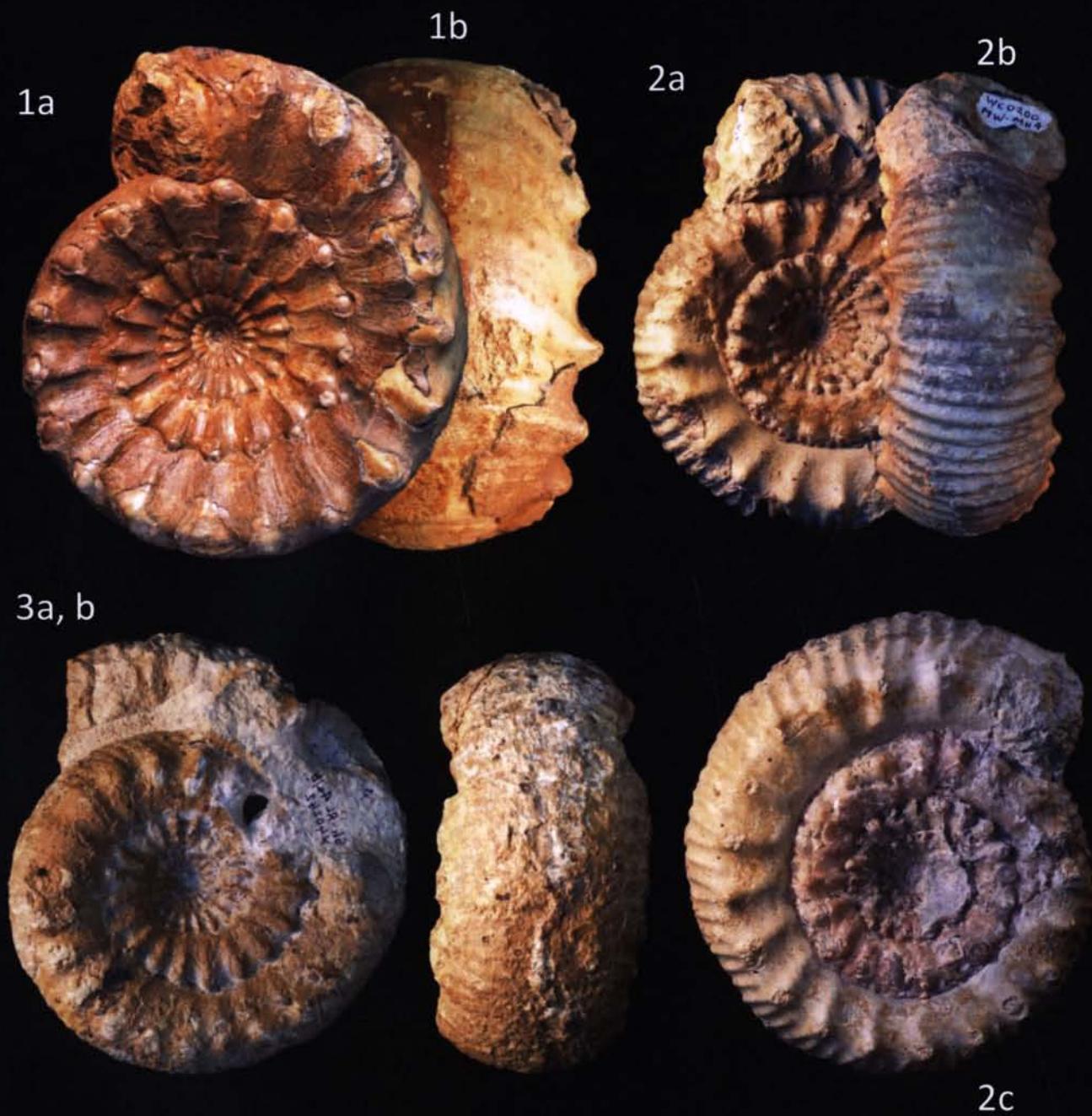
1. S. [N.] *quenstedti* Roché, Bj-15, Ob-MCF. ($d=100\text{mm}$).
2. S. [N.] *orbignyi* S. Buckman, Bj-15, Ob-MCF. ($d=65\text{mm}$).
- 3, 4. S. [N.] *orbignyi* S. Buckman, Bj-15, Sh-RL. ($d=75\text{mm}$).



Family STEPHANOCERATIDAE. Genus *Kumatostephanus* and teloceratoid ammonites [m] & ?[M].

Laeviuscula to Humphriesianum zones.

1. *K. [Epaxites] laticostatus* (Westermann), Bj-10, Ob-MCF. ($d=55\text{mm}$).
2. *Kumatostephanus* sp., Bj-11, Sh-SL. ($d=25\text{mm}$).
3. *K. [Itinsaites] mackenzii* (McLearn), Bj-10, Ob-MCF. ($d=55\text{mm}$).
4. *Kumatostephanus* sp., Bj-11, Sh-SL. ($d=22\text{mm}$).
5. *Teloceras cf. labrum* (Buckman), small ?[M], Bj-14b, Ob-FQ. (65mm).



Family STEPHANOCERATIDAE. Genus *Kumatostephanus* and teloceratoid ammonites, Sauzei and Humphriesianum zones, Bj-11 to 14.

1. *Teloceras cf. labrum* (S. Buckman), Bj-14b, Ob-FQ. ($d=190\text{mm}$).
2. ?*Kumatostephanus* trans. gen. nov., ?Bj-13, MW-MH. ($d=165\text{mm}$).
3. ?*Kumatostephanus* trans. gen. nov., Bj-11, Sh-RL. ($d=170\text{mm}$).

The origins of the genus *Teloceras* are uncertain. It is possible that it is polyphyletic, maybe having arisen on two separate occasions from different stock. The type species of the genus *Teloceras* is *Ammonites blagdeni* J. Sowerby, 1818 which occurs towards the top of the Humphriesianum Zone where it is present in significant numbers. The conventional view is that it arose from *Stephanoceras* via coarsely ribbed and inflated forms known as *Stemmatoceras*. In Type Ammonites (1922, Pl. CCCL, a & b) S.S. Buckman erected the species *Teloceras labrum* which comes from the Romani Subzone at the base of the Humphriesianum Zone. In many respects, *T. labrum* looks similar to *T. blagdeni*, however there is an extent of strata between these two, in the UK and elsewhere, where specimens resembling '*Teloceras*' have never been found.

Dietze and Chandler studied specimens from the Late Sauzei Zone that share features of *Kumatostephanus* and *T. labrum* and suggest that *T. labrum* arose from *Kumatostephanus*. A biphyletic origin for *Teloceras* thus seems possible and would not be surprising as homeomorphy is a common condition encountered in ammonites. Of course it may be that the missing *Teloceras* linking *T. labrum* with *T. blagdeni* have not yet been found and as the geological record is mainly one of gaps that would also not be surprising. Plate 35, fig. 1 shows a specimen close to the nominal species *T. labrum*. Figure 2 and 3 show intermediates between *Kumatostephanus* and *T. labrum* from the Late Sauzei Zone and Fig. 4 is an example from the Early Romani Subzone of Millers Hill, Milborne Wick.



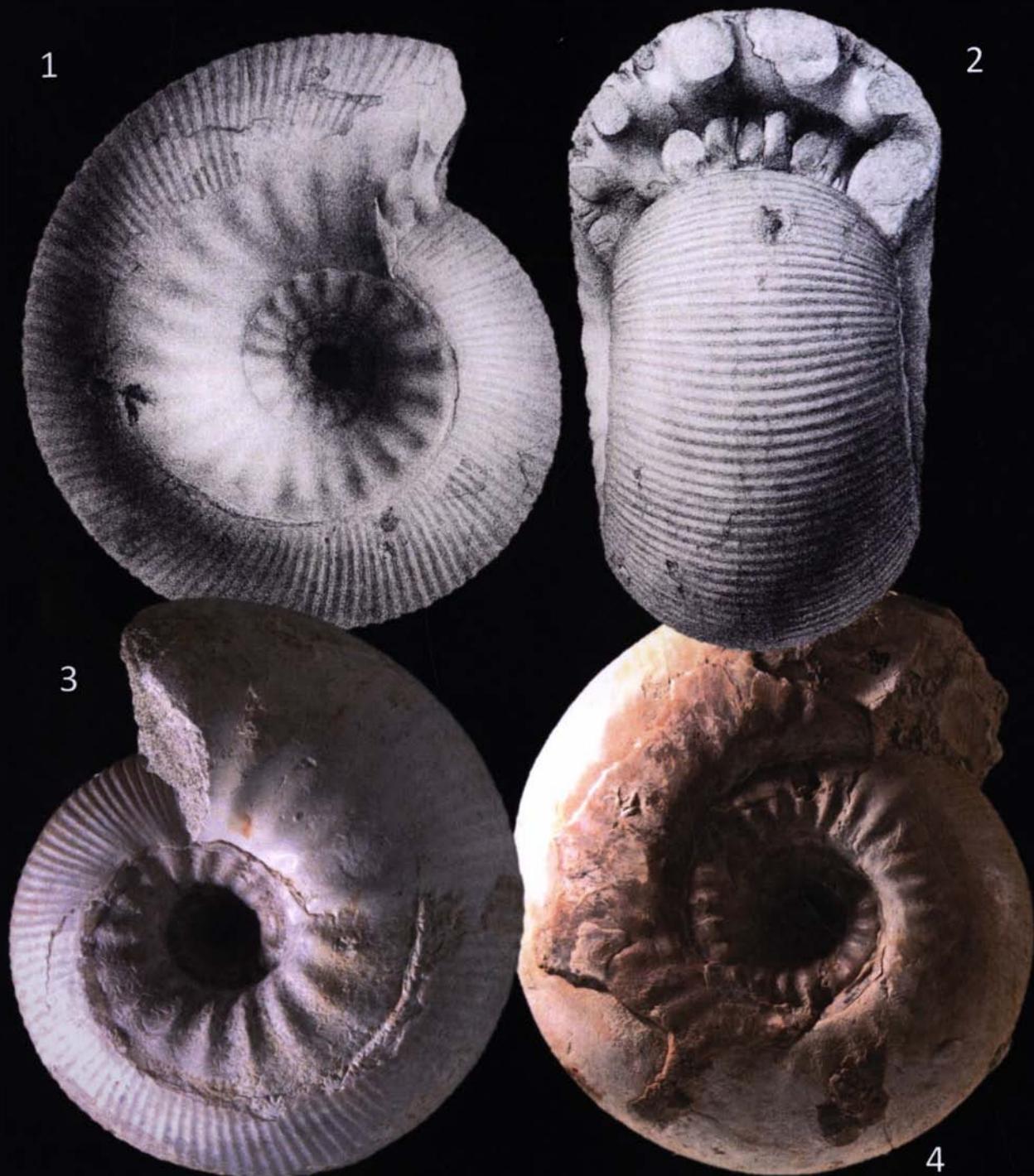
Family STEPHANOCERATIDAE. Genus *Teloceras*. Humphriesianum Zone.

1. *T. banksii* (J. Sowerby), Bj-18, Sh-RL. ($d=300\text{mm}$, with complete body chamber).
2. *T. blagdeni* (J. Sowerby), Bj-16, Ob-MCF. ($d=340\text{mm}$, with complete body chamber).
3. *T. banksii* (J. Sowerby).* HT.
4. *T. blagdeni* (J. Sowerby),[†] Buckman, S.S., 1908. Illustrations of type specimens of Inferior Oolite ammonites in the Sowerby collection. Palaeontographical Society. HT.



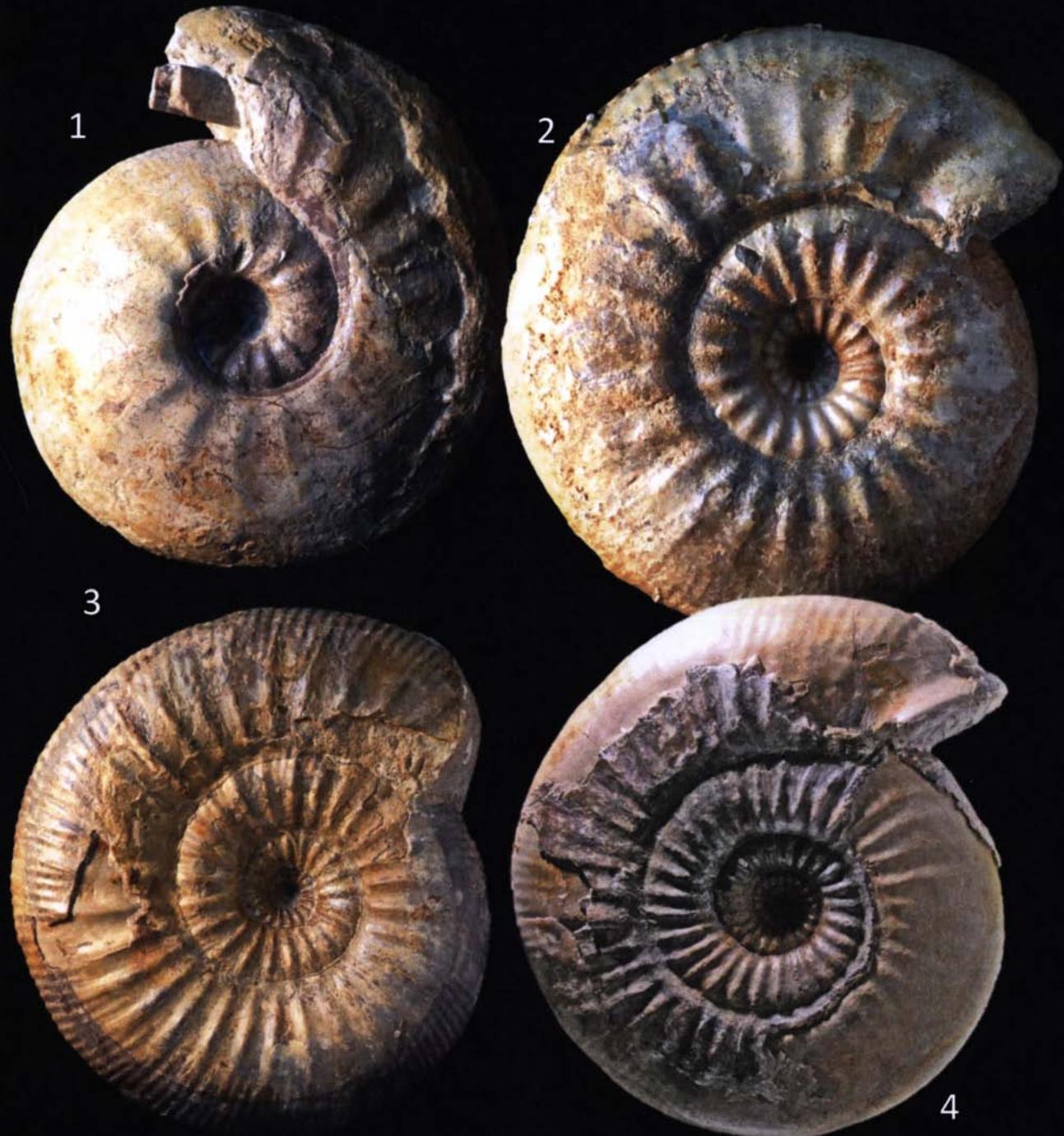
Family OTOITIDAE. Genus *Emileia*. Laeviuscula to Sauzei zones.

1. *E. cf. contrahens* S. Buckman, late involute morph, Bj-11a, Sh-SL. ($d=140\text{mm}$).
2. *E. dundriensis* Chandler & Callomon, Bj-8a, D-LDW. ($d=225\text{mm}$).
3. *E. contrahens* S. Buckman, Bj-8b, Sh-SL. ($d=210\text{mm}$).



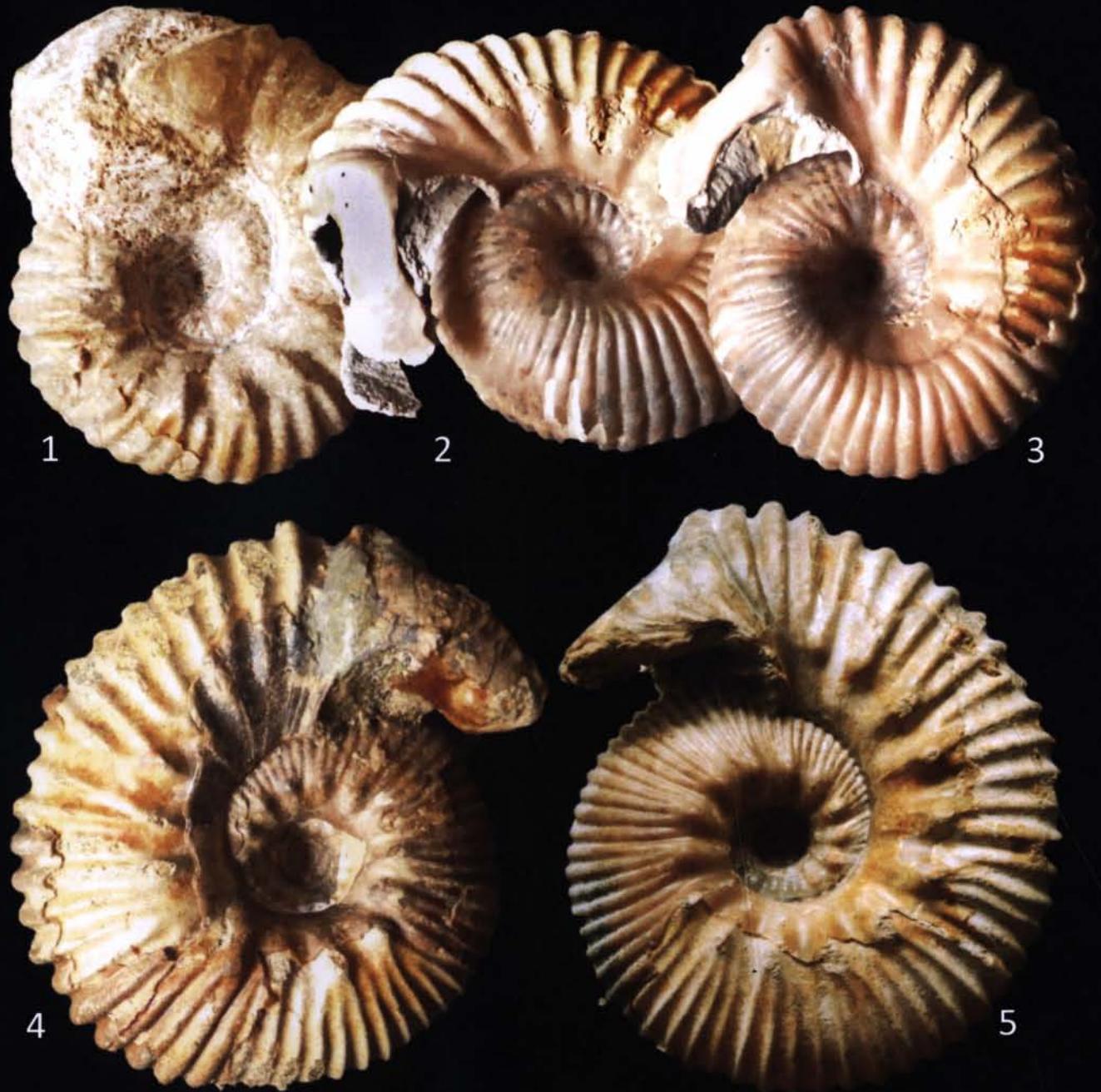
Family OTOITIDAE. Genus *Emileia*. Laeviuscula Zone.

- 1, 2. *E. brocchi* (J. Sowerby), Buckman, S.S., 1908. Illustrations of type specimens of Inferior Oolite ammonites in the Sowerby collection. Palaeontographical Society. HT.
3. *E. brocchi* (J. Sowerby), Bj-10a, Ob-MCF. ($d=100\text{mm}$).
4. *E. brocchi* (J. Sowerby), Bj-10a, Ob-OW. ($d=240\text{mm}$).



Family OTOITIDAE. Genus *Emileia*. Laeviuscula to Sauzei zones.

1. *E. polyschides* (Waagen), Bj-10c, Ob-MCF. ($d=170\text{mm}$).
2. *E. vagabunda* S.Buckman, Bj-11, D-SMR. ($d=170\text{mm}$).
3. *E. bulligera* S. Buckman, Bj-11, Sh-SL. ($d=215\text{mm}$).
4. *E. greppini* (Maubeuge), Bj-10a, Ob-OW. ($d=300\text{mm}$).



Family OTOITIDAE. Genus *Otoites* sensu lato. Ovale to Sauzei zones..

1. *O. fortis* Westermann, Bj-5, D-SMR. ($d=30$ mm).

2-3. *O. compressus* Westermann, Bj-6, Sh-SL. ($d=35$ mm).

4-5. *O. cf. contractus* (J. Sowerby), Bj-10, Ob-FQ. (4: $d=65$ mm; 5: $d=70$ mm).

For simplicity we have referred all the otoitid microconchs to the genus *Otoites*. An explanation of this reasoning is given in the text.



Family OTOITIDAE. Genus *Otoites* sensu lato. Sauzei Zone.

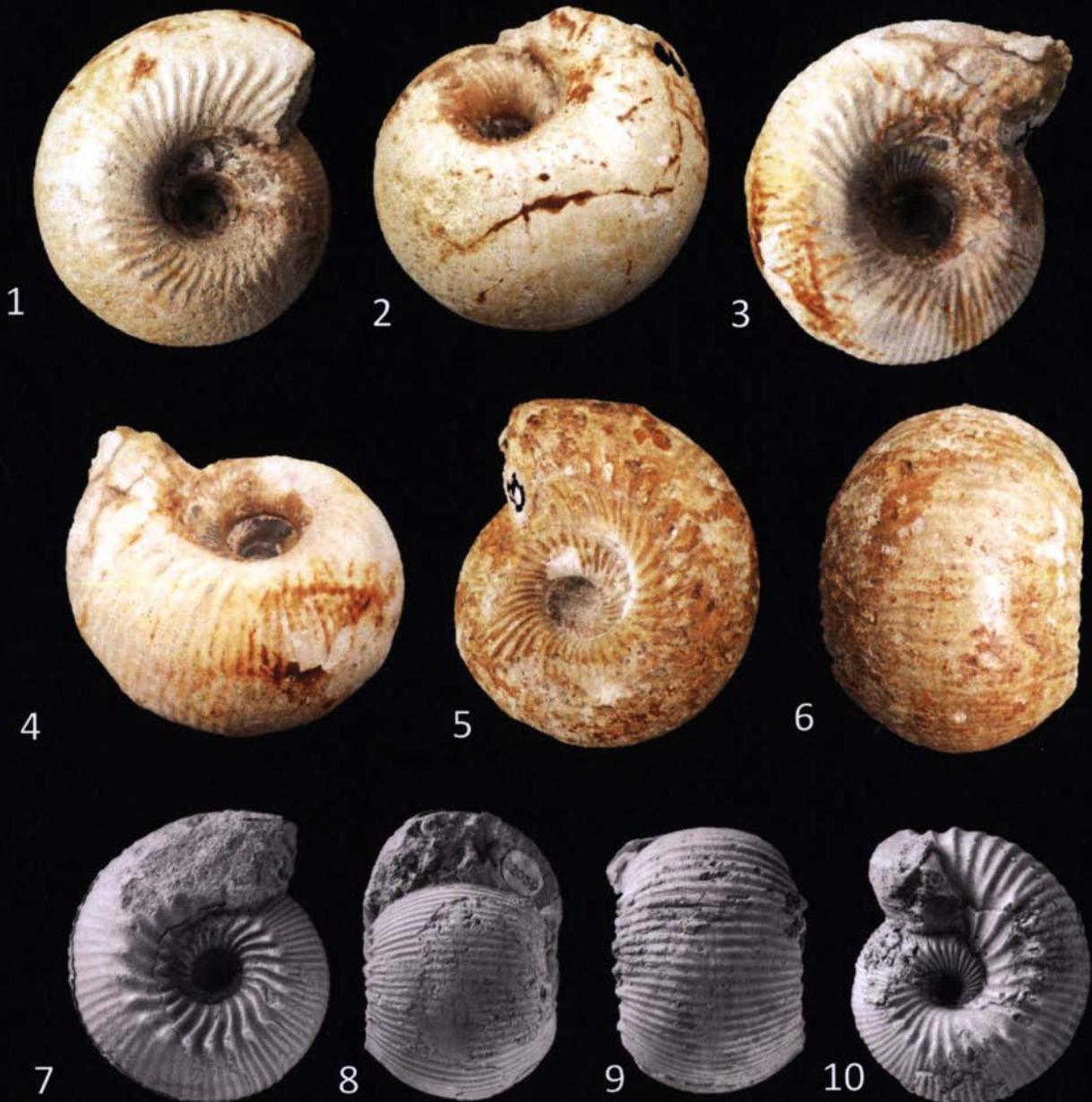
1. *O. contractus* (J. Sowerby), Bj-11, Sh-SL. ($d= 35$ mm).
2. ?*O. vulgaricostatus* (Westermann), Bj-11, Sh-RL. ($d=40$ mm).
3. *O. compressus* Westermann, Bj-10a, Ob-OW. ($d=45$ mm).
4. *O. contractus* (J. Sowerby), Bj-11, Sh-SL. ($d=50$ mm).
5. *O. contractus* (J. Sowerby), Bj-11, D-SMR. ($d=40$ mm).
6. *O. pauper* Westermann, Bj-11, Sh-SL. ($d=40$ mm).

For simplicity we have referred all the otoitid microconchs to the genus *Otoites*. An explanation of this reasoning is given in the text.



Family OTOITIDAE. Genus *Emileites*. Ovale to Sauzei zones.

1. *E. cf. catamorpha* (S. Buckman), Bj-8, Sh-SL. ($d=115\text{mm}$).
2. ?*E. mulifiida* (S. Buckman), Bj-11, Sh-SL. ($d=135\text{mm}$).
3. *E. cf. subcadiconica* S. Buckman, Bj-8, Ob-FQ. ($d= 90\text{mm}$).
4. *E. cf. catamorpha* with *Fissilobiceras*, Bj-8, Sh-SL. ($d= 110\text{mm}$).
5. *E. malemotatus* S. Buckman, Bj-5, D-LDW. ($d= 50\text{mm}$).
6. *E. liebi* (Maubeuge), Bj-5, D-LDW. ($d=45\text{mm}$).

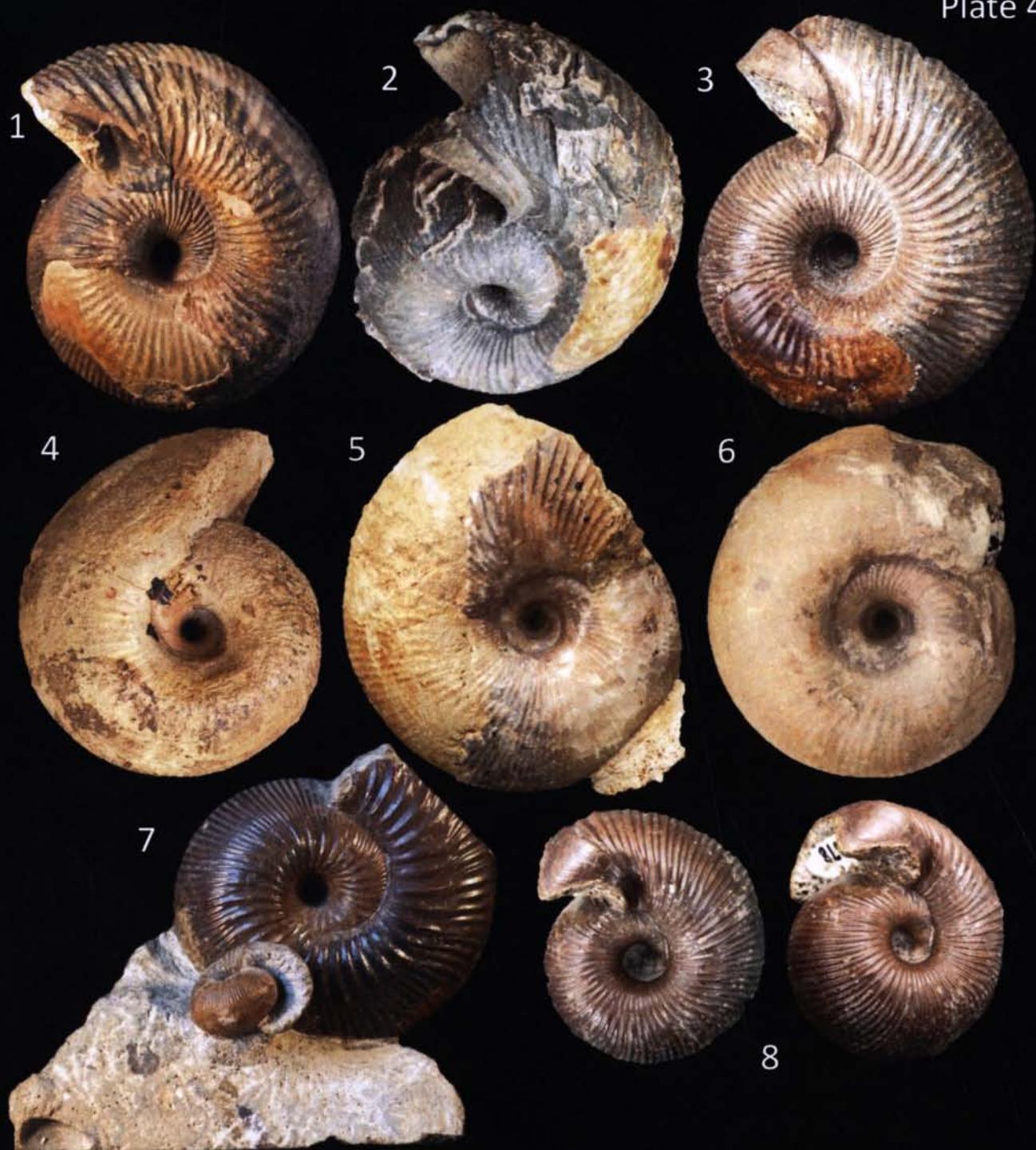


Family SPHAEROCERATIDAE. Genus *Frogdenites*. Laeviuscula Zone, Bj-10.

1-6. *F. spiniger* S. Buckman. 1-2. Ob-FQ. ($d=32$ mm); 3-4. Ob-FQ. ($d=35$ mm); 5-6. Bj-10 derived into Bj-11, Ob-OW. ($d=35$ mm).

7-8. *F. spiniger* Buckman, HT. Bj-10, Ob-FQ. ($d=50$ mm).

9-10. *F. extensus* Buckman, HT. of *F. profectus* [m], Bj-10, Dundry. ($d=55$ mm).



Family SPHAEROCERATIDAE. Genus *Labyrinthoceras*. Laeviuscula to Sauzei zones.

1-5. *L. meniscum* (Waagen), [M] Bj-11, 1. Sh-SL. ($d=111\text{mm}$); 2. Sh-SL. ($d=115\text{mm}$);

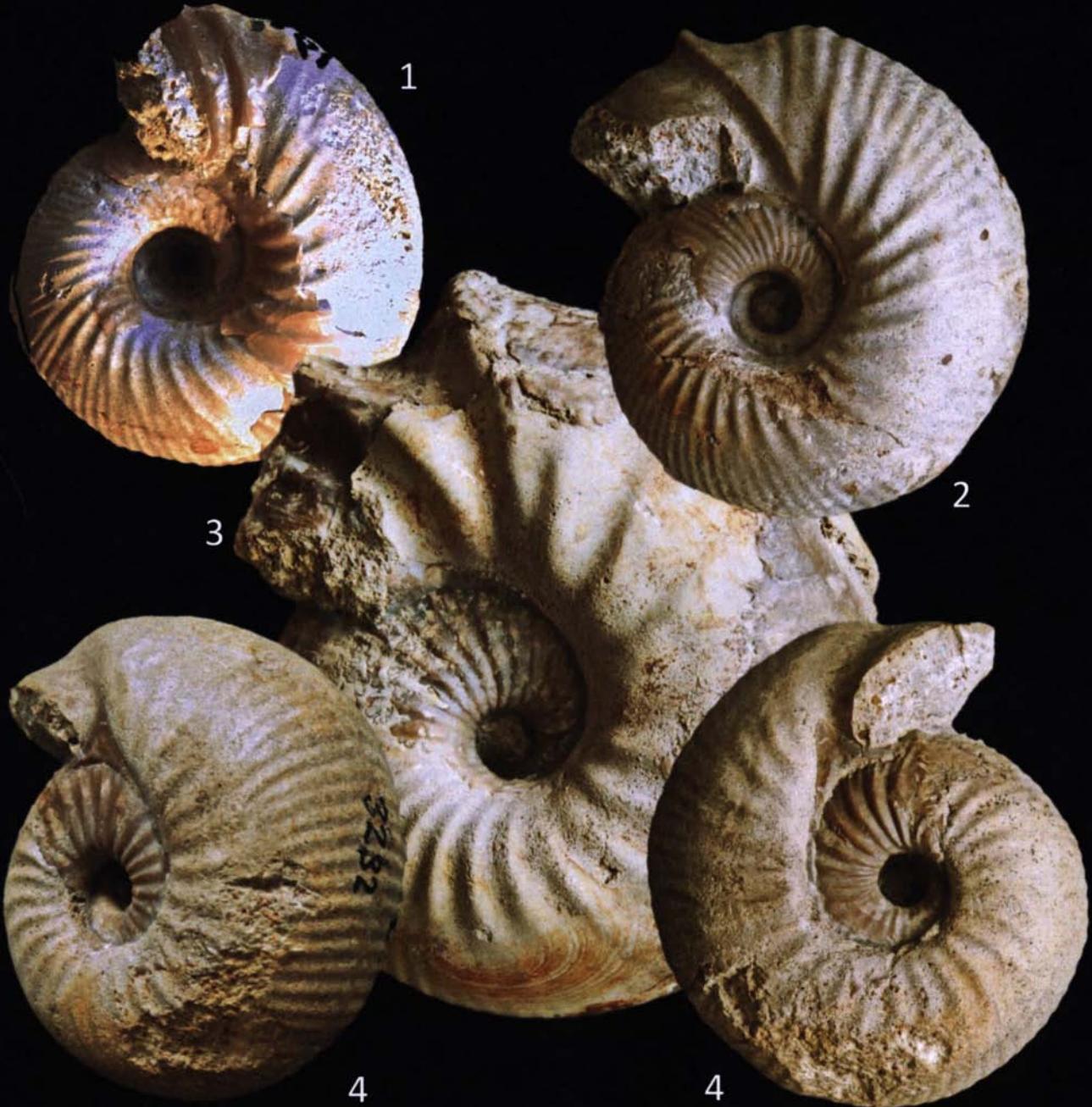
3. Sh-SL. ($d=65\text{mm}$); 4. Sh-RL. ($d=111\text{mm}$); 5. Sh-RL. ($d=80\text{mm}$).

6. *L. dietzeri* Sandoval & Chandler, HT, Bj-8, Ob-OW. ($d=70\text{mm}$).

7. *Labyrinthoceras* sp. nov., Bj-11, Sh-SL. ($d= 85\text{mm}$).

8. *L. meniscum* , [m] 8. Bj-11, Sh-RL. ($d= 45\text{mm}$); 9 Sh-SL. ($d=30\text{mm}$).

Variability in *Labyrinthoceras* from the Laeviuscula to Sauzei zones.



Family SPHAEROCERATIDAE. Genus *Chondroceras*. Humphriesianum Zone.

1. *C. gervillii* (J. Sowerby), Bj-14, Ob-OW. ($d=30\text{mm}$).
2. *C. delphinus* S. Buckman, Bj-14, Ob-OW. ($d=50\text{mm}$).
3. *C. grandiforme* S. Buckman, Bj-14, Ob-OW. ($d= 75\text{mm}$).
4. *C. wrighti* S. Buckman, Bj-14, Ob-OW. ($d= 45\text{mm}$).

Westermann (1956) places *C. delphinus* and *C. grandiforme* in synonymy with *C. evolvenscens* (Waagen, 1867).



Family SPHAEROCERATIDAE. Genus *Sphaeroceras*. Humphriesianum Zone.

1, 2. *S. brongniarti* (J. Sowerby), Oolite Ferrugineuse de Bayeux, France. d'Orbigny, A., 1842-1850. Palaéontologie française: description des mollusques et rayonnés fossiles.

Terrains Jurassiques. Les céphalopodes. Atlas. Vol. 1, Masson, Paris. Plate 140, Fig. 3-8.

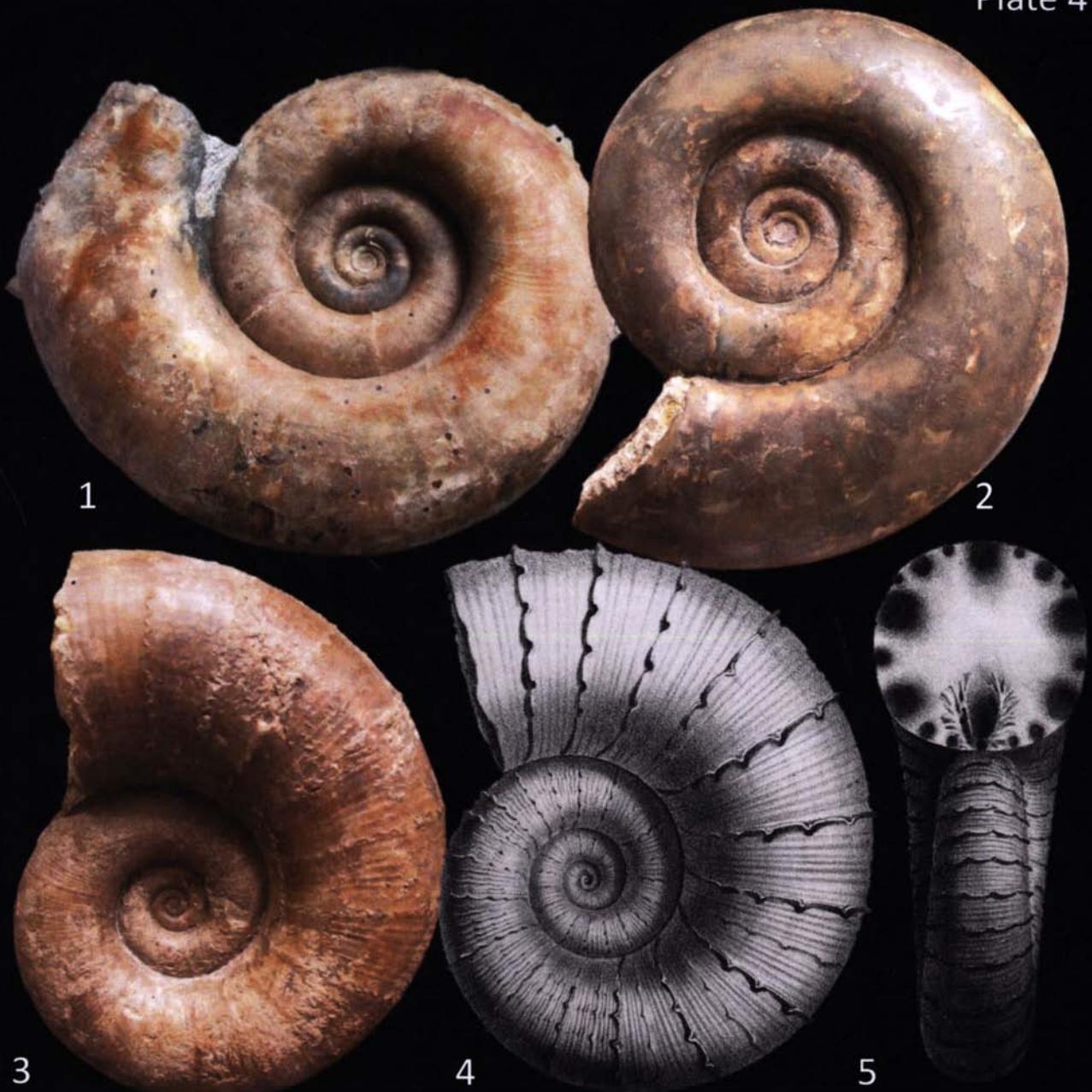
3. *S. brongniarti* (J. Sowerby), Oolite Ferrugineuse de Bayeux, France. Bayle, E., 1878.

Explication de la carte Géologique de la France. Atlas. Fossiles principaux de Terrains.

Tome 1. Imprimerie National, Paris. Plate 53, Fig. 3.

4. *S. brongniarti* (J. Sowerby), Bj-14, Ob-OW. ($d= 18\text{mm}$).

5. *S. brongniarti* (J. Sowerby), Bj-13, Ob-OW. ($d= 20\text{mm}$).



Family LYTOCERATIDAE. Genus *Lytoceras* and *Megalytoceras*. Sauzei and Humphriesianum Zones.

1. *Megalytoceras metretum* (S. Buckman), Bj-11, Sh-SL. ($d=200\text{mm}$).
 2. *Megalytoceras trapezum* (Quenstedt), Bj-11, Sh-RL. ($d=380\text{mm}$).
 3. *Lytoceras eudesianum* (d'Orbigny), Bj-15, Ob-MCF. ($d= 180\text{mm}$).
 - 4, 5. *Lytoceras eudesianum* (d'Orbigny), Oolite Ferrugineuse de Bayeux, France. NT. ($d= 92\text{mm}$). d'Orbigny, A., 1842-1850. Palaeontologie fran aise: description des mollusques et rayonn es fossiles. Terrains Jurassiques. Les c halopodes. Atlas. Vol.1, Masson, Paris.
- Plate 128, Fig. 1-3. The NT comes from the Parkinsoni Zone but the species ranges from the Laeviuscula to Zigzag Zones.



Family PHYLLOCERATIDAE. Genus *Holcophylloceras*. Humphriesianum Zone.
1-4. *H. privasense* Joly, Bj-14, Ob-FQ. ($d=40\text{mm}$). The genus *Phylloceras* *sensu lato* is very rare in the Bajocian of Dorset and Somerset. This specimen from the Romani Subzone appears to be unique.



Uncommon ammonite specimens from the Lower Bajocian of Dorset.

1. *Sonninia*. Showing one part of the jaw structure (Aptycus), Bj-1, Mp-CQ. (d=150mm).
- 2-4. Examples showing pathological development of shell growth probably due to injury or disease.
2. *Stephanoceras*, Bj-15, Ob-FQ;
3. *Otoites*, Bj-8, Sh-SL;
4. *Sonninia*, Bj-1, Sh-HH. (d=165mm).

Selected reading

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- Arkell, W.J., Furnish, W., Kummel, B., Miller, A.K., Moore, R.C., Schwindewolf, O.H., Sylvester-Bradley, P.C. & Wright, C.W., 1957. Part L, *Mollusca 4 Cephalopoda Ammonoidea*. Treatise on Invertebrate Paleontology, Geological Society of America and University of Kansas Press,
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Subscribers

Shaun Aldom, Stuart Baldwin, Yuri Bogomolov, Patrick Branger, Janet & Roger Brown, Graham Bull, Martin Callomon, John Cope, Andy Cowap, Gerd Dictl, Volker Dietze, Edward Digby, Martin Dodge, Murray Edmunds, Richard Edmonds, Raymond Enay, Andrew England, Michael Enkilde, Steve Etches, David Evans, Sixto Fernández-López, Doris & John Fredd, Roger Furze, András Galácz, Geologists Association, Wolfgang Grulke, Alan Holiday, Kelvin Huff, Zoë Hughes, John Huxtable, Philip James, William Jones, Andy King, Peter Langham, Anne & John Larkin, Jonathan Larwood, John Luchford, Lubomir Metodiev, Vasily Mitta, Eckhard Mönnig, Martin Munt, Alison & Adrian Neil, Kevin Page, Giulio Pavia, Carol Payne, David Roberts, Driss Sadki, José Sandoval, Armin Scherzinger, John Scott, Sam Scriven, Sönke Simonson, Doreen Smith, David Sole, Geoff Swan, Hugh Torrens, Robert Weis, John Wright, Jiarun Yin.

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John Whicher is a retired professor of experimental cancer research. He is a fellow of the Geological Society, a member of the Geologists Association and an author of papers on Dorset geology and palaeontology.





The classic section at Burton Cliff, near Freshwater, Burton Bradstock, at the western end of Chesil Beach on the Dorset Jurassic Coast World Heritage Site, UK.

Middle Jurassic Inferior Oolite and Fullers Earth cap the cliffs. Here fallen blocks can be seen in the foreground. The yellow cliffs are of sandstones of Toarcian, Upper Lias age and display hard 'sand burrs' or doggers.

This book illustrates the extraordinary and varied ammonite fauna of the Lower Bajocian, Inferior Oolite Formation of Dorset, one of the most famous areas for Jurassic geology in the World.

