The Inferior Oolite at East Hill Quarry, Bradford Abbas, Dorset

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ABSTRACT

The rocks of East Hill Quarry, Bradford Abbas are described in terms of beds and the faunas they contain. Comparison is made with S.S. Buckman's section, and for the first time in a century the Bradford Abbas Fossil Bed is described at this locality. The position of many important ammonites is given and their role in biostratigraphy highlighted.

1. Introduction:

Bradford Abbas (ST 588145), on the Dorset/Somerset border east of Yeovil, lies on the outcrop of some of the most richly fossiliferous rocks in the world. It is a classic region for rocks of the Middle Jurassic which were exposed in the past in numerous quarries and provided stone for building and road-making. The principal formation is the resistant limestone of the Inferior Oolite Formation which rests on softer recessive sands of the Upper Lias. The limestones are thin, often ironshot oolites, and have variable content of mostly quartz-based sand. Most of the quarries have now disappeared or are much overgrown and show only part of the section once exposed. The region has been the source of an immense number of fossils, including many that have become reference specimens, the types of species figured and described in the literature. Material from the region is to be found in countless museum and university collections.

Much of the fame of Bradford Abbas derives from the combined efforts of the Buckman family, accounts of which have appeared in these *Proceedings* and elsewhere (Lang, 1960; Torrens, 1978, 1988; Callomon and Chandler, 1990, Callomon, 1995 and in a recent book on the village by Eric Garrett (1989)).

James Buckman (1814 - 1884) was first to arrive, after resigning from a position as Professor of Botany and Geology at the Royal Agricultural College, Cirencester. He moved to Bradford Abbas in 1863 and was quick to acquaint himself with the local geology and archaeology, in particular by making collections of ammonites. He was one of the *founders* of the Dorset NFC. He died in 1884 and was buried in the churchyard of the parish church in the village. Plate 1 shows a recent photograph of his grave.

He was the author of a number of publications dealing with local geological problems (1875, 1877, 1881), but we owe the majority of descriptions to his son, Sydney Savory Buckman (1860 -1929), who produced an enormous volume of literature on the Jurassic of Dorset, including a zonal succession (Buckman, 1910). Of his writings on Middle Jurassic ammonites, two stand apart for the purpose of this work: his *Monograph of the Inferior Oolite Ammonites* (1887 - 1907) and *Type Ammonites* (1909 - 1930).

S.S.Buckman's descriptions of ammonites ' in the *Monograph* were, however, seldom accompanied by precise stratigraphical details, the location of specimens being frequently identified as simply 'Bradford Abbas'. More precise sections were published later, in the famous paper on

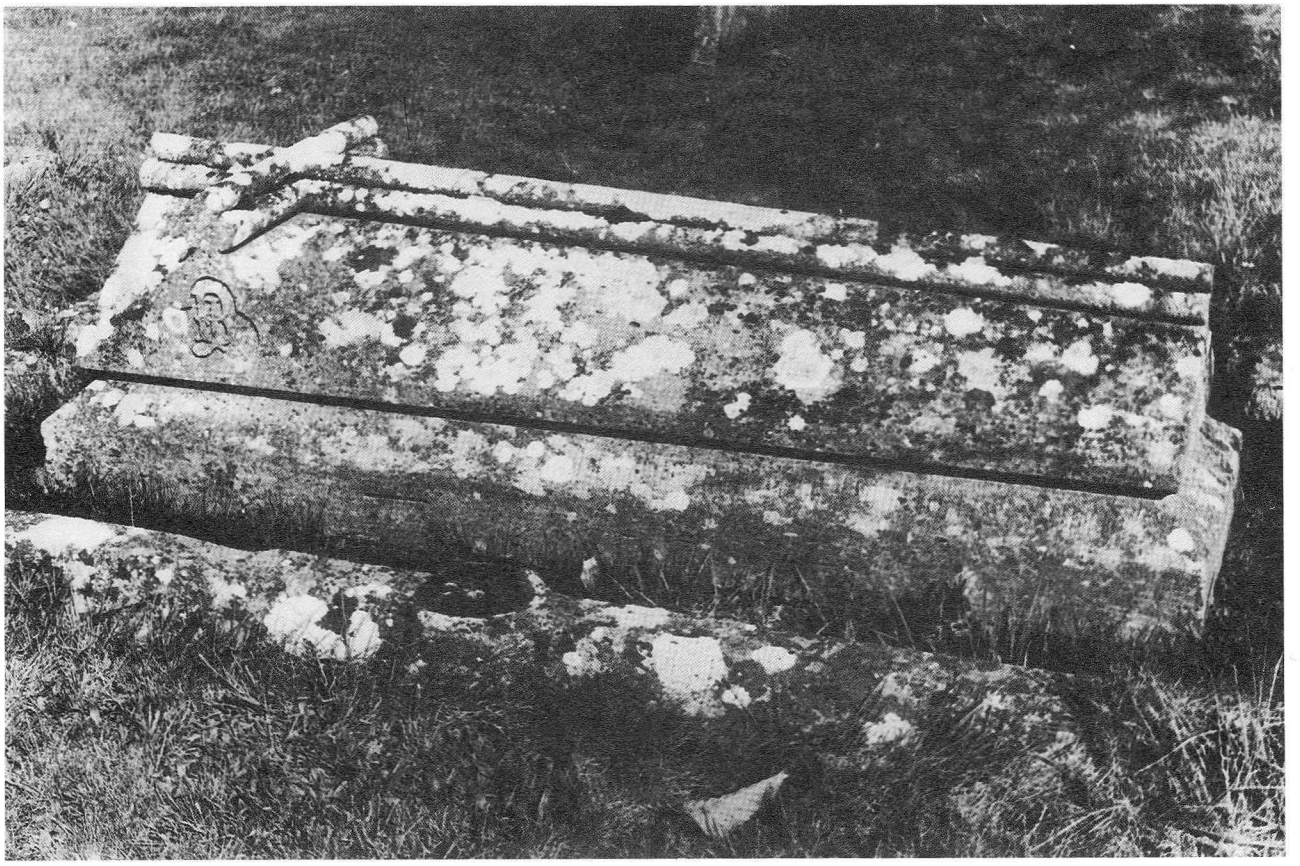

Plate 1 The grave of Professor James Buckman in the grounds of the parish church at Bradford Abbas. The photograph shows the condition of the grave in summer 1993. The letters J.B. at the top left of the stone are the only remaining evidence of its occupant.

the stratigraphy of The Inferior Oolite of Sherborne (Buckman 1893), but this did not then identify the precise type horizons of the many new species published in the *Monograph*. He mentions three main localities in his monograph, but in the text he does not distinguish between them as he regarded their successions as being practically identical: 'The strata which they exhibit are as similar in appearance as it is possible to be; and the fauna which they yield is ... exactly the same' (Buckman 1889, p.96-97). These localities are:

(1) The railway cutting near the village.
(2) East Hill quarry, Bradford Abbas.
(3) The quarry at Babylon Hill (otherwise known as Anbury, Hanbury or Henbury Quarry)

Many of the descriptions are of specimens collected by his father. The majority of these came almost certainly from East Hill quarry, worked by him for fossils and adjacent to the family house at Coombe, then called Bradford Villa. The most recent description is that of Richardson (1932, p.58. section 13) , which is essentially unchanged from Buckman (1893) although at the time less than two metres of top stone were still exposed. The nearby railway cutting (ST 594145) has been studied by Parsons (1980, p.8, column, AB 10; manu- script; 1974 pp.169-71) and his description stands, until now, as the only modern record of the ironshot Aalenian - Lower Bajocian part of the succession, termed the Bradford Abbas Fossil Bed by Buckman (1893, p.485). Figure 1 shows the section prepared during this work compared with that of Buckman (1893).

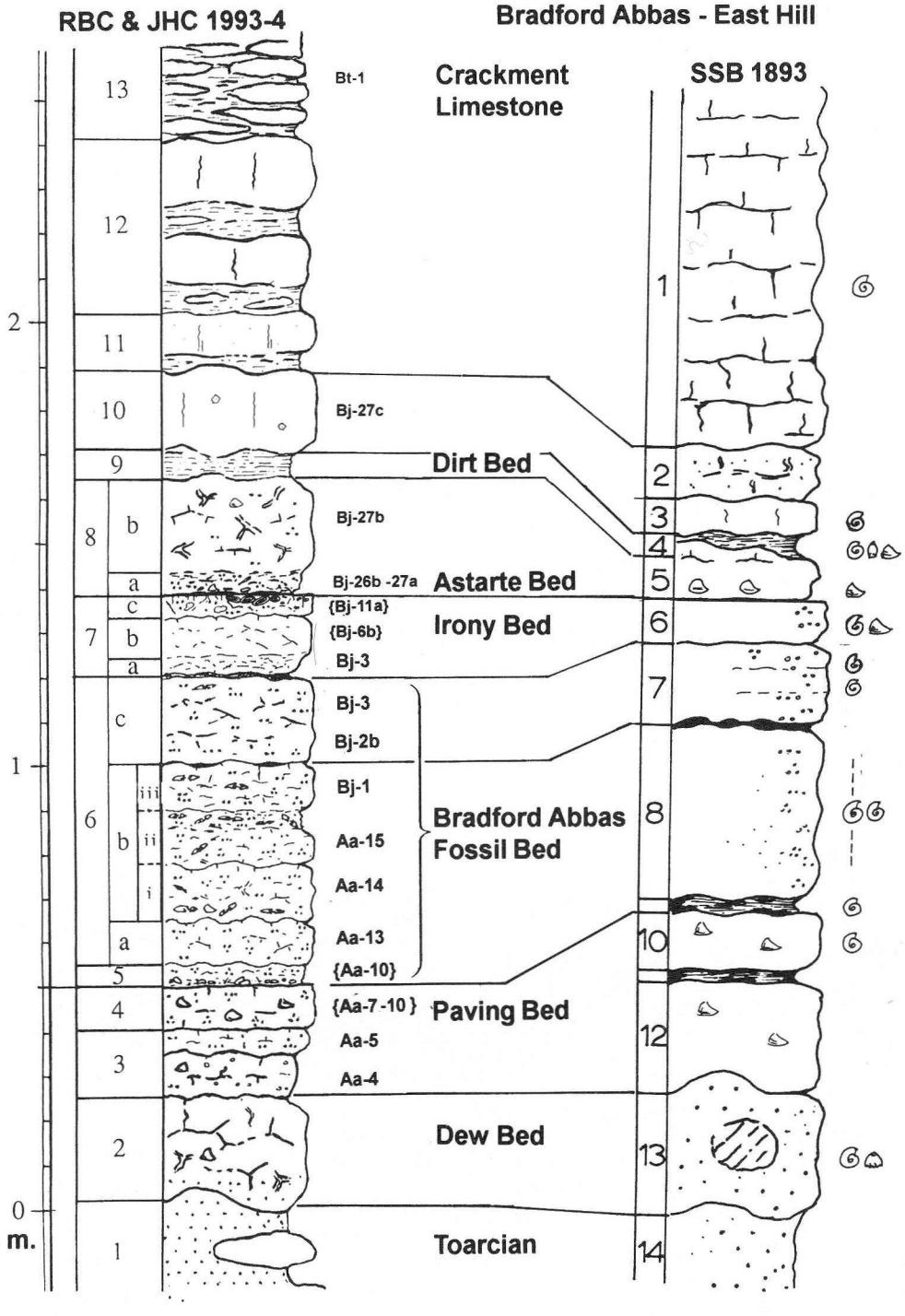

Figure 1. Schematic representations of the section at East Hill quarry described here. Also comparison with S. S. Buckman's section (redrawn) from his Sherborne paper of 1893.

The purpose of this paper is to redescribe the East Hill section on the basis of re-excavations of the old quarry in the summer of 1993 and 1994. This description of East Hill Quarry and its newly collected fossils may then be compared with Buckman's material, making it possible in many cases to identify the levels from which his specimens came. The hundreds of unlocalised specimens stored in the museums, previously only useful as variants of arbitrary morphospecies, may then be assigned to stratagraphical faunal horizons and hence conversely, assessed for their value as guide- fossils. Many of Buckman's figures depict the unusual. Without re-collecting, it would be impossible to gain a true impression of relative abundances or ranges of variability, which within a single horizon often exceed the differences between beds. Only with representative samples of carefully-collected material can we then hope to unravel the evolutionary history of the ammonites preserved in these rocks.

S.S. Buckman observed that, for biochronological purposes, the standard zonal subdivisions of the day (Oppel 1856) were relatively crude in comparison with what he was able to distinguish in Dorset (Buckman, 1910). He was particularly interested in the biochronology of the ammonites, in his quest for a 'natural', evolutionary classification. He focused attention, therefore, on the shortest time-interval, or geological 'moment', that could be distinguished biostratigraphically. For this he introduced the term 'hemera'. The rock equivalents of hemerae have been revised in recent years under the general description 'faunal horizons'.

When looking at the beds in a section, it may be possible to identify more than one assemblage of fossils from levels within a bed. Similarly, the faunal composition of a number of beds may be the same, as far as one can tell. Such assemblages constitute what is probably the closest we can expect to contemporary populations. They represent geologically brief instants, snapshots from a history most of which is missing through erosion and non deposition. The modern term for this is a "faunal horizon", defined as follows:- *A faunal horizon is a bed or series of beds, characterised by a fossil assemblage, within which no further stratigraphical differentiation of the fauna or flora can be distinguished* (Callomon 1995). This approximates closely to the rock equivalent of Buckman's hemerae stripped of any explicit reference to time.

Attempts to refine the biostratigraphy of the Aalenian and Bajocian rocks of Dorset and Somerset continue (Parsons in Cope 1980; Callomon & Chandler 1990; Morton & Chandler 1994). Figures 2, 3 & 4 show the most recent table of faunal horizons for the Aalenian and Lower Bajocian compiled by Callomon (1995) and updated from Callomon & Chandler (1990). One of the less well known parts of the succession lay around the Aalenian - Bajocian boundary. Beds of this age are rarely preserved in Dorset and one of the residual problems had lain in the source of some of the species described by Buckman, especially of the genus *Hyperlioceras,* not subsequently rediscovered elsewhere. They would have had to have come from East Hill, suggesting the presence here of a more expanded succession in the lowest Bajocian than found elsewhere. To check this, the only way forward was to reopen this quarry.

This has now been done and the succession at East Hill quarry has been carefully collected bed by bed and horizon by horizon. It was decided to commence the work to coincide with the centenary of S.S.Buckman's classic Sherborne paper of 1893 and continue it in the year of the Parish Council's centenary in 1994. The site is situated just south-east of the crossroads at Coombe (ST 591150) and lies beneath an arable field. The land is the property of Winchester College, and farmed by Mr. & Mrs. R. Loxton of Wyke Farm. Evidence of the original quarry face is hard to find now since the quarried area has served intermittently as a waste disposal site from Victorian times. The only indication of the original face was a

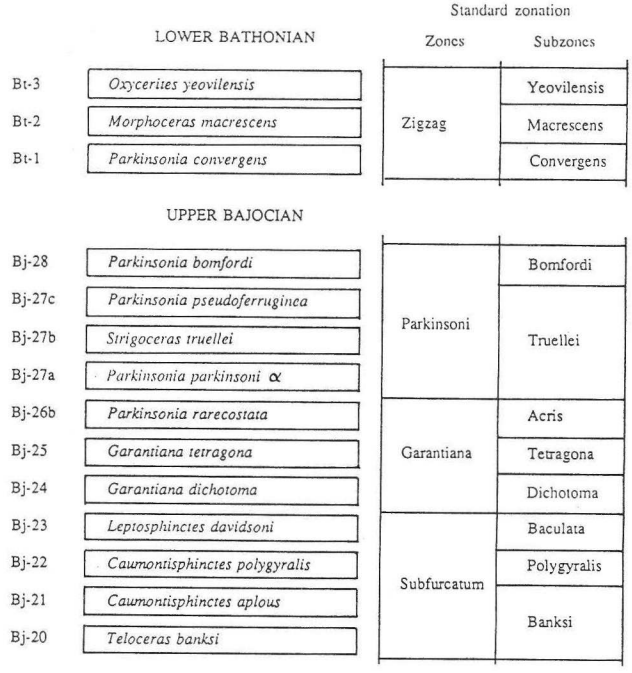

Figure 2. The ammonite faunal horizons of the Upper Inferior Oolite of Dorset and Somerset.

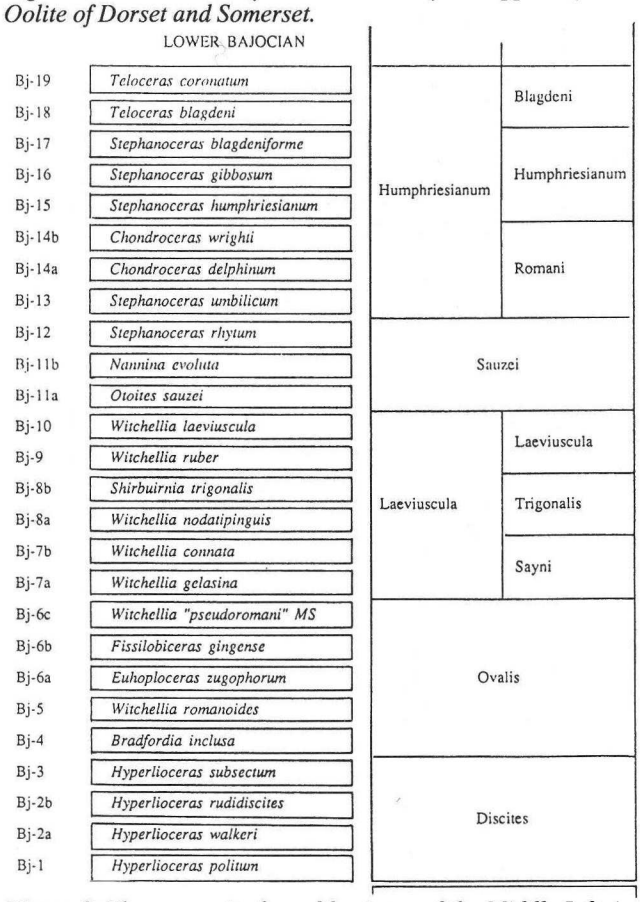

Figure 3. The ammonite faunal horizons of the Middle Inferior Oolite of Dorset and Somerset.

slight semi-circular rise running parallel to the rubbish site but some 20m. into the field. Trial digs in 1993 revealed that the face had been banked up with top-soil in an attempt to level it. Any new excavation had to be temporary, so that as much information as possible had to be gathered in the limited time available, of about five days on each occasion. Specialists in the Middle Jurassic rocks of other areas invited to attend the second session in 1994 included, J.H. Callomon (U.K), G. Dietl (Germany), and J. Sandoval (Spain).

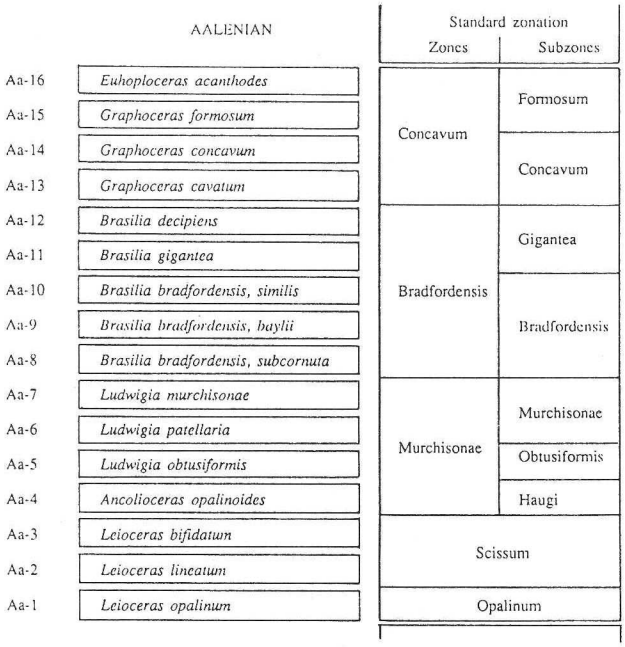

Figure 4. The ammonite faunal horizons of the Lower Inferior Oolite of Dorset and Somerset.

A more complete description of the section and its fauna will appear elsewhere once the material has been fully evaluated. The list given here is merely intended to provide a broad picture of what was found. The stratigraphic position of only important and characteristic ammonite species will be given.

The description of the section here will be in terms both of beds and of ammonite faunal horizons. Faunal horizons are labelled Aa for Aalenian and Bj for Bajocian, following Callomon & Chandler (1990). Bed numbers follow those of Parsons (1980), with additions. For comparison, S.S. Buckman's section is also given. References to the monograph are *Mon.*_= Monograph (1907-1894) and *Suppl.*_= Supplement (1898-1907). Dimorphs are recorded as [M] & [m] for macroconch and microconch respectively. (VC) very common, (C) common, (R) rare, (VR) very rare. The specific names are used in a morphospecific sense; they are Buckman's species unless otherwise indicated, listed as far as possible in the order of from finest to strongest ornament. Additional notes are added as appropriate. Material collected will be donated to the Sedgwick Museum, Cambridge. Specimen numbers refer to the author's collection. Species that have proved to be useful guide- fossils and therefore characteristic of their faunal horizons are marked by an asterisk.

2. The Section:

This provisional account is based on excavations in 1993 & 94 (RBC & DTCS) with refinements and additions by J.H. Callomon 1994, who has kindly prepared drawings and figures for us (figs.1-4 given here with additions by the authors). Comparison is made with Buckman's section of 1893, with his bed numbers and other indications in square brackets. { } = provisional numbering where collecting has not been adequate and we cannot be certain of the faunal horizon in which an assemblage should be placed.

From below:

Upper Toarcian

Bed 1 [14]: Yeovil Sands. Yellow to brown, fine-grained sand, locally indurated into hard sandstone, forming the base of the section. ...seen to 0.4m.

Bed 2 [13]:" The Dew Bed" [SSB]. Sandy limestones, grey, nodular or concretionary; shelly, including large bivalves. An indistinct gradational boundary with the sands. No ammonites seen. ...0.25m.

From this bed Buckman recorded *Dumortieria moorei*, which would put the bed firmly into the Yeovil Sands. But the lithology and presence of large, thick shelled bivalves suggest the Scissium Bed of the Lower Aalenian.

..... undulating parting .....

Aalenian

Bed 3 [12]: Murchisonae Zone. Limestone, shelly and oolitic, divisible into two parts.

Bed 3a: (Aa-4) Limestone with light brown ooliths and bivalve shells embedded in a soft marly orange carbonate. ....0.10m.

Ludwigia sp?, *Ancolioceras* sp.

..... undulating parting .....

Bed 3b: (Aa-5) Limestone shelly and oolitic, the ooids dark brown, and dense. ....0.05m.

Ludwigia obtusiformis [M](R)

..... erosion plane.....

Bed 4 [10]: "The Paving Bed" Murchisonae or Bradfordensis Zones {Aa-7-10}. Limestone, cloudy, ironshot and very hard. Many thick decalcified bivalves. No ammonites seen. ...0.10m.

This may be the equivalent of bed 4 in the Bradford Abbas railway - cutting (Callomon & Chandler 1990, fig.3), which has yielded *Brasilia* of horizons Aa-9 or 10. Buckman, however, recorded *Ludwigia murchisonae*. He also records the following : *Abbasites abbas, Parammatoceras dolium* and *P. rugatum* of which the first was assigned to the *bradfordensis* hemera, the others to a Ludwigian *planiforme* hemera. Chandler records a typical *L. murchisonae* from the lower part of this bed at the railway-cutting, thus the bed may be divisible into two faunas, a lower Aa-7 and an upper Aa-9 or 10.

....planed off erosion surface....

Bed 5 & 6 [7 - 9]:"Bradford Abbas Fossil Bed". Bradfordiensis to Discites Zones.

Bed 5 [9]: Bradfordensis Zone{Aa-10}. Marl, conglomeratic, strongly ironshot, oolitic, many pebbles and much iron crust. *Brasilia* [M] & [m] but fragmentary. ...c0.05m.

Buckman's bed [9] was said to be a soft, yellow marl 3cm thick and lay beneath his bed [8], i.e. below bed 6 of this work and hence at the level of bed 5. It was said to have yielded '*Lioceras bradfordense* and *L. v-scriptum*', indicating the Bradfordensis Zone. Current research indicates a first appearance of *Graphoceras v-scriptum* in the lower Concavum Zone (Aa-13) where *Brasilia* is still present, but we have found no ammonites that indicate a Concavum Zone age for bed 5 at East Hill. There is a similar bed at a similar horizon in the railway cutting. Whether these beds are the equivalents of bed 5 of this work is not clear. The *bradfordensis* hemera was said to be absent at Stoford quarry, 2km. to the South West of East Hill quarry.

Bed 6 [7&8]: Concavum and Discites Zones. Yellow to grey, variably ferruginous bioturbated oolitic limestones packed with fossils and divisible into three parts on the basis of lithology and palaeontology.

The Bradford Abbas 'fossil bed' was divided by Buckman into two; a lower soft brown 'iron shot' included in his *concavum* hemera and an upper black stained ironshot assigned to the *discites* hemera. Parsons (1974) states "In the Bradford Abbas railway cutting, the 'fossil-bed' was found to be divided by two marly partings, into three approximately equal components. The upper, main parting, which separates the black stained limestone from the rest, is consistent in thickness over the length of the cutting, whilst the second, lower parting, is less persistent, but it is still traceable over most of the exposure."

Bed 6a [8]: Concavum Zone, Concavum Subzone (Aa-13). Hard conglomeratic brown to purple ironshot oolitic limestone, which divides into two.

Bed 6ai: Conglomeratic ironstone with a proportion of quartz sand. The base is full of pebbles, *Graphoceras* sp., *Brasilia decipiens* . ...0.05m.

.....slightly marly undulating parting .....

Bed 6aii: At +0.05m. a marly slightly undulating parting with purple hard limestone above, fossils scarce. Bioturbated by faint burrows infilled with indurated marl. *Graphoceras concavum* (J.Sowerby) and sp.aff. ...0.10m.

.....undulating parting.....

Bed 6b [8]: Concavum & Discites Zones.

Bed 6bi: Concavum Zone, Concavum Subzone (Aa-14). Yellow limestone, ironshot oolitic and shelly in the lower part, *G. concavum* common. ...0.12m.

Graphoceras formosum [M](FR), *G.concavum* [M](VC)[*], *G.[Platygraphoceras] apertum* [M] (FC), *G.magnum* [M](FC)[*], *G. v-scriptum* [M](FC), *G. marginata* [M](R), *G. [Ludwigella] attenuata* [m](C), *G. [L.] cornu* [m](C)[*], *G. [L.] rudis* [m](FC), *Parammatoceras* cf. *obtectum* [M](R), *Eudmetoceras eudmetum* [M](FR), *Parammatoceras rugatum* [M](FR), *Hammatoceras diadematoides* [m](FC)[*], *Megalytoceras* [M](C).

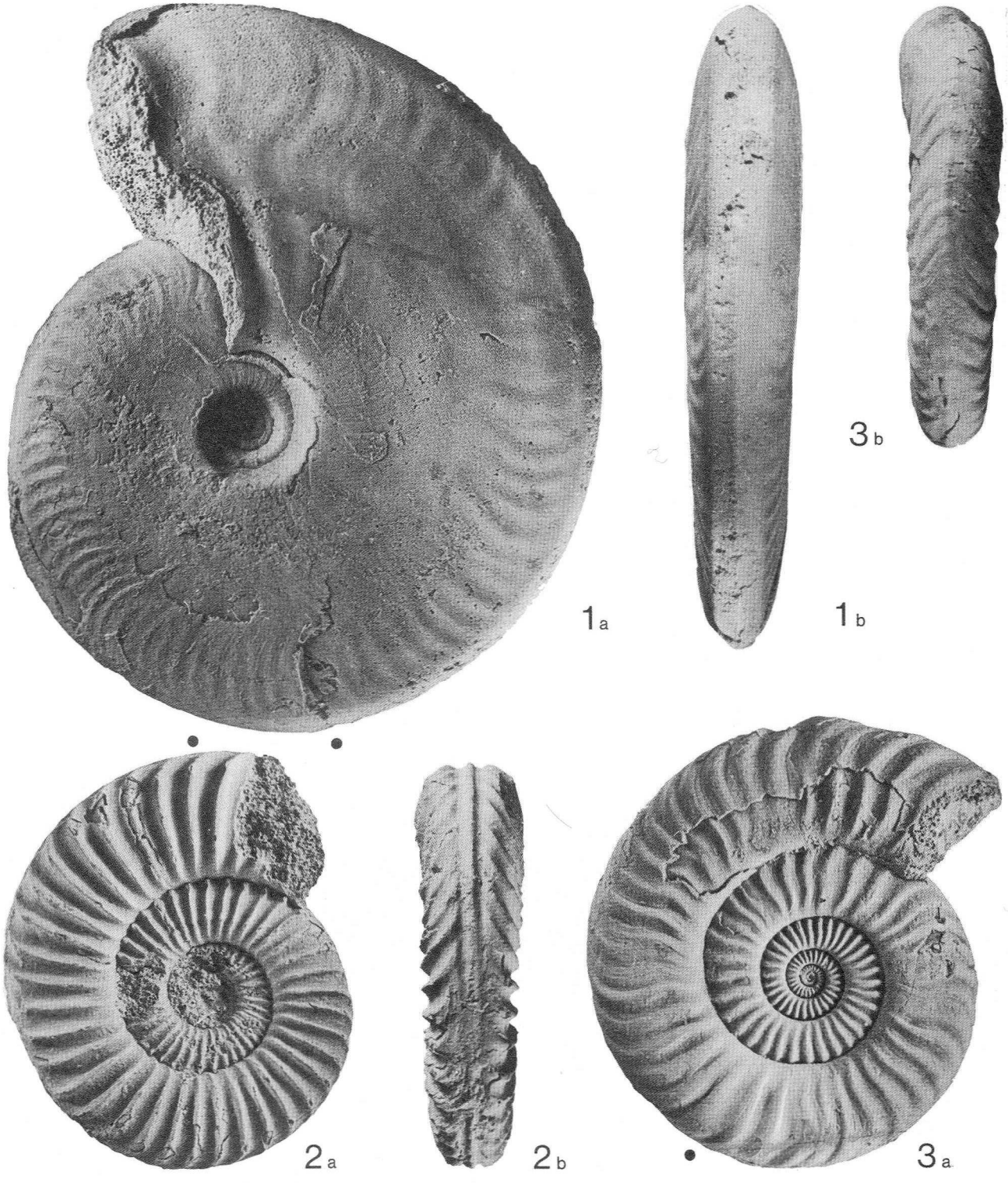

Plate 2 All figures natural size. The black dot indicates the end of the phragmocone. Figs.1a-b. Graphoceras concavum (J.Sowerby). Concavum Zone and Subzone. A typical macroconch from bed 6a of the Bradford Abbas railway cutting, (R.B.C. 84). Figs.2a-b. Haplopleuroceras subspinatum. Discites Zone. One of the species commonly found only in the vicinity of Bradford Abbas. The figured example is a large macroconch, which is almost fully septate. East Hill quarry, Bradford Abbas, bed 6biii, (R.B.C.868). Figs.3a-b. Fontannesia explanata. Discites Zone. A species common around the Aalenian-Bajocian boundary in the region of Bradford Abbas. A complete macroconch with mouth border (note pathogenic twisting of the body chamber). East Hill quarry, Bradford Abbas, bed 6biii, (R.B.C.786).

..... mud seam, undulating parting .....

... ? lower parting recorded at the railway cutting by Parsons ...

The correlation between East Hill and the railway cutting lower parting is made here on the basis of the ammonite fauna. The top of bed 6a at the cutting is highly fossiliferous and contains abundant *Graphoceras concavum* (see Pl. 2, figs. 1a-b). The fauna of bed 6bi at East Hill appears similar to it in every way.

Bed 6bii: Concavum Zone, Formosum Subzone. (Aa-15) Hard splintery stone, becoming more fossiliferous, marly and ferruginous near the top with broken belemnites, worm tubes and pockets of yellow marl. Fossils abundant, particularly ammonites. Shelly in the lower part. Here we see the first relatively abundant *Euhoploceras* . They are contemporary with but are already distinct from hammatoceratids. ....0.10m.

Graphoceras decorum [M](C), *G. limitatum* [M](FC), *G. scriptitatum* [M](FR), *Hyperlioceras mundum* [M](R), *G. concavum* [M](FC), *G. formosum* [M](VC)[*], *G. stigmosum* [M](C)[*], *G. [Ludwigella] debile* [m](C), *G. [L.] attenuata* [m](C), *Euhoploceras modesta* [M](FR), *E. dominans* [M](FR), *E. marginata* [M](R), *E. crassispinata* [M](FC), *E. acanthodes* [M](C)[*], *Eudmetoceras amplectens* [M](FC)[*], *E. eudmetum* [M](FC)[*], *Euaptetoceras euaptetum* [M](FR), *E. infernense* [M](FC), *Stephanoceras [Docidoceras] perfectum* [M](VR)[*], *S. [Abbasitoides]* aff. *modestum* [m](R), *Trilobiticeras* sp. [m](R), *Haplopleuroceras subspinatum* [M](R), *Fontannesia explanata* [M](VR), *F. concentrica* [m](R), *F. boweri* [m](R), *F. aurita* [m](R), *Bradfordia costata* [M](R).

... undulating parting with a thick laminated irony crust.

.. ....0.03m

(?= upper parting in the railway cutting recorded by Parsons.)

Callomon & Chandler (1990, p96) suggested a non sequence between beds 6b and c at the railway cutting. The absence in parts of the quarry of bed 6biii due to erosion confirms this.

Lower Bajocian

Bed 6biii: Discites Zone (Bj-1). Crisp yellow to mid brown finely oolitic limestone packed with fossils which are preserved in calcite and have a matt brown coating. *Graphoceras* and *Hyperlioceras* exist in roughly equal numbers. Cut out by erosion in some parts of the quarry face. ...0.10m.

G. decorum [M](C)[*], *H. incisum* [?M](R)[*], *H. discitiforme* [M](FC), *H. mundum* [M](FC)[*], *G. limitatum* [M](VC)[*], *H. politum* [M](VC)[*], *H. walkeri* [M](R), *H. rudidiscites* [M](R), *G. stigmosum* [M](C)[*], *H. [Reynesella] lineata* [m](FC), *H. [R.] juncta* [m](VC), *H. [R.] rodburgensis* [m](C), *H. [Lopodoceras] furcatum* [m](C), *H. [Braunsina] aspera* [m](C), *H. [B.] elegantula* [m](C), *H. [Braunsella] rotabilis* [m](C), *Euhoploceras dominans* [M](C)[*], *E. marginata* [M](C), *E. obtusiformis* [M](C), *E. acanthodes* [M](VC)[*], *E. crassispinata* [M](C), *E. irregularis* [M](R), *Eudmetoceras amplectens* [M](R), *E. eudmetum* [M](R), *Euaptetoceras infernense* [M](FC)[*], *E. euaptetum* [M](R)[*], *Docidoceras perfectum* [M](FC as fragments), *S. [D.] planulatum* [M](R), *S.[A.]* aff. *modestum* [m](VR), *Haplopleuroceras subspinatum* [M](C)[*], *H. mundum* [M](C)[*], *Fontannesia grammoceroides* [M](FC)[*], *F. explanata* [M](FC)[*], *F. laculenta* [M](FC), *F. obruta* [M](FC), *F.curvata* [m](C), *F. despecta* [m](C), *F. tortiva* [m](C), *Bradifordia costata* [M](R), *B. liomphala* [M](R),

..... undulating parting .....

Bed 6c [7]: Discites Zone (Bj-2b & 3). Ironshot, burrowed, very hard blue-grey bioturbated stone. In places the bed thickens and a lower yellow part is developed. In both parts the graphoceratids are now exclusively *Hyperlioceras. Euhoploceras* is now equally abundant.

Bed 6ci: Discites Zone (Bj - 2b). Yellow finely oolitic shelly limestone very similar to the bed below and full of ammonites preserved with a brown coating. This bed appears to be absent at the railway cutting. ...0.10m.

Hyperlioceras rudidiscites [M](C)[*], *H. liodiscites* [M](C), *H. [Deltotoceras] cuneatum* [M](VR), *H. [Toxolioceras] tenerum* [M](FR), *H. [Dissoroceras] excavatum* [M](FC)[*], *H. [Deltoidoceras] subdiscoideum* [M](R)[*], *H. [D.] inodeum* [M](C)[*], *H. lucyi* [M](R), *H. [Lopadoceras] euides* [m](C), *H. [Reynesella] inops* [m](FC), *H. [Darellina] docalis* [m](FC), *Euhoploceras substriatum* [M](FR), *E. modesta* [M](FC), *E. marginata* [M](FC)[*], *E. costata* [M](C), *E. obtusiformis* [M](FC), *E. biplicata* [M](FR), *E. locuples* [M](R), *Euaptetoceras infernense* [M](VR), *S. [D.] perfectum* [M](R), *S. [D.]* aff. *cylindroides* [M](R), *S. [Trilobiticeras] platygaster* [m](FC), *Haplopleuroceras mundum* [M & m](R), *Fontannesia obruta* [M](R), *Bradfordia liomphala* [M](R),

Bed 6cii: Discites Zone (Bj-3). Very hard blue- grey stone, heavily burrowed and full of rotted marly pockets, ironstaining and clouds of large red ooliths. Fossils more scarce than below. Terminated by a marked erosion surface containing ammonites from which the matrix has rotted away. ...0.10m.

H. deflexum [M](FC)[*], *H. liodiscites* [M](C), *H. [Deltotoceras] subsectum* [M](FC)[*], *H. cuneatum* [M](VR)[*], *H. [Deltoidoceras] astrictum* [M](C), *H. [Oedania] falcigera* [m](C), *H. [Hugia] micca* [m](VC)[*], *H. [Hugia] curva* [m](C)[*], *Euhoploceras parvicostata* [M](FC), *E. nuda* [M](R), *E. simplex* [M](FR), *E. inaequa* [M](R), *E. palmata* [M](FC)[*], *E. costatum* [M](FC)[*], *E. duplicata* [M](FC), *E. locuples* [M](R), *E. regularis* [M](R)[*], *E. spinea* [M](R), *? Euaptetoceras* sp.[M](VR), *S.[D.] cylindroides* [M](R)[*], *S. [T.] platygaster* [m](FC) [*],

Buckman's beds [7] & [8] were the source of most of the Graphoceratidae described by him in his Monograph. That they were divisible both litho- and boistratigraphically was realized only during the course of publication of the Monograph, in which the Concavum and Discites Zones (and hemerae) were first separated. Besides material in the Monograph, the following were published in Type Ammonites: *Graphoceras scriptitatum* (IV, 388), *Euaptetoceras euaptetum* (IV,299), *Eudmetoceras eudmetum* (III, 179,-a), *E. amplectens* (III,189A,B), *E. prosphues* (IV,397).

..... Very marked erosion surface with clay parting .....

Bed 7 [6]: Discites, Ovalis and Sauzei Zones. "The Irony Bed" [S.S.B] Divisible into three parts.

Bed 7a: Discites Zone (Bj-3). Ferruginous marl, decalcified with small snuff boxes, with much iron crust. ...0.03-0.05m.

Ammonites are very rare, some are definitely *Hyperlioceras* but in very poor condition. This evidence supports research at nearby Baggerbush Lane where similar finds have been made and confirms the variable age of "the Irony Bed" in this area, in particular that the lowest part is still Discites Zone

Hyperlioceras sp. [M](R), *Euhoploceras* sp. [M](R).

Bed 7b: ?Ovalis Zone {Bj-6b}. Ochrous red marl and limestone, hard, with pockets of coarse blue limestone with large red ooliths. Small snuff boxes are common, fossils rare. Much broken fossil debris.

Plagistoma sp., *Ctenostrum* sp., *Witchellia* sp., *Emileia* sp.(nucleus).

Bed 7c: ? Sauzei Zone {Bj-11a}. At plus 0.13m. Limestone, biosparitic, hard, heavily-burrowed, ironshot oolite, the ooliths large and reddish brown; shelly, with many broken shells as well as contemporary archaeogastropods; locally laminated red limonite with numerous oncolities with accumulations of typical ferruginous snuff boxes near the top up to 15cm in diameter, and scattered pebbles of limonite-encrusted limestone with fossils rather more common than below. A layer of *Ctenostrum* sp. near the base. ...together c.0.20m.

Sonninia ? [Papilliceras] sp. [M] (R), *Emileia* sp., nucleus, *Bathrotomaria* sp.

In parts of the quarry the entire bed is indivisible. From these areas the following have been obtained:

Euhoploceras cf. *rude* (Quenstedt), *E.* cf. *frankonicum* (Dorn), *Sonninia* aff. *mesacantha* (Waagen), - closer to the figure of a syntype in Dorn than to the specimen figured by Buckman and still more like *Euhoploceras* than *Sonninia* s.s., hence probably older., *Witchellia* sp., cf. *patefactor* Dietl (1980) non Buckman, {Bj-6}.

..... 'Vesulian unconformity': prominent erosion plane, flat .....

Upper Bajocian

Bed 8 [5]: Parkinsoni Zone (Bj-26b-27b). Pale brown slightly sandy to buff limestone, heavily burrowed, some crinoidal debris and disarticulated bivalves, also occasional belemnites. Divisible into two parts. ....together 0.28m.

Bed 8a: Astarte Bed (Bj-26b / 27a). Typical, the basal part decalcified , ferruginous, with much shell debris and intact shells.

Garantiana sp., cf. *garantiana*?, *"Phanerosphinctes"* (early *Procerites* ?) *costulatosus* (1924, T.A. iv,386) - topotype, *Lissoceras* sp. indet., nucleus. *Astarte* sp., detached valves common.

Bed 8b: (Bj-27b). Lightly oolitic, the ooliths light brown to buff.

Parkinsonia parkinsoni (J.Sowerby) [m](R), *P.* cf. *dorsetensis* (Wright) [M](R), *Gonoxyites goniophorus* (topotype)[M}(R), *Bigotites* cf. *petri* Nicolesco [M](R), *Neocrassina modiolaris*, large, typical; and belemnites.

Bed 9 [4]: "The Marl" or "Dirt Bed". Parkinsoni Zone. Grey crumbly slightly sandy uncemented, marly interbed, soft, light grey, locally indurated, boundaries gradational; probably only a somewhat decalcified upper part of the bed below. ...0.08m.

..... erosion surface .....

Bed 10 [2?/3]: Burton Limestone, Parkinsoni Zone (Bj-27c)

Massive yellow-buff, fine grained, homogeneous, limestone with occasional echinoderm ossicles.

Parkinsonia pseudoferruginea Nicolesco [M](R). ...0.28m.

It is worthy of note that this locality is only 2km SW of Halfway House where the apparent equivalent of this bed is slightly older, much more massive with common and well preserved ammonites..

..... marly at base, flat parting indistinct in places .....

Bed 11 [1 partim or 2]: Limestones, thin-bedded, fracturing in blocks, hard, pale yellowish and somewhat sandy. ...0.10m.

..... irregular generally flat parting .....

Bed 12 [1 partim]: Biodetrital, fine grained, homogeneous, white limestone, in several fairly massive courses separated by softer marly interbeds. Fossils fairly common, often decalcified and fragmentary. ...0.40m.

Parkinsonia sp. [M](R), *Oxycerites aspidoides* (Oppel) [M](R).

Lower Bathonian

Bed 13 [1 partim]: Zigzag Zone, Convergens Subzone, Crackment Limestone(Bt-1) . Limestones, thin-bedded, many marly partings. Fossils scarce. Ammonites occur near the top of the bed this only being preserved in parts of the quarry....c. 1.20m.

Parkinsonia convergens [M](R), *?Procerites* sp (nucleus), *Oppellia* sp. [M](R).

Buckman (1893) commented on the age of the so-called 'top beds' at East Hill, here beds 11-13, his bed [1]. "In the lower part *zigzag* hemera, while in the upper part *fuscae* hemera". In his section 3 (1883), Bradford Abbas; quarry near the vicarage, he records 10 ft of top stone, possibly all belonging to the *fuscae* hemera. He considered that the top beds at East Hill, excepting the uppermost part, lie below those exposed near the vicarage. The ammonites recorded here suggest that only bed 13 is Lower Bathonian.

..... top of section and base of topsoil .....

3. Discussion:

In his paper of 1893 (p.484), Buckman remarks 'the "incompleteness of the record" and the attenuation of the deposits are especially noticeable'. He is referring to the Sherborne area, but his words apply equally well to the Inferior Oolite in any part of England. The following remarks attempt to place the East Hill sequence into the context of what is currently known elsewhere in Dorset and Somerset. As many horizons are clearly missing here, any discussion must take account of the incompleteness of the record.

The process of identifying and evaluating the fossils collected at Bradford Abbas is continuing. By a process of trial and error we evaluate what is and is not useful for correlation. We know that the majority of the specimens figured by Buckman from the Concavum - Discites Zones are from Bradford Abbas. We begin by identifying the horizons of Buckman's nominal species at their type locality. It is now possible to pinpoint the probable horizons and strata at Bradford Abbas for all of Buckman's graphoceratids, his sonninids of the genus *Euhoploceras,* and other, less common, and stratigraphically more restricted groups.

An important discovery is the presence of a faunal assemblage in bed 6biii which is apparently restricted to this area although it may in future be found further afield. It is likely that its presence here is all that remains of it after penecontemporaneous erosion. Bed 6biii has been provisionally included in horizon Bj-1, although no exact equivalent of it is known so far elsewhere in Britain and possibly in Europe. At East Hill it contains high abundances of short-ranging species, while the remainder of the fauna is typical of Bj-1 elsewhere. In his monograph, Buckman (1892, p.266), writing of *Dumortieria [Fontannesia] grammoceratoides* Haug, 1887, says that it "is like so many of the Concavum zone species- practically confined to a small area around Bradford Abbas". He repeated this later (Buckman 1905, p.188), in relation to *Fontannesia*: " hitherto nearly all specimens have come from a small area ..... of Bradford Abbas". Of another ammonite that is equally restricted and occurs abundantly at the same level, Buckman writes (1892, p.301): "*Haplopleuroceras subspinatum* is not a rare fossil, but it seems to be very local. It is practically confined to a small area - a two mile radius from Bradford Abbas". Subsequently, both *Fontannesia* and *Haplopleuroceras* have been found further afield (eg. Horn Park, Bed 5dii-5e), but they are very rare and not associated with abundant *Graphoceras* and *Hyperlioceras* as they are at Bradford Abbas. Bed 6biii appears to contain a fauna slightly different from that included in Bj-1 elsewhere. Until we can establish whether this difference is merely a local variation, or a difference due to age, we retain it in Bj-1. As this horizon appears to be unique to this region it would explain why a number of the species found in Buckman's works have not been found again as abundant elements in collections until now.

The top of the Bradford Abbas Fossil Bed (6c) also contains a fauna poorly represented outside the region, but in this case its content is reasonably consistent with what is known elsewhere, both in Britain and the rest of Europe.

The vertical range of a nominal species depends on a number of variables, including its geographic location and the current state of knowledge. The lists of ammonites given above can be used to identify the first and last appearances of particular forms. They are the *local range biozones.*

4. Conclusion:

(a) The Bradford Abbas Fossil Bed spans faunal horizons Aa - 10 to Bj - 3, a range crossing the Aalenian - Bajocian boundary. Fossils from Bj-1 are well represented and can therefore be useful for identification of the stage boundary locally. *Hyperlioceras* does occur very rarely in strata older than Bj-1. Here we draw the base of the Bajocian immediately below the level at which the genus *Hyperlioceras* joins *Graphoceras* in becoming a significant component of the fauna including its macroconchs, and incorporating characteristic guide fossils from other taxa. This places the Aalenian-Bajocian boundary between faunal horizons Aa-16 and Bj-1, and has the advantage of making the boundary recognisable in the field.

(b) The biostratigraphical classification of the Aalenian and lowest Bajocian strata is conducted by means of the ammonites of the family Graphoceratidae which abound here. As these are largely restricted to Europe north of the Tethys, their use as guide fossils is limited to that region.

(c) Species known from elsewhere, other than graphoceratids, also occur here. Some have restricted ranges in England and typify particular levels. In some cases e.g. *Haplopleuroceras, Fontannesia* and *Bradfordia*, appearances are cryptogenic and locally short lived, so provide useful tools for correlation. As some of these are more abundant outside Britain, they will aid in the comparison of horizons from which graphoceratids may be absent.

(d) Stephanoceratids have been recorded elsewhere from strata as early as the Bradfordensis Zone but they remain in the minority well into the Bajocian. They are useful guide fossils, and are characteristic elements of the fauna. *Docidoceras perfectum* is present in the Bradfordensis to lower Discites Zones while *D. cylindroides* is not found below Bj-2b in Britain.

(e) "The Irony Bed" is present over a large part of this area. It contains fossils often preserved as oncoliths together with contemporaneous material. At East Hill the Bed is much thickened and divisible. The age of the base is certainly Discites Zone as at the nearby Baggerbush Lane quarry, and contains *Euhoploceras* and very late *Hyperlioceras*. At Louse Hill where the bed is only a few centimetres thick, ammonites occur which may be as late as early Parkinsoni Zone, thus the Irony Bed is of considerably variable age across the region. At East Hill the youngest ammonites recorded by Buckman and those collected here probably belong to faunal horizon Bj-11a of the Sauzei Zone.

(f)The Upper Bajocian and Lower Bathonian is very sparsely fossiliferous here and further work is needed to confirm the ages of some beds and their relationship to

adjacent localities. So far the latest ammonites are *Parkinsonia* sp. and *Procerites* sp. of the Lower Bathonian.

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