J.H. CALLOMON – R.B. CHANDLER

A REVIEW OF THE AMMONITE HORIZONS OF THE AALENIAN-LOWER BAJOCIAN STAGES IN THE MIDDLE JURASSIC OF SOUTHERN ENGLAND

Estratto dalle

MEMORIE DESCRITTIVE DELLA CARTA GEOLOGICA D'ITALIA

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ISTITUTO POLIGRAFICO E ZECCA DELLO STATO

1. – INTRODUCTION

The early Middle Jurassic was a time of exceptional interest in the history of ammonites. It was marked by a major radiative evolutionary expansion that saw the appearance of the three superfamilies that were to dominate the shelf-seas of the world until well into the Cretaceous — the Haplocerataceae, Stephanocerataceae and Perisphinctaceae — as well as numerous phyletic units of lesser renown. Although the roots of all these groups in the Hildocerataceae of the Lias have long been well known in a general way, the details remain even now in many cases obstinately obscure. As we follow well-known lineages downwards, the trail often comes to an abrupt stop at a cryptogenic first appearance: of the Oppeliidae in *Bradfordia* of the Upper Aalenian; of the Zurcheriinae (principally *Witchellia*) in *Fontannesia*, also in the Upper Aalenian; of the Strigoceratidae in *Praestrigites* of the Lower Bajocian; of the Spiroceratidae in *Spiroceras* of the early Upper Bajocian; and those of such isolated genera as *Vacekia*, *Bajocia*, *Parastrenoceras* and other curiosities, at various levels.

Two developments have widened our horizons in more recent times. The first is the discovery of Aalenian-Bajocian successions along the eastern margins of the Pacific, from Alaska to the Andes, that are as complete and just as rich in ammonites as those of the classical regions of the western Tethys and its adjacent shelf-seas. Many of the ammonites are recognizably the same down to generic level, but there are some notable differences: the Graphoceratidae that dominate the Aalenian of Europe are absent in the Pacific; and there are important Pacific Sphaeroceratinae that do not occur in Europe.

Within Europe itself it is possible to discern a degree of differentiation in the Aalenian-Bajocian similar to that seen in the rest of the Jurassic, into a Tethyan faunal domain in which Erycitinae and Hammatoceratinae dominate among the Ammonitina, and the circum-Tethyan epicontinental domains in which the Graphoceratidae dominate. There was at the time no separate Boreal Realm to be considered. In trying to unravel phylogenies it is therefore important to take this spatial bioprovincialism into account: cryptogenesis may reflect merely faunal migrations. Even more important in such exercises is of course the most precise temporal correlations within and between faunal provinces. Conversely, the satisfactory resolution of these factors opens the door to problems of much wider interest. Faunal migrations raise the question of routes and hence of palaeogeography. One of the intriguing observations to be explained is the astonishing homotaxial parallel between the ammonites of the Lower Bajocian of Alaska and Oregon and those of Dorset, and the striking absence of any such immediately obvious resemblance both in the Aalenian below and the Upper Bajocian above. Precise chronostratigraphical correlations, down to the level of an ammonite subzone, would for once provide real opportunities to test the allegedly «world-wide event stratigraphy», embodied in such things as eustatic sea-level curves or geomagnetic reversal scales. Either way, the primary need is for precise, properly-defined standard chronostratigraphical time-scales. Progress in this direction for the Aalenian and Bajocian has been relatively good, but there remain numerous points of correlation be to settled and decisions on definitions to be agreed upon. In reaching such decisions it is necessary to re-examine and to compare the evidence from as many regions as possible. The purpose of the present notes is to summarize the current state of knowledge in one region, that of southern England.

2. – THE INFERIOR OOLITE OF BRITAIN

The outcrops of the Aalenian and Bajocian in Britain may be divided into four parts (see Fig. 1):

a) Dorset-Somerset-Avon, south of Bristol;

b) The Cotswolds;

c) The Midlands, from Oxfordshire to Lincolnshire, and the Yorkshire coast;

d) The Inner Hebrides: Skye and Raasay.

The lithostratigraphy is fully summarized in the Geological Society's Correlation Tables (Parsons in Cope, 1980).

By far the most important region for ammonoid biostratigraphy is of course that between the Dorset coast and Bristol, (*a*) in the list above. The successions in the Cotswolds are much thicker than those to the south, but ammonites are scattered and rare. They have added nothing to what is known from Dorset. The Midlands see a gradual transformation into largely non-marine sediments north-eastwards and in those fully marine members that remain, ammonites are extremely rare. Similar remarks apply to the Yorkshire coast.

The successions in the Hebrides, (*d*) above, are again important, being both thick and rich in ammonites. They have been extensively studied by MORTON. He has described and figured most of the Bajocian forms (1971, - 72, - 73, - 75) but the Aalenian faunas, including the all-important Graphoceratidae, have so far only been indicated in faunal lists (1985). Even so, with perhaps three notable exceptions, the faunal successions add little to what is known from the south. The faunal horizons are more widely separated but the ammonites tend to be concentrated in widely scattered concretions, so that exact temporal relationships between them may not be any more certain than they are in Dorset. The known assemblages are notably less diverse; at least, many of the rarer groups known in the south have not yet been found. And, finally, a local peculiarity lies in the fact that at several levels over a considerable range of strata, the ammonites occur as accumulations of complete, well-preserved but predominantly juvenile forms. This is trying to tell us something of great interest about the habitat of ammonites during their life-cycle but can make them difficult to identify closely, which detracts from their value as guide-fossils. The Hebridean faunas will therefore here be referred to only where they offer significant additions to the general succession of the south.

3. – THE AALENIAN-BAJOCIAN OF DORSET AND SOMERSET

Our knowledge of this classical chapter of biostratigraphy has been, and continues to be, dominated by the name of S.S. BUCKMAN.

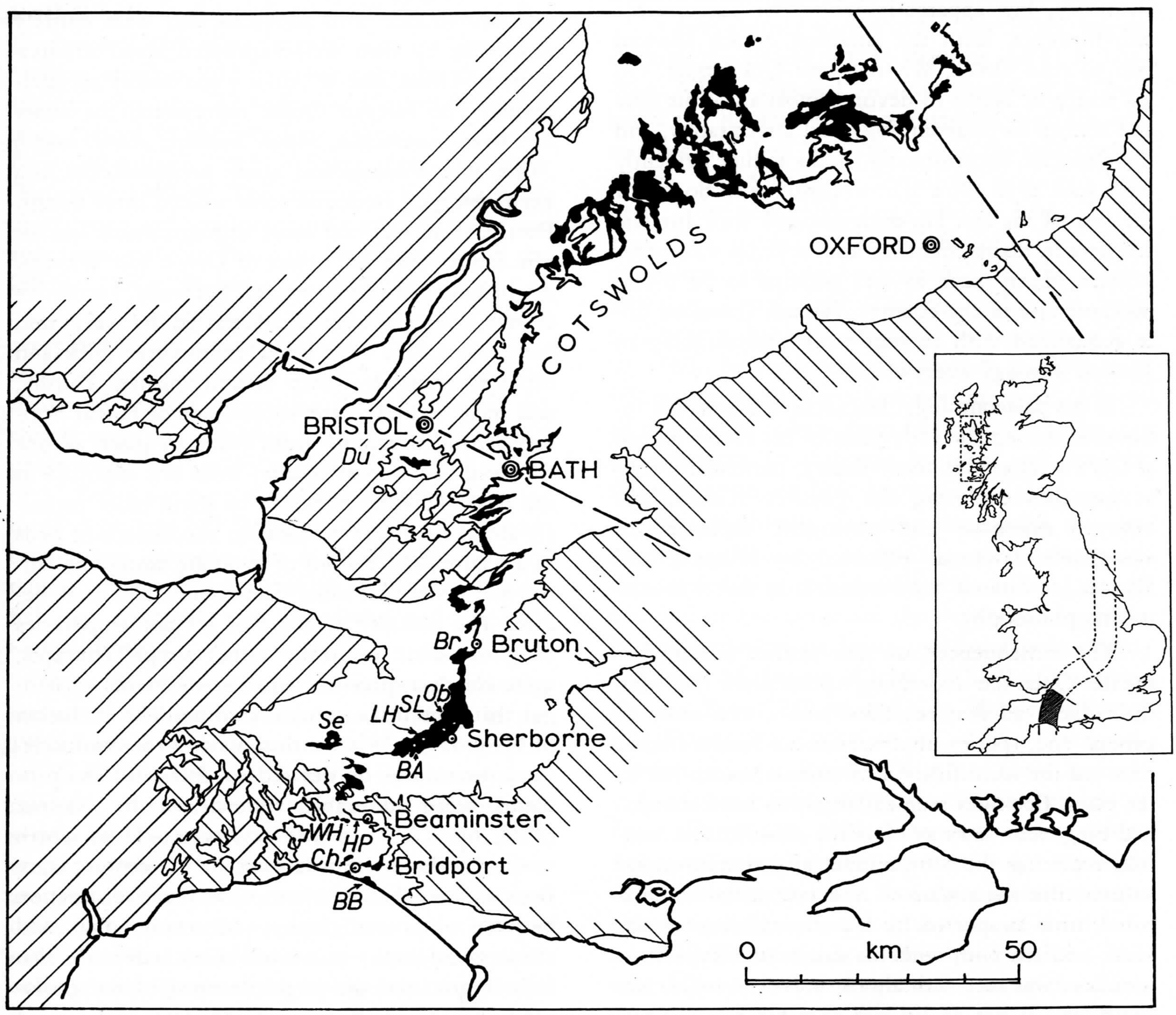

Fig. 1. – Map of the outcrops of the Inferior Oolite in southern England. Diagonal shading to the west: pre-Jurassic rocks. Diagonal shading to the east: post-Jurassic rocks. Important sections labelled by key letters: see explanation of figures 2-4.

Born in 1860, he grew up on his father's farm at Bradford Abbas, 6 km WSW of Sherborne in north Dorset. His formal education was limited to attendance at nearby Sherborne School and appears to have been conventional, including a strong element of the classical languages that is everywhere apparent in his palaeontological writings. His interest in geology derived from his father, J. BUCKMAN, who had been Professor of Geology at Cirencester Agricultural College. It was stimulated from his youngest days by the wealth of fossils that poured out of the numerous quarries in the area then still actively being worked: an area that includes one of the most richly fossiliferous developments of Jurassic rocks in the world.

After leaving school, he was sent to Germany for a year with a view to developing an interest in chemistry, but apparently with little success. He did, however, learn the language, which allowed him to read OPPEL, WAAGEN and QUENSTEDT. On his return he began to devote almost all of his time and energy to palaeontology and stratigraphy, and the financial circumstances of his family evidently were such as to allow him to continue to do so for the rest of his life. He corresponded with Jurassic workers in many countries and built up a comprehensive library such as was perhaps to be found nowhere else in the country. He was therefore fully acquainted with current work and thinking in Jurassic geology everywhere.

In his palaeontology, BUCKMAN was strongly influenced during the early years of his career by post-Darwinian evolutionary theory, particularly those branches exploring the possible relationships between ontogeny and phylogeny expressed in «biogenetic laws» as espoused by HAECKEL and HYATT. He himself contributed little that was new to this philosophy.

The consequences, we now realise, were unfortunate. Once the underlying «principles» had been discredited, all that remained was a vast array of genera and species that served to hinder rather than aid the identification of ammonites. In his later years, BUCKMAN seemed largely to have abandoned biogenetic laws as basis for classification himself, replacing them by minute attention to septal sutures. But the stream of new taxa remained unabated, now supported by few explanations of any kind; and the end, with his death, of «Type Ammonites» was met with almost universal relief. Nevertheless, it has to be said that his monumental work presents still the single most comprehensive pictorial description of British Jurassic ammonites we have — the equivalent of Germany's QUENSTEDT or France's d'ORBIGNY — for an area scarcely of lesser importance. And if «excessive splitting» is now to be condemned as sinful, the disinterested observer might be forgiven for thinking that even today it is a sin that shows few signs of dying out.

Finally, as the classification of ammonites changes more and more from descriptions in terms of parallel, vertical morphospecies to successions faunal horizon by horizon, of horizontal faunal assemblages thought to approximate more or less closely to contemporaneous populations or biospecies, many of BUCKMAN'S nominal species are being given renewed life as useful entities to characterize these successions.

In stratigraphical matters, BUCKMAN found himself face to face with problems that were entirely new. The by then well-established zonal subdivisions of OPPEL and WAAGEN were readily recognizeable. The Inferior Oolite represented the zones of *Amm. murchisonae, Amm. sowerbyi, Amm. sauzei, Amm. humphriesianus* and *Amm. parkinsoni*. But as a keen observer, BUCKMAN soon noticed three things. Firstly, there were far more distinguishable ammonite faunas than the zones of OPPEL and WAAGEN might have led one to expect. Secondly, successive faunal horizons were characterised by very thin beds, sometimes only a few centimetres thick and often separated by sharp bedding-planes. Thirdly, and most seriously, the successions of faunal horizons changed rapidly from place to place as one followed beds across country from one exposure to the next. This led BUCKMAN to think more seriously about the relations between successions of beds in a section, successions of evolving ammonite faunas and geological time, than anyone had done before. The inability of some of his contemporaries to grasp what are really rather simple concepts, quite clearly expressed, led to some verbal exchanges that now make comical reading. The evolution of his thoughts, his conclusions and the nomenclatural procedures he devised to deal with the problems were admirably summarized by ARKELL (1933, pp. 17-37), whose review is still as worth reading today as it was over half a century ago. BUCKMAN recognized quite clearly the distinction between lithostratigraphy, biostratigraphy and chronostratigraphy as we call them today. He also fully appreciated the incompleteness of the geological record, which he summarized in the last of his papers based on direct field observations in the Inferior Oolite of Dorset (1910, p. 90): «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 bands of deposit.».

This was written after BUCKMAN had left Dorset and had moved, in poor health, to Thame, east of Oxford. His «polyhemeral system» of biochronology was taken up by others, notably LANG and TRUEMAN in the Lias, who communicated their results to him. He was given new material from various localities, e.g. by TUTCHER, and became more and more frequently consulted by the Geological Survey, to identify new collections made by fieldworkers all over the country in the course of mapping. This led him in the last 20 years of his life to extend his interest to the whole of the British Jurassic, and to take into account also the older material already in the collections. The spirit of *Palaeontologia Universalis* prompted him to attempt a modern revision, and in many cases the first illustration, of numerous species of Yorkshire ammonites created in the previous century by YOUNG, BIRD and SIMPSON, and so began *Type Ammonites* (BUCKMAN, 1909-30). The connection between field-observation and stratigraphical supposition became ever more tenuous. Based on his experiences in the Inferior Oolite, BUCKMAN assumed that the rest of the succession would be similar, and that almost every previously undescribed ammonite would therefore indicate a new, previously unrecognized horizon and hemera. Arranging these hemera in the correct sequence had often to rely on intuition and guess-work. The results we know: OPPEL'S Jurassic of 33 Zones having a duration now subdivided into 47 Ages and 370 Hemerae. Not all of this succession was incorrect, but as there was no way of telling which of it was reliable, the whole scheme fell into disrepute and was abandoned on BUCKMAN'S death.

It is therefore perhaps ironic to see how the revival of interest in Jurassic stratigraphy in the 1960s has led to the resurrection of a stratigraphical classification that at its lowest level bears a remarkable resemblance to BUCKMAN'S polyhemeral system (cf. CALLOMON, 1985a, b). The main differences are that the principal units of classification are rocks rather than time units, based on d'ORBIGNY'S and OPPEL'S Stages and Zones now sharpened by definitions of boundary time-planes explicitly into the chronostratigraphic units that OPPEL and most of his followers had always treated them as being, and welded into continuous standard scales. The equivalents of the hemerae are now simply distinguishable «faunal horizons», also rock-units but informal, carrying no implications of duration or continuity of time, or of «acme of species» in any biological sense. They are intended simply to describe what is seen in the field, but are labelled by the name of a characteristic taxon, usually an ammonite species.

After BUCKMAN'S departure from Dorset, the Inferior Oolite of the whole of southern England was minutely re-examined by RICHARDSON (1907-32, references in COPE, 1980). He added almost innumerable local details to what was known previously. Ammonites were sent for determination by BUCKMAN, and ages were expressed in the familiar hemeral scheme without change.

Thereafter interest in the stratigraphy of the Inferior Oolite and its ammonites languished.

A new chapter started in the late 1960s, largely through the efforts of C.F. PARSONS and H.S. TORRENS. All the classical localities described by BUCKMAN and RICHARDSON were revisited, with the ammonites and their successions now the primary objective. Aided by some fortuitous temporary sections, large new collections could be made. At the same time, guided by the insights of modern sedimentology, the lithostratigraphy could be re-examined in a new light. The results have in large part been published (references in PARSONS in COPE, 1980). In brief, they demonstrate a nearly total affirmation of BUCKMAN'S pioneering work. Almost all of his species have been recollected with increased precision, so that type horizons and levels in the succession are now known.

Stratigraphically, we may distinguish two extremes in the range of lithological developments that are found in Aalenian-Bajocian successions. At one end of the range are the expanded sequences in marl-and-siltstone facies that have been described from SE France (CALOO, 1970-71; Opalinum-Discites Zones 245 m) and Cap Mondego, Portugal (FERNANDEZ LOPEZ *et alii*, 1988; Opalinum-Humphriesianum Zones, 200 m), or those in marl-and-limestone facies from the Iberian chains of Spain (URETA GIL, 1983; FERNANDEZ LOPEZ, 1985; Aalenian-Lower Bajocian, up to 100 m). Ammonites occur at many levels, but the amount of material that can be collected at any one of them is limited. Sequences such as these are good for constructing range-charts at generic level of the dominant faunal elements. They give a rough but quasi-continuous vertical description of the faunal successions and hence, of their evolution.

The Inferior Oolite of Dorset continues to epitomize the other extreme of sedimentary development. The thicknesses are very small (1-10 m), but individual beds do not give the impression of being particularly condensed. That is, the ammonites within any one of them tend to be freshly preserved and closely homogeneous in age, with relatively few broken shells. The beds are all highly bioturbated, and in many of them the predominantly flat, graphoceratid ammonites are found embedded at all angles. This indicates that the sediments remained unconsolidated for times long compared with their accumulation-periods and bioturbation turnover-times, although both of these could have been geologically short, perhaps no more than a few years. On the other hand, adjacent beds with clearly distinguishable ammonite faunas, differing in some cases at subzonal level, are so intimately welded together by bioturbation across the boundary that no parting or other discontinuity, such as a slight change in lithology, is any longer apparent. Sometimes there remains a layer of large, disarticulated bivalves. This indicates that such beds must have remained soft for times that were comparable to the age-difference between the ammonite-faunas, that is, for times of the order of tens to hundreds of thousands of years. Yet elsewhere, non-sequences are revealed by spectacular erosion-planes that can cut clearly through ammonites whose phragmocones had already been infilled by calcite. These erosion-planes are often encrusted by stromatolitic crusts. All the beds are lenticular. In some cases a bed can be seen to wedge out totally along a single quarry-face. In others, a bed 30 cm thick may extend unchanged over distances of 20 km.

The beds are often spectacularly rich in well-preserved fossils; collections can number hundreds of specimens. Sequences such as these provide us with highly detailed descriptions of the faunal composition at brief but well-spaced moments in time («hemerae»). They allow us to study the faunas horizontally: to characterize species in terms of their variabilities and hence to identify assemblages approximating to isochronous populations, or bio-species. Conversely, such well-characterized faunal horizons can provide firm anchor-points on which to hang the faunal succession as a whole, and any biochronology or chronostratigraphy based on it. Herein lies the value of the English sequences.

In the notes that follow we try to summarize what is now known of the English succession and hence what it may have to offer as contribution to Aalenian-Bajocian biostratigraphy.

4. – THE AMMONITE SUCCESSION

Of the many sections in Dorset described in the past, a relatively small number accounts for most of the nominal species created by BUCKMAN and suffices to establish the faunal succession. Some have disappeared, such as the quarry at East Hill which yielded most of the specimens from «Bradford Abbas» described by BUCKMAN in his *Monograph* (1887-1907), but in some of these cases alternative sections could be found sufficiently close by to act as substitutes.

Important sections that have been restudied in the last 20 years are indicated on the map, figure 1, and shown schematically in figures 2-4.

The succession of ammonite faunal horizons at present recognizable in southern England is summarized in figures 5-6. Only the Aalenian and Lower Bajocian have been included. The Upper Bajocian remains to be worked out in detail, but it is already clear that it is faunally highly incomplete and unlikely to contribute much to generalized biostratigraphy.

The notes that follow list only important or interesting elements of the faunas. The compilation of complete lists including all of BUCKMAN'S nominal species is beyond the scope of the present work. The task of re-collecting continues and the best we can present is a progress report. Much remains to be added.

Each faunal horizon is labelled by the name of a characteristic species, very much in the spirit of BUCKMAN'S hemerae. Localities and beds in which the horizons are clearly recognizable are indicated with the symbols of figures 2-4. Specific names are used in a morphospecific sense, and dimorphs may be distinguished subgenerically. Species cited without author are those of BUCKMAN. Species whose types are definitely known to have come from a particular horizon are indicated by a dagger (†). In many cases, however, even the types remain to be designated within syntype series, often from several localities and horizons.

Generic assignments are conservative, and no attempt is made to achieve consistency in the naming of dimorphs. Microconchs of e.g. *Brasilia* and *Graphoceras* may be morphogenerically inseparable, e.g. as *Ludwigella*.

Symbols: VC, C, O, R: very common, common, occurs, rare.

4.1. – Aalenian

Aa-1 *Leioceras opalinum*

Leioceras opalinum (Reinecke) [m] (VC)
Leioceras opaliniforme [M] (VC)
Leioceras subglabrum [M] (O)
Bredyia subinsignis (Oppel) [= *B. crassornata*] [M] (O)
Bredyia newtoni [m]
Pachylytoceras cf. or aff. *torulosum* (Zieten) (R)
Tmetoceras cf. *scissum* (Benecke) (O)

Occurrence: BB-4, 5 and widespread at analogous levels in Dorset. These beds are classified as still belonging to the Upper Lias, Bridport Sands. Good sections in Gloucestershire described by Buckman (1887-1907).

Notes: The fauna is rich in numbers, poor in species and much better represented elsewhere in Europe.

Aa-2 *Leioceras lineatum*

Leioceras lineatum [M] (VC)
Leioceras comptum (Reinecke) [m] (VC)
Leioceras striatum [m]
Leioceras etc.
Bredyia subinsignis (Oppel) [= *B. crassornata*] [M] (C)
Bredyia newtoni [m] (C)
Tmetoceras scissum (Benecke) (C)

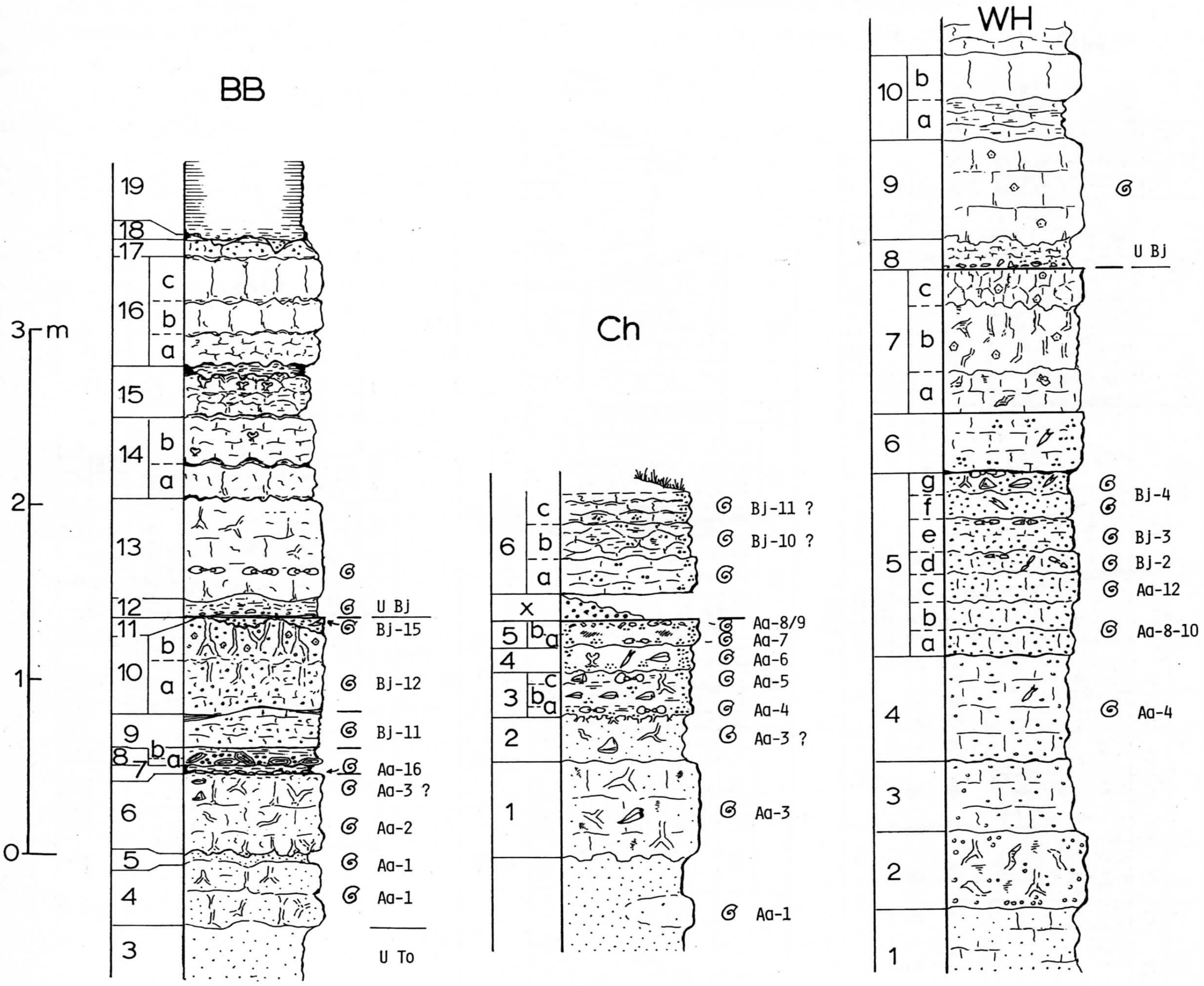

Fig. 2. – Schematic representation of some important sections in the inferior Oolite of Dorset and Somerset.

BB: Burton Bradstock cliff. After Richardson (1928), with additions; beds renumbered from below as in Torrens (1969). Bed 4: Scissum Bed; bed 13: Truellei Bed.

Ch: Quarry Hill, Chideock. Top part of the succession at present visible re-measured, beds renumbered. Beds 2-5 are the «Wild Bed» of Buckman (1910, p. 63, beds 4c-a). Bed «x» is Buckman's bed 3b, not now visible.

WH: Waddon Hill, also known as Stoke Knap after a nearby farm. Only the upper part of the section is now exposed, bed 5 and upwards. Older accounts are not mutually consistent. The most reliable for the lower beds appears to be that in the Survey Memoir (Wilson, 1958), and this has been adopted here, renumbered. Bed 4 is the «Bottom Bed» of Buckman (1910, p. 76); bed 5 is the «Building Stone» (*id.*, bed 5 pars), and its subdivisions have been renumbered 5g-5b, corresponding to Buckman's «lst Bed ... 6th Bed» downwards.

Occurrence: BB-4, Ch-1, HP-2a, and widespread as the «Scissum Bed» as far as Oxfordshire.

Notes: We prefer to use the less familiar English specific name *lineatum* in the present context to label the fauna, instead of the *comptum* preferred elsewhere in Europe, because the type of the species came from a precisely-known horizon. Neotype of *L. comptum* illustrated by DORN (1935, pl. 26, fig. 3 from Franconia).

Aa-3 *Leioceras bifidatum*

Leioceras bifidatum [M]
† *Leioceras capillare*

Occurrence: HP-2b; BB-6, Scissum Bed, upper part? So far clearly distinguished only at Horn Park, but probably widespread. Better characterized in France, where CONTINI (1969) recognizes a «horizon à *L. comptum bifidatum*».

Aa-4 *Ancolioceras opalinoides*

Ancolioceras opalinoides (MAYER)
Ancolioceras costatum
Ancolioceras subfalcatum
†*Ancolioceras substriatum*
†*Ancolioceras capillare*
†*Ancolioceras evertens*
Staufenia sinon (BAYLE) (R)

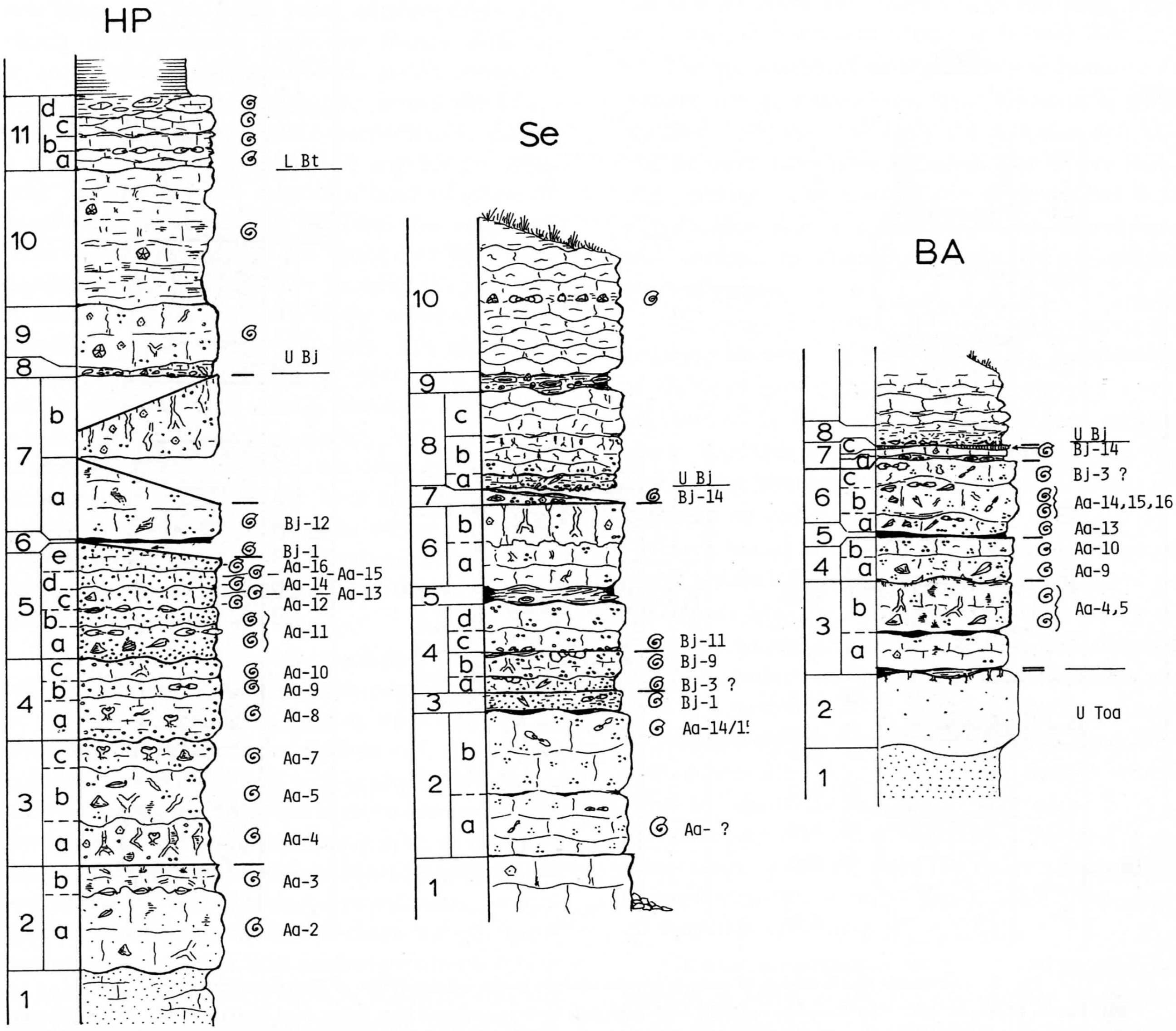

Fig. 3. - Schematic representation of some important sections in the Inferior Oolite of Dorset and Somerset.
HP: Horn Park. Numbering that of SENIOR et al. (1970) with additions. Bed 2 is the Scissum Bed.
Se: Seavington St. Mary. First described by WILSON (1958, p. 91), beds numbered as by TORRENS (1969).
BA: Bradford Abbas railway-cutting, 600 m SSE of East Hill quarry (BUCKMAN 1893b, p. 485), now defunct. There are significant differences, but the overall resemblance is close. Beds 6a,b and 6c together are the «Bradford Abbas Fossil Bed», equivalent to BUCKMAN'S beds 8 and 7 respectively; modern description by PARSONS (1974, p. 170).

Ludwigia crassa (HORN) (R)
Megalytoceras confusum (C)
Pachylytoceras aff. *torulosum* (ZIETEN) [M] & [m] (C)
Tmetoceras cf. *scissum*.

Occurrence: Ch-3a, WH-4, HP-3a, BA-3b

Notes: Interpretation of *A. opalinoides* discussed by RIEBER (1963). First occurrence of *Ludwigia*, already fully developed and distinct from *Ancolioceras*. Distinction between *Ancolioceras* and *Staufenia* at this level probably arbitrary. Microconchs of *Ancolioceras* differ little from those in the next higher horizon, q.v.

Aa-5 *Ludwigia obtusiformis*

Ancolioceras substriatum
Ancolioceras costosum
Ancolioceras subfalcatum
Ancolioceras subacutum
Staufenia sehndensis (HOFFMANN) (R)
Ludwigia haugi (DOUVILLÉ) [M]
Ludwigia haugi (DOUVILLÉ) [M]
† *Ludwigia obtusiformis*
† *Ludwigia pustulifera*
† *Ludwigia wilsoni*
† *Ludwigia laciniosa*
† *Ludwigia brasili*
† *Ludwigia* [*Strophogyria*] *bullifera* [m]
† *Ludwigia agria* [m]
† *Ludwigia cosmia* [m]
Bredyia boyeri (ELMI, 1963) (R)
Bredya [*Parammatoceras*] aff. *rugata* (BUCKMAN, 1925)
Planammatoceras cf. *planiforme* (0)
Vaceckia stephensi [M] (R)

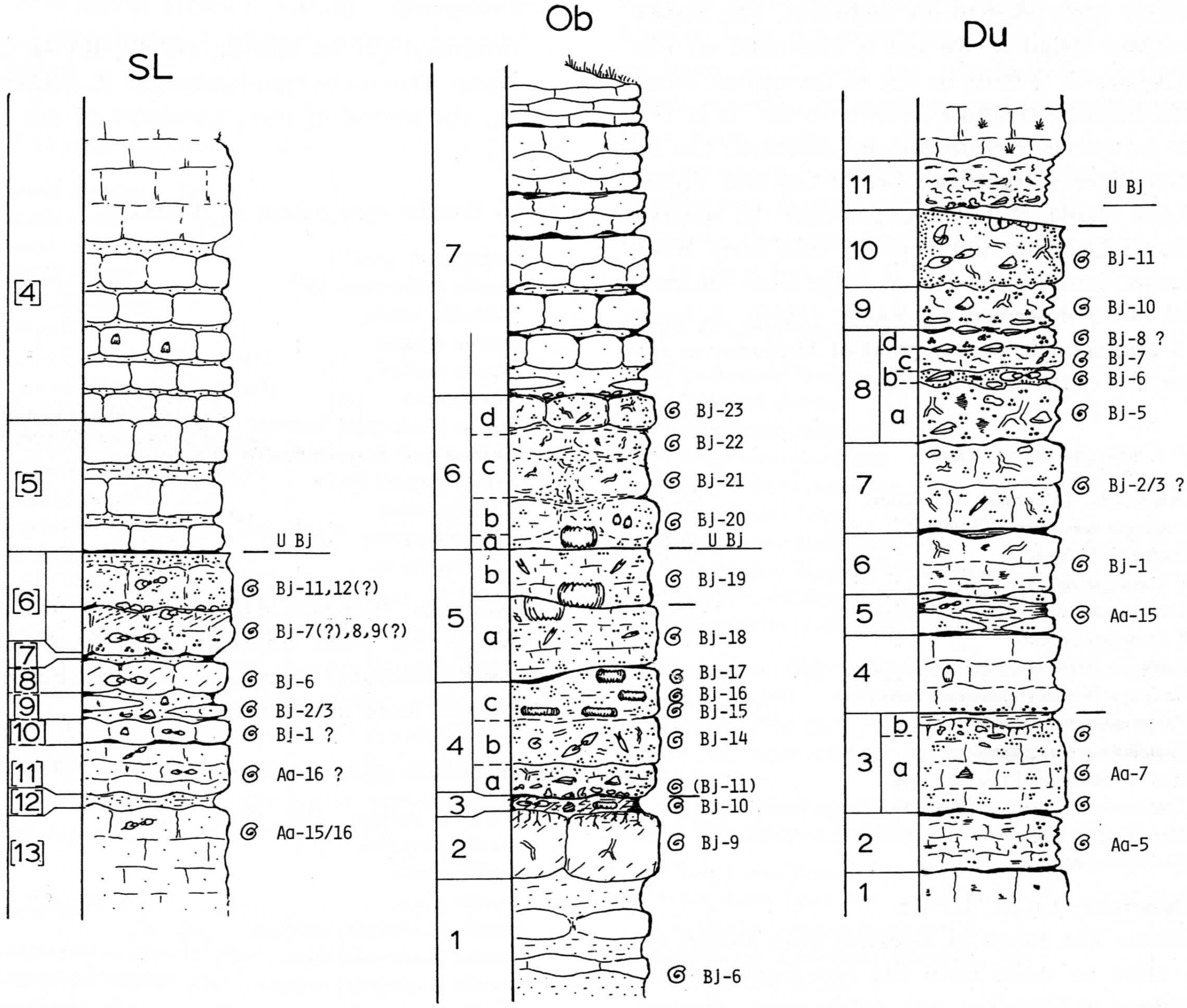

Fig. 4. - Schematic representations of some important sections in the Inferior Oolite of Dorset and Somerset.

SL: Sandford Lane, Sherborne. Long out of use, the best description is still that by BUCKMAN (1893b), whose numbering has been retained here. The «Sandford Lane Fossil Bed» [6] has been re-examined bv PARSONS (1974) who finds it divisible into only two parts. Beds 5 and 4: Sherborne Building-stone, Upper Bajocian.

Ob: Frogden quarry, Oborne. Numbering that of PARSONS (1976) based on nearby temporary exposures. Bed 3: the «Green-grained Marl», cross-hatching indicating glauconite. Bed 7: Sherborne Building-stone.

Du: Dundry, Bristol. Beds 1-7, 8a,b as described at Barns Batch Spinney by PARSONS (1979). Higher beds modified as recorded at Main-road South quarry: bed 10 is the «Brown Ironshot», Sauzei Zone, his bed 10b; bed 9 the «Upper White Ironshot», his bed 10a.

Asthenoceras nannodes [m] (R)
Tmetoceras cf. *scissum* (R)
Megalytoceras confusum

Occurrence: Ch-3c, HP-3b, BA-3b; perhaps best seen at Chideock.

Notes: The *Staufenia* has been described by one of us (CHANDLER, 1982).

Aa-6 *Ludwigia patellaria*

Ancolioceras sp.
† *Ludwigia patellaria* [M]
Planammatoceras cf. *klimakomphalum* (VACEK) (O)
Stephanoceras (Abbasitoides) modestum (VACEK) [m] (R)
Tmetoceras cf. *scissum* (R) (pl. 1, fig. 1)

Occurrence: Ch-4.

Notes: This species of *Ludwigia* has a very characteristic acute edge to the umbilicus. The *Stephanoceras* was found *in situ* and is illustrated on Plate 1, figure 2. It must be one of the earliest forms of the Stephanoceratidae known so far. It is certainly neither an *Erycites* nor an *Abbasites*. The type came from a condensed bed at Cap San Vigilio on Lake Garda, that is younger than the *comptum* horizon (Aa-2) but not younger than early Bradfordensis Zone (ca. Aa-10), to judge from the associated fauna described by VACEK (1886). It looks like a microconch, perhaps that of *Stephanoceras longalvum* associated with it.

Aa-7 *Ludwigia murchisonae*

Ancolioceras [Manselia] subfalcatum
Ludwigia murchisonae (SOWERBY) [M]
Ludwigia laevigata
† *Ludwigia reflua*
Ludwigia tuberata
† *Ludwigia depilata*
Ludwigia [Pseudographoceras] literata [m]
Ludwigia [Pseudographoceras] tuberculata [m]
Parammatoceras rugatum
Planammatoceras planiforme
Erycites intermedius (PRINZ) (R)
Tmetoceras aff. *scissum* (BENECKE) (large form) (O)
Megalytoceras confusum
Pachylytoceras sp.

Occurrence: Ch-5a, HP-3c

Notes: The forms of *Ludwigia* from Dorset are very close to those from the type-locality of *L. murchisonae* in Skye, but may not be quite identical.

Aa-8 *Brasilia bradfordensis* α, *B. subcornuta*

Ludwigia aff. *murchisonae*
Brasilia bradfordensis [M]
† *Brasilia austera*
Brasilia cf. platychora
Brasilia [Pseudographoceras] subcornuta [m]
Brasilia carinata [m]
Brasilia glevensis [m]
Planammatoceras sp.
Erycites partschi PRINZ
Tmetoceras sp.
Megalytoceras confusum

Occurrence: HP-4a, WH-5a, b?

Notes: The fauna is transitional between *Ludwigia* and *Brasilia*. The dividing-line between these «genera» is arbitrary.

Aa-9 *Brasilia bradfordensis* β, *B. baylii*

Ludwigia aff. *gradata* (O)
† *Brasilia bradfordensis* β, s.s. (VC)
† *Brasilia baylii*
Brasilia austera
Erycites partschi PRINZ (O)
Tmetoceras sp. (R)

Occurrence: Ch-5b, WH-5a, HP-4b, BA-4a

Notes: This is the-type-horizon of *B. bradfordensis* s.s., the second of three transients of this species.

Aa-10 *Brasilia bradfordensis* γ, *B. similis*

Ludwigia aff. *gradata*
Brasilia bradfordensis [M]
† *Brasilia similis*
Brasilia ambigua
Brasilia tutcheri
Brasilia deleta [m]
Brasilia [Ludwigella] rudis etc. [m]
Eudmetoceras? klimakomphalum (VACEK)
Erycites partschi PRINZ
Abbasites abbas
Abbasites aegrotus
Pachylytoceras sp.

Occurrence: WH-5a/b, HP-4c, BA-4b.

Notes: The third transient of *B. bradfordensis* with still occasional morphs of *Ludwigia* but now also larger, more involute forms.

Aa-11 *Brasilia gigantea*

† *Brasilia gigantea* [M] (VC)
Brasilia platychora (C)
Brasilia similis
Brasilia platys
Brasilia [Ludwigella] arcitenens [m] (C)
Brasilia [Ludwigella] tenuis (C)
Brasilia [Ludwigella] carinatus (C)
Brasilia [Ludwigella] rugosus (C)
?B. maggsi (R)
Parammatoceras grande (ELMI) and spp. aff.
Praestrigites praenuntius [here?]
Abbasites abbas
Stephanoceras sp. nov. aff. *perfectum* α [M]
S. (Abbasitoides) aff. *modestum* (VACEK) [m]
Tmetoceras sp.
Megalytoceras confusum

Occurrence: WH-5b/c?, HP-5a,b; recognized widely in continental Europe.

Notes: This is one of the most easily recognized faunal horizons, marked by its gigantic «dinner-plate» graphoceratids, which attain diameters of 0.5 m. Its spectacular development in the ironshot oolites of Horn Park Quarry have made that locality world-famous. There are also interesting ancillary forms. *Praestrigites praenuntius* BUCKMAN (1924, pl. 466) came from the Horn Park Ironshot and he assigned it to the «*platychora* hemera». It appears to be the oldest-known member of the Strigoceratidae. The *Stephanoceras* [M] was found by J.R. SENIOR at Horn Park in bed 5a (recorded as «*Docidoceras*» in SENIOR *et alii*, 1970) and is also the oldest member of the genus known from Britain. It is almost identical with the two specimens figured here from slightly higher levels, 5c and 5d, q.v. below.

Aa-12 *Brasilia decipiens*

Brasilia decipiens [M]
Brasilia similis
Brasilia aperta
Brasilia pulchra
† *Brasilia sublineata*
† *Brasilia tutcheri*
† *Brasilia [Ludwigella] impolita* [m]
† *Brasilia [Ludwigella] attracta*
Brasilia [Ludwigella] rudis
† *?Brasilia [Paquieria] crinalis*
† *?Brasilia [Paquieria] floccosa*
Brasilia [Paquieria] maggsi
Graphoceras cf. *concavum* (SOWERBY) α [M] (R)
Abbasites cf. *abbas*

Occurrence: HP-5c(i), the lower part of bed 5c.

Notes: The fauna is dominated by late forms of *Brasilia*, but the first forms that are morphologically *Graphoceras* appear. There are also some forms (*crinalis, floccosa, maggsi*) closely resembling the much earlier Leioceratinae, and the question remains whether these are merely homoeomorphs or the last representatives of this family.

Aa-13 *Graphoceras cavatum*

Graphoceras cavatum [«*Lucya*»] [M]
Graphoceras magnum
Graphoceras marginatum
† *Graphoceras decorum*
Graphoceras concavum (SOWERBY) β
Graphoceras [Ludwigella] arcitenens [m]
Graphoceras [Ludwigella] cornu
Graphoceras [Ludwigella] robustum
Eudmetoceras euaptetum [here?]
Eudmetoceras infernense (ROMAN) - BUCKMAN
Eudmetoceras aff. grande ELMI
Stephanoceras aff. *perfectum* β [M] (Pl. 3, fig. 1)
S. (Abbasitoides) aff. *modestum* α [m] (Pl. 1, fig. 3)
Tmetoceras cfr. scissum (Pl. 1, fig. 1)
Megalytoceras confusum

Occurrence: HP-5c(ii), the upper part of bed 5c; BA-6a.

Notes: The succession has been best studied at Horn Park. There is a fairly marked change in the middle of bed 5c from *Brasilia* to *Graphoceras*. The four assemblages that follow show an evolutionary shift in the morphological components rather than any abrupt changes, so that there is considerable overlap in the ranges of morphospecies. Most of those that have been named came from the Bradford Abbas fossil-bed in which no detailed collecting has yet been carried out, and so the exact horizon of many of BUCKMAN'S species may never be known. Only the more commonly-used names have been listed, and the type-horizons assigned, where possible, by comparison with new material from Horn Park.

The lower Concavum Zone has also produced *Stephanoceras*, figured on plates 1 and 3. It sees the youngest *Tmetoceras* known so far in Britain, figured as plate 1, figure 1.

Aa-14 *Graphoceras concavum*

† *Graphoceras concavum* (SOWERBY) γ [M] (VC)
Graphoceras decorum (C)
† *Graphoceras marginatum* (C)
† *Graphoceras v-scriptum*
† *Graphoceras scriptitatum* (R)
† *Graphoceras fallax* (C)
† *Graphoceras [Ludwigella] cornu* [m] (C)
† *Graphoceras [Ludwigella] arcitenens* (C)
Graphoceras [Ludwigella] impolitum (C)
† *Graphoceras [Ludwigella] attenuatum* (C)

Occurrence: HP-5d(i), the lower part of bed 5d; BA-6a.

Notes: The rarer ancillary forms from bed 5d cannot be more closely dated and are listed under Aa-15 below.

Aa-15 *Graphoceras formosum*

† *Graphoceras formosum* [M] (C)
† *Graphoceras limitatum* (C)
Graphoceras concavum (SOWERBY) δ
Graphoceras [Ludwigella] attenuata [m]
† *Graphoceras micra*
Graphoceras tenue
Braunsina cf. *aspera* and spp. aff. [m] (R)
Eudmetoceras eudmetum
Eudmetoceras amplectens
Stephanoceras aff. *perfectum* γ [M] (Pl. 2, fig. 2)
S. (Abbasitoides) aff. *modestum* (VACEK) β [m] (Pl. 1, fig. 4)
† *Bradfordia costata*
Haplopleuroceras subspinatum

Occurrence: HP-5d(ii); Se-2b; BA-6a/b?; Du.

Notes: Microconchs begin to contain significant proportions of the small, evolute, coarsely-ribbed forms called *Braunsina*. Both *Bradfordia* and *Haplopleuroceras* appear at this level. *Eudmetoceras* (?) *amplectens* is fairly common and shows little variability. It is closer to *Hammatoceras klimakomphalum* VACEK than the other species of *Eudmetoceras*, in what appears to be a separate group containing also *Planammatoceras*: the *Csernyeiceras* of GÉCZY (1966).

Aa-16 *Euhoploceras acanthodes*

Graphoceras formosum [M] (C)
Graphoceras limitatum (C)
Graphoceras inclusum [R]
Graphoceras marginatum (C)
Graphoceras stigmosum (C)
Graphoceras concavum ε (R)
Braunsina contorta
Braunsina semilenis (R)
Hyperlioceras cf. *walkeri* (R)
Hyperlioceras cf. *discitiforme* (R)
Eudmetoceras eudmetum
† *Euhoploceras acanthodes* (VC)
Euhoploceras crassispinatum spp.
Fontannesia grammoceroides (HAUG) [M]
Fontannesia spp.
F. (Nannoceras) boweri [m]
Megalytoceras confusum (VC)

Occurrence: BB-7, the Yellow Conglomerate; HP-5e(i), which forms the top of the ironshot under the erosion-plane in most of the quarry; BA-6b, the middle of the Fossil Bed.

Notes: *Braunsina* is now common among microconchs. There can be little doubt that the first forms ascribable to true *Hyperlioceras* already occur here, although they are rare.

4.2. – LOWER BAJOCIAN

The Aalenian-Bajocian boundary is not marked by an physical break more prominent than elsewhere in the succession. It has been generally taken at the faunal dividing-line between *Graphoceras* and *Hyperlioceras*. The faunal horizons of Dorset are sufficiently closely spaced in time to show that the transition between these genera is entirely gradual. The distinction between them rests on a single character: the form of the ventral whorl-section, tegulate in *Graphoceras*, subquadrate with keel in *Hyperlioceras*. All other characters — coiling, ribbing, whorl-section — are the same, as are their ranges of variability. We take as the first horizon of the Bajocian, therefore, one in which a majority of morphs are assignable to *Hyperlioceras*.

We can at present recognize three separate faunal horizons of *Hyperlioceras*, but their evaluation is not yet complete. Macroconch material is not easy to collect at present, and so not enough is yet available to match all the forms described from Bradford Abbas by BUCKMAN. It seems clear that the East Hill quarry must have shown horizons not represented in the railway-cutting section visible today, perhaps lost in a non-sequence between beds 6b and 6c. The following descriptions therefore provisional.

Bj-1 *Hyperlioceras rudidiscites*

Hyperlioceras rudidiscites [M] (Pl. 3, fig. 2)
Hyperlioceras liodiscites
Hyperlioceras politum [«*Darellia*»] (C)
Hyperlioceras laevis (C)
Hyperlioceras cf. *discitiforme*
Hyperlioceras mundum
H. [*Braunsina*/*Reynesella*] *aspera* (C)
H. [*Braunsina*/*Reynesella*] *juncta*
Graphoceras limitatum (R)
Graphoceras decorum (R)
Eudmetoceras amplectens
Euhoploceras marginatum (C)
Trilobiticeras sp.

Occurrence: HP-5e(ii); Se-3; Du-6 (teste PARSONS, 1979).

Notes: Although now a minority, undoubted *Graphoceras* still does occur in this fauna. A fine large *Hyperlioceras* from Horn Park is shown in plate 3, fig. 2. Note the well-differentiated but still rather blunt keel. If reference-sections are sought for the Aalenian-Bajocian boundary in England, those at Horn Park and Seavington would do well. The boundary coincides closely with the erosion-planes above bed 5e(i), Aa-16, at Horn Park, and below bed 3, Bj-1, at Seavington.

Bj-2 *Hyperlioceras* cf. *walkeri* α

Hyperlioceras spp. [M] & [m]

Occurrence: WH-5d; in course of study.

Bj-3 *Hyperlioceras* cf. *walkeri* β

Hyperlioceras spp. [M] & [m]
Euhoploceras modestum
† *Stephanoceras perfectum* [M]
Stephanoceras ? *planulatum* [m]

Occurrence: WH-5e; BA-6c(?); Du-7(?).

Notes: There are some additional important ancillary forms that occur in either Bj-2 or Bj-3. They include:

Bradfordia liomphala
Strigoceras protrusus
Docidoceras cylindroides [M]
D. (Trilobiticeras) trilobitoides [m]

Haplopleuroceras and *Fontannesia* continue into these levels.

Bj-4 *Bradfordia inclusa*

Fissilobiceras cf. *fissilobatum* (Waagen) [M] (C)
Witchellia aff. *romanoides* Douville
W. (Nannoceras) nannomorpha [m] (C)
† *Bradfordia inclusa* (C)
Docidoceras sp. (C)
Stephanoceras cf. *perfectum*

Occurrence: WH-5f,g.

Notes: These are the «post-*discites* beds of Buckman (1910). *Hyperlioceras* has disappeared, but the remaining fauna has changed relatively little. The *Fissilobiceras* closely resembles the syntype of *F. fissilobatum* figured by Waagen (1867, pl. 27, fig. 1; refigured by Dorn, 1935, pl. 13, fig. 1 - lectotype, designated here). Whorl-section, keel, coiling and complex sutures are almost identical. Inner whorls are ribbed but not spinose. Only the obtuse ribbing is lacking on the Dorset forms. The affinities appear to be much closer with *Hammatoceras* of the *amplectens* group than any sonninid. The type came from beds with *Sonninia adicra*, as did another British specimen figured by Buckman (1920, pl. 181). These are somewhat younger, Bj-8. «*Fissilobiceras*» *phlyctaenodum* Buckman (1923, pl. 387) is a Sonninid, *Papilliceras*.

Bj-5 *Witchellia romanoides*

Euhoploceras cf. *jugiferum* (Waagen)
Witchellia romanoides (Douvillè) [M] (C)
W. (Pelekodites) cf. *pelekus* [m]
Bradfordia cf. *inclusa*
Strigoceras compressum
Docidoceras (Emileites) aff. *malenotatum* [M]
Docidoceras (Trilobiticeras) cricki Parsons [m]
Emileia catamorpha [M]

Occurrence: Br; Du-8a (see Parsons, 1979 for further details).

Bj-6 *Sonninia ovalis*

«*Sonninia*» [*Shirbuirnia?*] *ovalis* (Quenstedt-Buckman (Pl. 1, fig. 5; Pl. 2, fig. 1)
«*Sonninia*» [*Shirbuirnia?*] cf. *gingensis* (Waagen)
Witchellia romanoides (Douvillè)
Docidoceras (Emileites) liebi (Maubeuge)

Occurrence: SL-8; OB-1; Br; Du-8b; Cotswolds.

Notes: This is a well-characterised horizon that can be widely recognized in southern England. The comparison with the large, smooth forms called *Amm. sowerbyi ovalis* by Quenstedt (1886, non 1845) goes back to Buckman (1893b, p. 493) and has persisted, working its way through to the point at which *Sonninia ovalis* (Quenstedt) is today the index-species of an Ovalis Zone or Ovalis Subzone of the Laeviuscula Zone. There are however several uncertainties. Firstly, the name *ovalis* is preoccupied, being used by Quenstedt himself for other taxa back at least to 1845. Secondly, the species is poorly characterized. The lectotype, from southern Swabia (Quenstedt 1886, pl. 62, fig. 1, des. Oechsle, 1958) is fragmentary and has so far not been refigured. Thirdly, the precise horizon from which it came was not known. These problems are being sorted out by G. Dietl and will not be discussed further here. But to show the nature of the forms to which the name *ovalis* has been applied in England, two specimens from Dundry are figured here (Pl. 1, fig. 5; Pl. 2, fig. 1). The species is large, evolute and typically sonninid on the inner whorls, becoming totally smooth. The inner whorls suggest a close affinity with *Sonninia gingensis* (Waagen) or *Sonninia rudis* (Quenstedt) as refigured by Dorn (1935, pl. 11, fig. 2; pl. 21, fig. 3).

Bj-7 *Witchellia connata*

Witchellia sayni Haug [M]
Witchellia cf. jugifera (Waagen
Witchellia cf. gelasina
† *Witchellia connata W.* (*Pelekodites*) cf. *pelekus* [m]
Docidoceras (Emileites) malenotatum
Bradfordia (*Iokastelia*) sp.

Occurrence: SL-6a, lower part of Fossil-bed?; Du-8c.

Notes: Not yet well-characterized in Britain, but certainly equivalent in part of the «Sowerbyi-Bank» of Gingen in Swabia.

Bj-8 *Shirbuirnia trigonalis*

Fissilobiceras fissilobatum (Waagen)
Euhoploceras adicrum (Waagen) [«*Sherbornites*»]
† *E.* [«*Stiphromorphites*»] *nodatipingue*
† *E.* [«*Sherbornites*»] *projectiferum*
Papilliceras phlyctaenodum
† *Shirbuirnia stephani* (Buckman)
† *Shirbuirnia trigonalis* Buckman
Witchellia albida [M]
W. (*Pelekodites*) *aurifer* [m]
† *Lissoceras semicostulosum*

† *Strigoceras clypeus* [M]
† *Cadomoceras costellatum* [m]
† *Emileia brocchii* (SOWERBY) [M]
† *Emileia contrahens*
E. (Otoites) delicata [m]
Emileia catamorpha
Mollistephanus cf. *mollis*

Occurrence: SL-6a, the lower part of the Sandford Lane Fossil-bed; Du-8d; Br. Skye: Bearreraig Bay (MORTON, 1975).

Notes: First occurrence of *Lissoceras* of the Lissoceratidae which then continue almost unchanged into the Upper Jurassic. For further details, see PARSONS (1974).

Bj-9 *Witchellia ruber*

Papilliceras cf. *arenatum* (QUENSTEDT)
† *Witchellia ruber*
W. (Pelekodites) aurifer
Emileia polyschides (WAAGEN)
Emileia catamorpha
«*Emileia*» *crater*

Occurrence: Se-4b; SL-6a?; OB-2

Notes: The fauna is still not well characterized, but the *Witchellia* is distinct. For notes on *«Emileia» crater*, see horizon Bj-14 below.

Bj-10 *Witchellia laeviuscula*

Papilliceras arenatum (QUENSTEDT)
† *Shirbuirnia superba* [M]
† *Shirburnia platymorpha*
† *Witchellia laeviuscula* (SOWERBY) [M] [incl. *spinifera, patefactor, glauca, plena, falcata, actinophora*]
† *W. (Pelekodites) peleka* [m] [incl. *macra, spatians*]
Bradfordia [*Iokastelia*] sp.
† *Amblyoxyites amblys*
† *Protoecotraustes spiniger* SPATH [m]
Strigoceras strigifer [M]
Emileia brocchii (SOWERBY) [M]
Emileia bulligera
E. (Otoites) contracta (SOWERBY) [m]
Frogdenites spiniger and spp.
Stephanoceras (Skirroceras) leptogyrale
Mollistephanus cf. *mollis*

Occurrence: OB-3; Du-10.

Notes: This is one of the most diversely fossiliferous horizons in the whole of the Bajocian. For more details, see PARSONS (1974).

Bj-11 *Otoites sauzei*

Papilliceras mesacanthum (WAAGEN)
† *Papilliceras papillatum*
† *Papilliceras micracanthum*
† *Sonninia sowerbyi* (MILLER in SOWERBY)
Sonninia proprinquans (BAYLE)
† *Sonninia subtrigonata*
† *Sonninia acanthera*
† *Sonninites felix tessonianus* (D'ORBIGNY)
† *Sonninites corrugatus* (SOWERBY)
† *Witchellia hyalina* [M]
Witchellia simulans
† *W. (Nannina) evoluta* [m]
Witchellia undifera
† *Emileia bulligera* [M] [incl. *multifida, vagabunda*]
† *E. (Otoites) sauzei* [m]
Labyrinthoceras meniscum (WAAGEN)
Labyrinthoceras perexpansum
† *Sphaeroceras manselli* (J. BUCKMAN) [M] & [m]
Frogdenites profectus
† *Stephanoceras kalum*
St. (Skirroceras) bayleanum (OPPEL)
St. (Skirroceras) macrum (QU.-BUCKMAN)
† *St. (Skirroceras) dolichoecum*
† *St. (Skirroceras) leptogyrale*
† *St. (Normannites) braikenridgii* (SOWERBY)
† *Kumatostephanus kumaterus*
† *Kumatostephanus perjucundus*

Occurrence: BB-9; Se-4c; SL-6b, upper Fossil-bed; OB-4a; Du-10, the «Brown Ironshot».

Notes: Several groups carrying over from the Laeviuscula Zone not listed; for further details, see PARSONS (1974). One of the most prominent indicators is the large, discoidal *Sonninites felix*. Some groups that may occur elsewhere in Europe at distinct levels cannot be separated here.

Bj-12 *Stephanoceras rhytum*

Sonninites cf. *felix*
† *Stephanoceras rhytum*
† *Stephanoceras skolex*

Occurrence: BB-12; HP-7a; Br. The main part of the «Red Bed» of southern Dorset, although sparsely fossiliferous, consistently yields this characteristic, if restricted, assemblage.

Bj-13 *Witchellia pinguis*

Occurrence: Skye: see MORTON (1975).

Notes: Here lies the largest gap in the Lower Bajocian succession of southern England. Only the lower part of the Sauzei Zone is preserved where it has not been cut out altogether. The next horizon to be well represented is that with *Poecilomorphus cycloides* of the Humphriesianum Zone (see below). Into this gap have to be fitted a number of faunal horizons known in continental Europe. The best known so far is that of the «Pinguis-Schichten» of north-western Germany. Equivalents of these have been found in Scotland on the island of Skye. The ammonites have been described by MORTON (1975). There are indications of additional, higher faunas in Swabia characterized by various assemblages of *Stephanoceras* and *Sphaeroceras* but these remain to be worked out (DIETL, pers. comm.). A lot of the present uncertainty rests on taxonomic problems involving such species, deeply entrenched in the literature, as *Stephanoceras umbilicum, pyritosum, mutabile, nodosum, frechi*, based on fragmentary types (where designated) from unidentified horizons. These problems will have to be resolved before a satisfactory definition of the Sauzei Humphriesianum boundary can be found. To this the British successions can contribute little.

Bj-14 *Poecilomorphus cycloides*

† *Sonninites tectum* [M] (C)
† *Sonninites subtectum* (C)
† *Sonninites liostracum* (C) (lectotype BUCKMAN 1891, pl. 155, fig. 3, des. HUF 1968)
Witchellia romani (OPPEL) [M] (0)
† *Witchellia complanata*
W. (Nannoceras) deltafalcata (QUENSTEDT) [m] (R)
† *Dorsetensia pulchra* [M] (R)
Dorsetensia edouardiana (d'ORBIGNY) [m] (R)
Poecilomorphus cycloides (d'ORBIGNY) [M] & [m] (C)
† *Oppelia subradiata* (WAAGEN) [M] (VC)
† *O. (Oecotraustes) geniculare* (WAAGEN) [m] (VC)
Chondroceras gervillei (SOWERBY) [M] & [m] (VC)
† *Chondroceras delphinum*
† *Chondroceras grandiforme*
Sphaeroceras brongniarti (SOWERBY)
Stephanoceras spp. cf. and aff. *humphriesianum* (SOWERBY)
† *St. (Normannites) orbignyi*
† *Phaulostephanus paululum*
† *Teloceras labrum* (Pl. 4) (R)

Occurrence: Ob-4b and widely in very thin, condensed lenticles of stromatolitic, ferruginous «Irony Beds» in southern Dorset, e.g. BB-11, Se-7, BA-7c.

Notes: For more details, see PARSONS (1976). There has long been confusion over the taxonomy of the «sonninids». There are four quite distinct groups, as indicated. The large, smooth, discoidal forms with high, hollow-floored keels, connect naturally back with *Sonninites* of the Sauzei Zone. Their microconchs differ little other than in size. They are quite disinct from *Dorsetensia* s.s., which does not have hollow keels (as already noted by BUCKMAN), and which seems to have had a cryptogenic, short-lived career. Its roots seem most plausibly to lie in Grammoceratinae rather than the Phymatoceratinae of the sonninids. The *romani-complanata* group, in contrast, connects effortlessly back with the late forms of *Witchellia* in the Sauzei Zone, in size, sculpture and form of the dimorphism.

There also remain problems with *Chondroceras*-/*Sphaeroceras*. These have been discussed by one of us elsewhere (CALLOMON 1984, p. 146). There are now collections of hundreds of specimens from the one bed at Oborne showing the whole range of variability, and it becomes impossible to draw any natural boundary between *Chondroceras *gervillei* and *Sphaeroceras *brongniarti*. The types, from an unknown level in Normandy, are in the British Museum and can be matched exactly with specimens from Oborne. The question of dimorphism is quite distinct and presents no special problems.

The section at Oborne has also resolved another question. Bed 4b yields occasional specimens of what is without doubt already fully-fledged *Teloceras, T. labrum* BUCKMAN, unconnected by intermediaries to *Stephanoceras* or its coronate variants, *Stemmatoceras*. A specimen is shown on plate 4. It seems therefore that *Teloceras* represents a distinct lineage that split off from *Stephanoceras* (or *Emileia*?) already much earlier, in the Sauzei Zone. This had already been suggested by some of the extremely coronate microconchs (*Epalxites*) described from about these levels by WESTERMANN (1954). The genus may go back even further. «*Emileia*» *crater* BUCKMAN, 1920 (pl. 164) looks remarkably like *T. labrum*. It was said to have come from Sandford Lane, Bj-8/9, Laeviuscula Zone, but this is supposition. PARSONS (1974, p.168) records another from the same level.

Bj-15 *Stephanoceras humphriesianum*

Stephanoceras humphriesianum (SOWERBY) [M] & [m] (VC).
Stephanoceras spp.

Occurrence: Ob-4c(i).

Notes: At the bottom of bed 4c at Oborne is a layer of beautifully preserved, largely complete *Stephanoceras* that must have been the source of SOWERBY'S type. Large new collections have been made, and PARSONS (1976, p.131) gives a list of names. But until the material has been properly studied, and ranges of specific variability established, these names do not mean much. A cursory examination shows that there are, besides *Stephanoceras* s.s., forms that seem still typical of *Skirroceras*, some like «*Rhytostephanus*» *rhytus* (Bj-12) and coronate forms (*Stemmatoceras*) resembling *Teloceras* but retaining the ribbing of *Stephanoceras*.

Bj-16 *Stephanoceras gibbosum*

† *Stephanoceras gibbosum*
Chondroceras cf. *evolvescens* (WAAGEN)
Chondroceras orbignyianum (WRIGHT)

Occurrence: Ob-4c(ii)

Notes: A second layer of *Stephanoceras*, consistently stouter and more coarsely ribbed than the forms below. The *Chondroceras* are similarly coarser, the ribbing remaining strong on the body-chamber.

Bj-17 *Stephanoceras subblagdeniforme*

Stephanoceras subblagdeniforme (ROCHÈ)

Occurrence: Ob-4c(iii); western France; Rhône valley.

Notes: The top of bed 4 undulates below the erosion-plane at the base of bed 5. At a high point in Frogden quarry a third layer of *Stephanoceras* appeared, whose forms were now all coronate almost to the stage of *Teloceras*. The coiling and ribbing remain those of *Stephanoceras*, however. The interest in this little fauna lies in the fact that it appears to be the same as one in western France that has yielded large collections now to be seen in Poitiers, in which these forms also dominate.

Bj-18 *Teloceras blagdeni*

Stephanoceras sp. (R)
† *Teloceras blagdeni* (SOWERBY) [M] & [m] (C)

Occurrence: Ob-5a, and scattered records; Br.

Notes: Undoubtedly the source of SOWERBY'S type. Very common around Oborne in what appears to have been a local accumulation of these ponderous shells. Often planed off by the erosion-plane on top. For further discussion, see PARSONS (1976).

Bj-19 *Teloceras blagdeni/banksi*

Teloceras blagdeni - banksi (SOWERBY)

Occurrence: Ob-5b.

Notes: PARSONS (1976) lists already the first Perisphinctids from this bed, but this may be due to having drawn the boundary between beds 5 and 6 slightly higher in the section he studied, 300 m to the north-west from Frogden. At Frogden quarry there seems to be a genuine intermediate bed with *Teloceras* transitionsl between *blagdeni* and *banksi* from which we have not obtained any perisphinctids. There is room for additional horizons of *Teloceras*, such as, for example, forms well known in Swabia as *Teloceras coronatum* (ZIETEN, non BRUGUIÈRE).

4.3. – UPPER BAJOCIAN *(Subfurcatum Zone)*

Bj-20 *Teloceras banksi*

† *Teloceras banksi* (SOWERBY), typical (C)
Caumontisphinctes aplous [M] (R)
Caumontisphinctes diniensis PAVIA
C. (Infraparkinsonia) cf. *phaula* [m] (R)
Leptosphinctes sp.

Occurrence: Ob-6a

Notes: The overlapping ranges of *Teloceras, Caumontisphinctes* and *Leptosphinctes* have now been well established both in Britain and elsewhere in Europe, especially in SE France around Digne (PAVIA 1973; PARSONS 1976). The Banksi Subzone is generally accepted as marking the base of the Upper Bajocian.

For descriptions of the higher horizons of the Subfurcatum Zone in Dorset (Bj-21, 22, 23), see PARSONS (1976).

5. – CONCLUSION

The Aalenian and Lower Bajocian of southern England are now rather well understood. The stratigraphical relationships are intricate but can be unravelled by a minute attention to detail. BUCKMAN'S pioneering contributions to this field of microstratigraphy have turned out to be almost wholly reproducible: they were ahead of his time. Although many details remain to be filled in, the correlations between the English succession and those established in the last 25 year in many other parts of Europe are so close that is seems unlikely that there are any major and as yet unsuspected gaps to be filled in.

ACKNOWLEDGMENTS

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AALENIAN

Aa – 16	*Euhoploceras acanthodes*	Concavum	Formosum
Aa – 15	*Graphoceras formosum*		
Aa – 14	*Graphoceras concavum*		Concavum
Aa – 13	*Graphoceras cavatum*		
Aa – 12	*Brasilia decipiens*	Bradfordensis	Gigantea
Aa – 11	*Brasilia gigantea*		
Aa – 10	*Brasilia bradfordensis, similis*		Bradfordensis
Aa – 9	*Brasilia bradfordensis, baylii*		
Aa – 8	*Brasilia bradfordensis, subcornuta*		
Aa – 7	*Ludwigia murchisonae*	Murchisonae	Murchisonae
Aa – 6	*Ludwigia patellaria*		
Aa – 5	*Ludwigia obtusiformis*		Obtusiformis
Aa – 4	*Ancolioceras opalinoides*		Haugi
Aa – 3	*Leioceras bifidatum*	Scissum	
Aa – 2	*Leioceras lineatum*		
Aa – 1	*Leioceras opalinum*	Opalinum	

Fig. 5. – The ammonite faunal horizons of the Inferior Oolite of Dorset - Somerset.

UPPER BAJOCIAN

Bj – 20	*Teloceras banksi*	widespread non-sequence	

LOWER BAJOCIAN

Bj – 19	*Teloceras bladgeni / banksi*	Humphriesianum	Bladgeni
Bj – 18	*Teloceras bladgeni*		
Bj – 17	*Stephanoceras blagdeniforme*		Humphriesianum
Bj – 16	*Stephanoceras gibbosum*		
Bj – 15	*Stephanoceras humphriesianum*		
Bj – 14	*Poecilomorphus cycloides*		Cycloides
Bj – 13	*Witchellia pinguis*	Sauzei	
Bj – 12	*Stephanoceras rhytum*		
Bj – 11	*Otoites sauzei*		
Bj – 10	*Witchellia laeviuscula*	Laeviuscula	Laeviuscula
Bj – 9	*Witchellia ruber*		
Bj – 8	*Shirbuirnia trigonalis*		Trigonalis
Bj – 7	*Witchellia connata*		
Bj – 6	*Sonninia 'ovalis'*	Ovalis	
Bj – 5	*Witchellia romanoides*		
Bj – 4	*Bradfordia inclusa*		
Bj – 3	*Hyperlioceras walkeri* β	Discites	
Bj – 2	*Hyperlioceras walkeri* α		
Bj – 1	*Hyperlioceras rudidiscites*		

Fig. 6. – The ammonite faunal horizons of the Inferior Oolite of Dorset - Somerset.

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PLATE 1 (all figures natural size, except figure 5)

Figs. 1a, b. – *Tmetoceras* cf. *scissum* (Benecke). - Horn Park, bed 5c; lower Concavum Zone (RBC coll.). Nearly complete adult, note slight modification of the ribbing at the end. The youngest *Tmetoceras* yet found in Britain.

Figs. 2a-c. – *Stephanoceras (Abbasitoides) modestum* (Vacek). Chideock, bed 4 (Aa-6), lower Murchisonae Zone and Subzone (JHC 1303). Complete adult; the obverse side shows the onset of the peristome which appears to have had a collar as in figure 4. - Presumed to be the microconch of *Stephanoceras longalvum* (Vacek); the earliest *Stephanoceras* found so far in Britain.

Figs. 3-4. – *Stephanoceras (Abbasitoides)* aff. *modestum* (Vacek). Horn Park. 3a-c (α): bed 5c, lower Concavum Zone and Subzone (RBC 226); 4a-c (β): bed 5d, Formosum Subzone. Both complete adults, presumed microconchs of the specimens shown on plates 2 and 3.

Figs. 5 a, b. – *Sonninia ovalis* (Quenstedt) *sensu* Buckman. Dundry, bed 8b (Bj-6) (JHC 1298). A nearly complete adult, x 0.40: maximum diameter 450 mm. The umbilical seam indicates the former presence of about another eigth whorl. The cross-section was reconstructed at about 0.2 whorls back, with a spiral half-whorl constant of 1.375.

PLATE 1

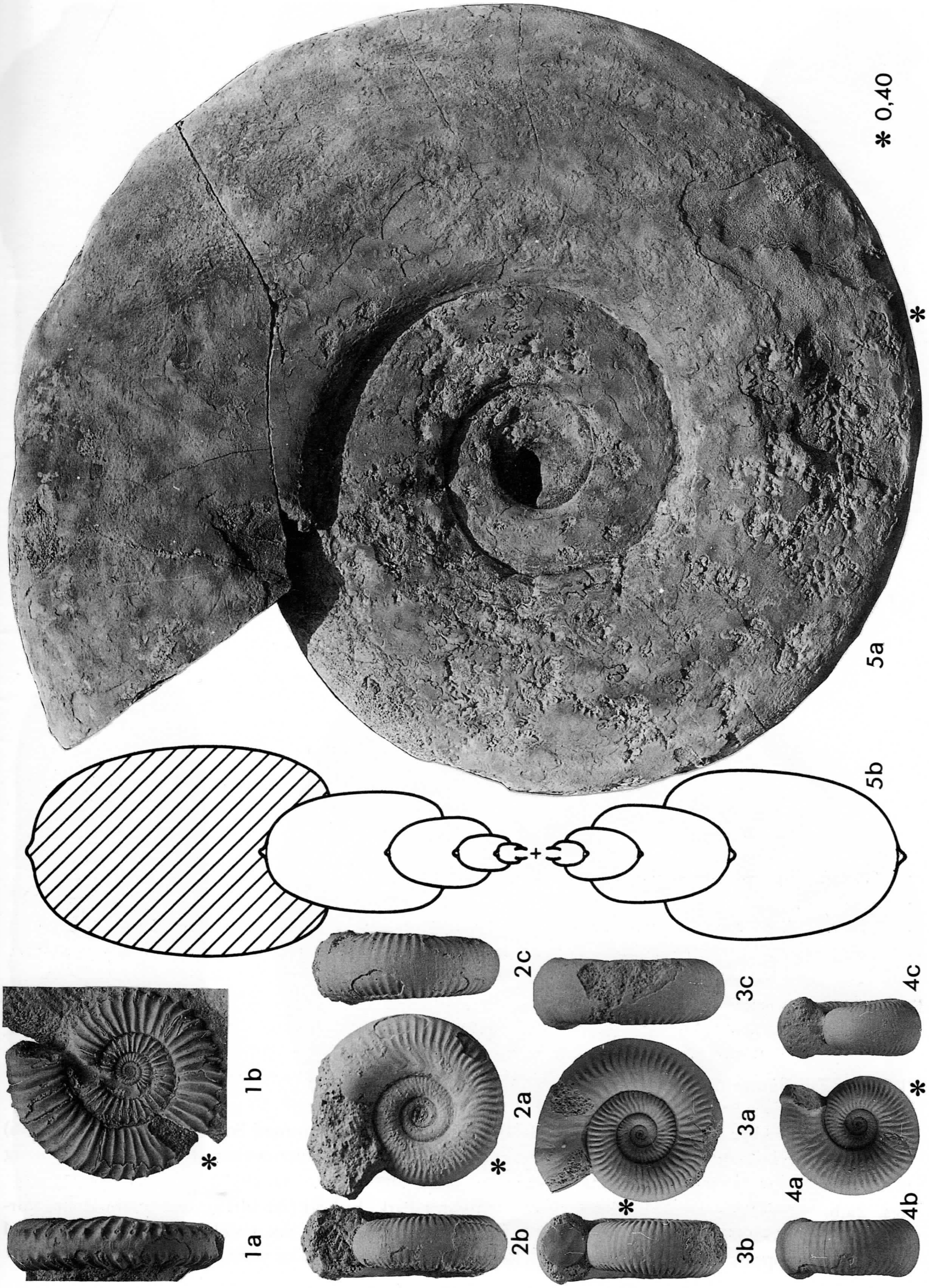


PLATE 2 (all figures natural size)

Figs. 1 a-c. – *Sonninia ovalis* (QUENSTEDT) *sensu* BUCKMAN. Dundry, Main-road South quarry, bed 8b (Bj-6) (JHC coll.) Inner whorls, showing the transition from rather evolute, ribbed sonninid coiling to a more compressed, involute whorl-section.

Figs. 2 a,b. – *Stephanoceras* aff. *perfectum* (BUCKMAN) Horn Park, bed 5d (Aa-14/15), Concavum Zone, Formosum Subzone (RBC coll.). Test preserved and sutures not visible, but the last 0.8 whorl appears to be body-chamber. The presumed macroconch of plate 1, fig. 4.

PLATE 2

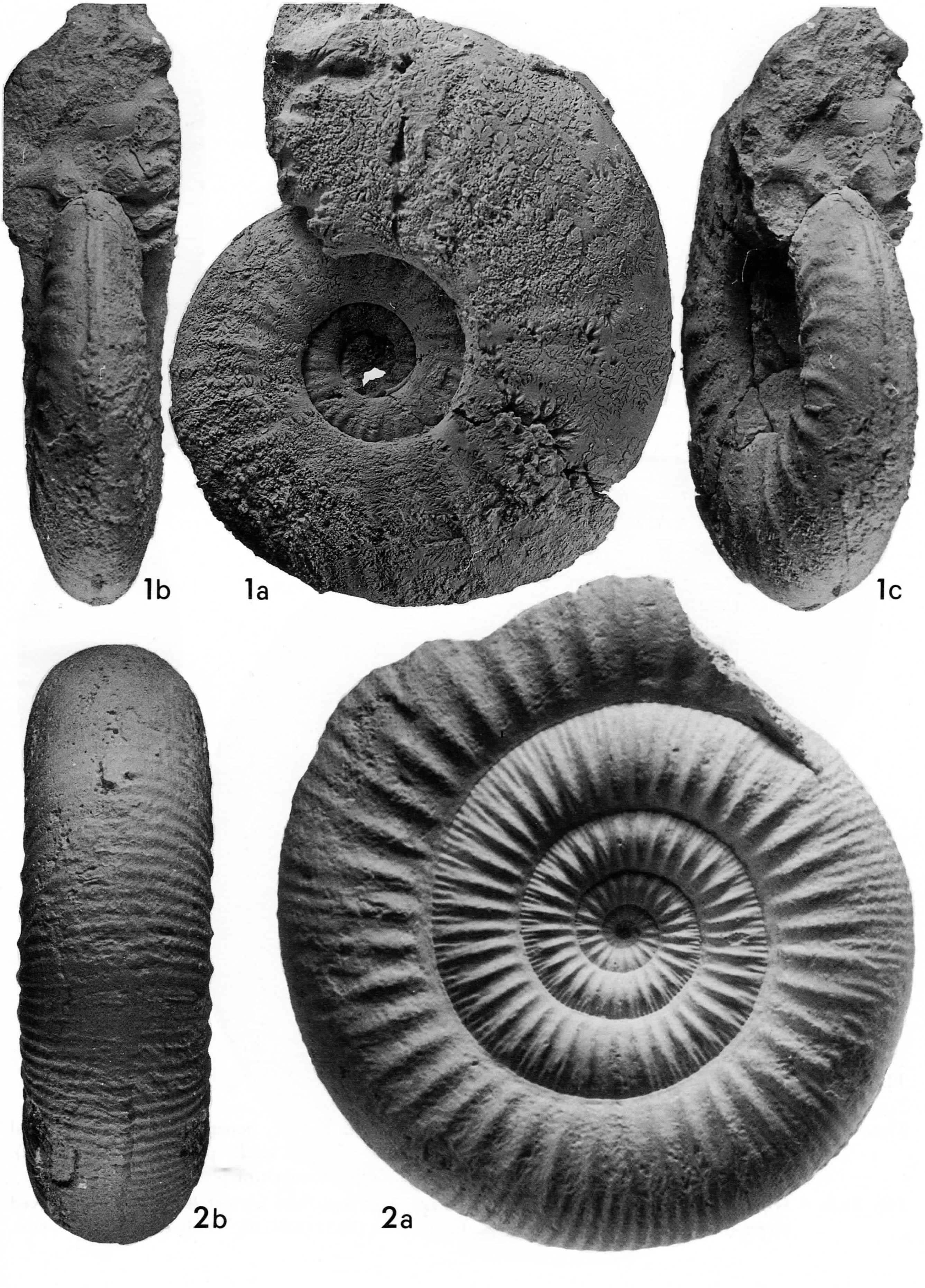


PLATE 3 (all figures natural size)

Figs. 1a-c. – *Stephanoceras* aff. *perfectum* (BUCKMAN) β. Horn Park, bed 5c, upper Bradfordensis or basal Concavum Zone (Aa-12/13) (D. SOLE coll., photo of a cast kindly provided by H. RIEBER). Test preserved, no sutures visible. The presumed macroconch of plate 1, fig. 3.

Fig. 2a,b. – *Hyperlioceras rudidiscites* BUCKMAN. Horn Park, bed 5e(ii), the highest level locally preserved under the erosion plane at the top of the ironshot (Bj-1) (RBC 85). Body-chamber 0.7 whorl.

PLATE 3

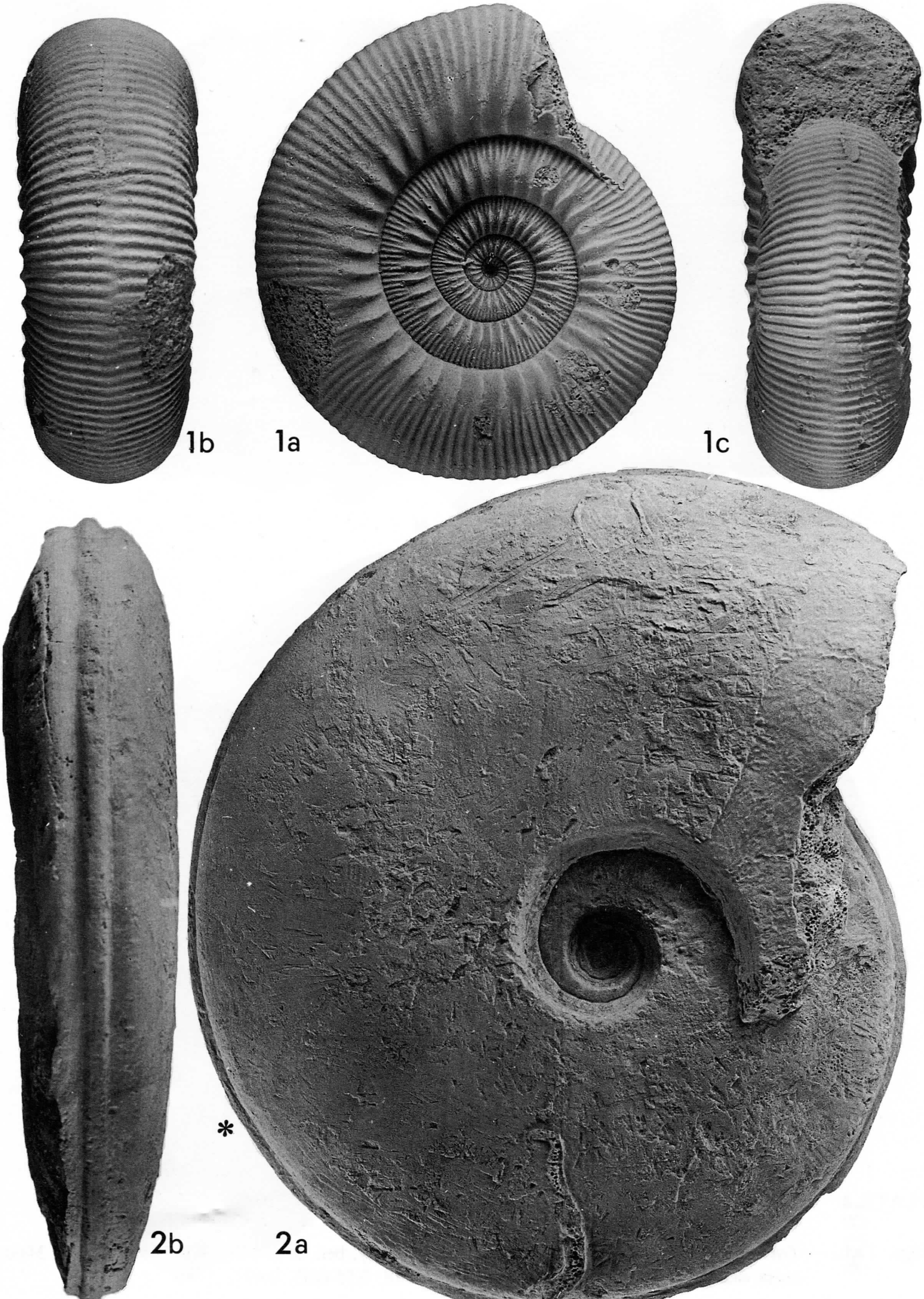
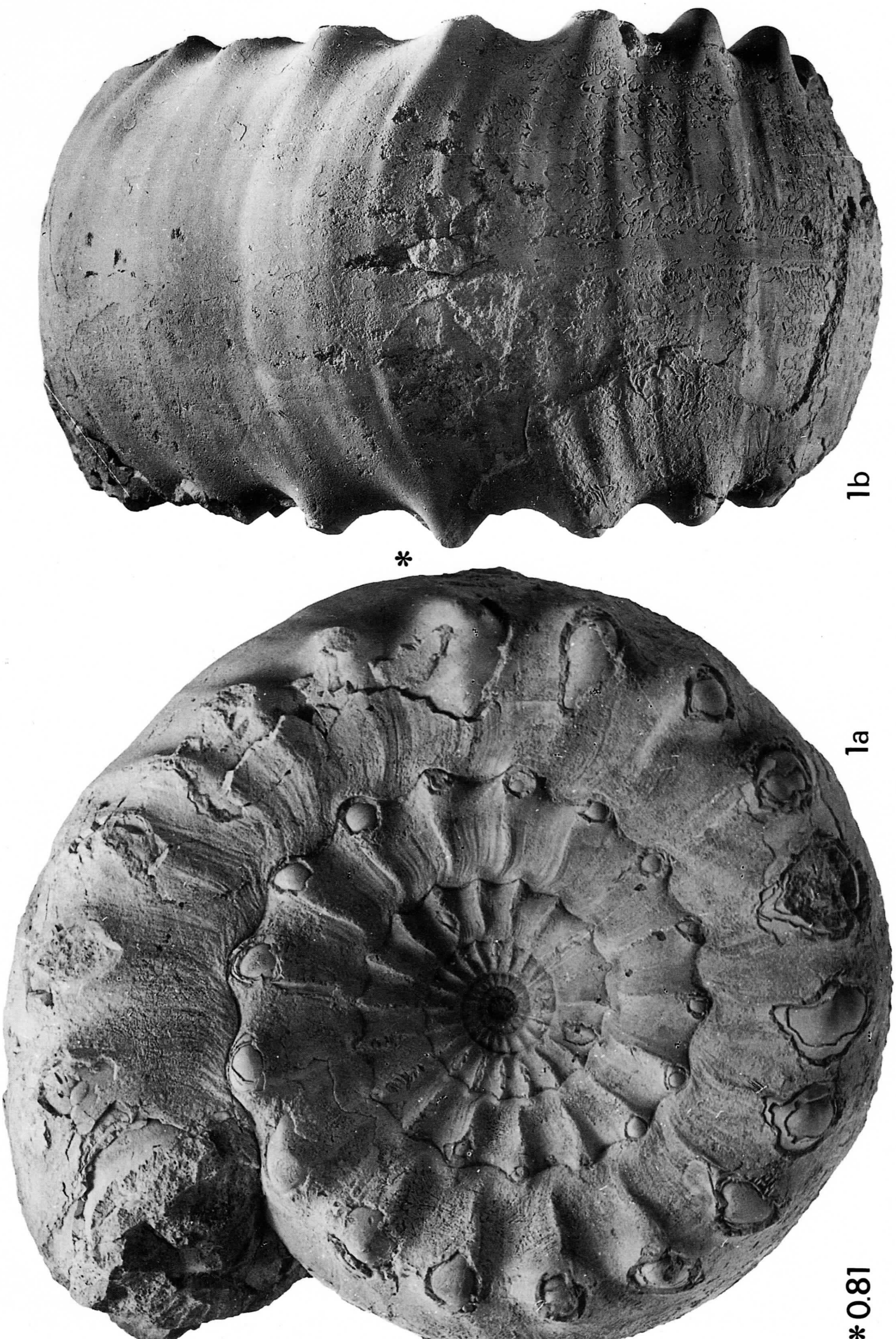


PLATE 4

Figs. 1 a,b. – *Teloceras labrum* Buckman. Oborne, Frogden quarry, bed 4b (Bj-14) (RBC 355), x 0.81. Maximum diameter 200 mm. Dimensions: 165: 0.28, 0.55-0.63, 0.47.

PLATE 4



1b

1a

*0.81