

Mesozoic Res.	2(4)	163-180	4 Plates 10 Text-figs, 1 Table	Leiden 1990
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## A temporary exposure of Lower Lias (Late Sinemurian) at Dimmer Camp, Castle Cary, Somerset, south-west England

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**Abstract:** The *Oxynoticeras oxynotum* Zone together with the overlying *Echioceras raricostatum* zone of the Lower Lias, previously thought to be absent or much attenuated in east Somerset is represented by over 20 metres of clays containing an abundant and well-preserved diagnostic ammonite fauna. Low faunal diversity in the *oxynotum* Zone is attributed to substrate control with ammonites providing benthic islands on which a limited epifaunal biota was established. Higher subzones in the *oxynotum* Zone and the *raricostatum* Zone yields a more diverse benthic fauna indicating a more oxygenated sea floor. An increase in faunal diversity upwards through the sequence is also attributed to gradual shallowing. This culminated in minor sediment reworking preceding renewed transgression and deepening in the latter part of the *raricostatum* Zone.

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Accepted: 21 November 1989

### INTRODUCTION

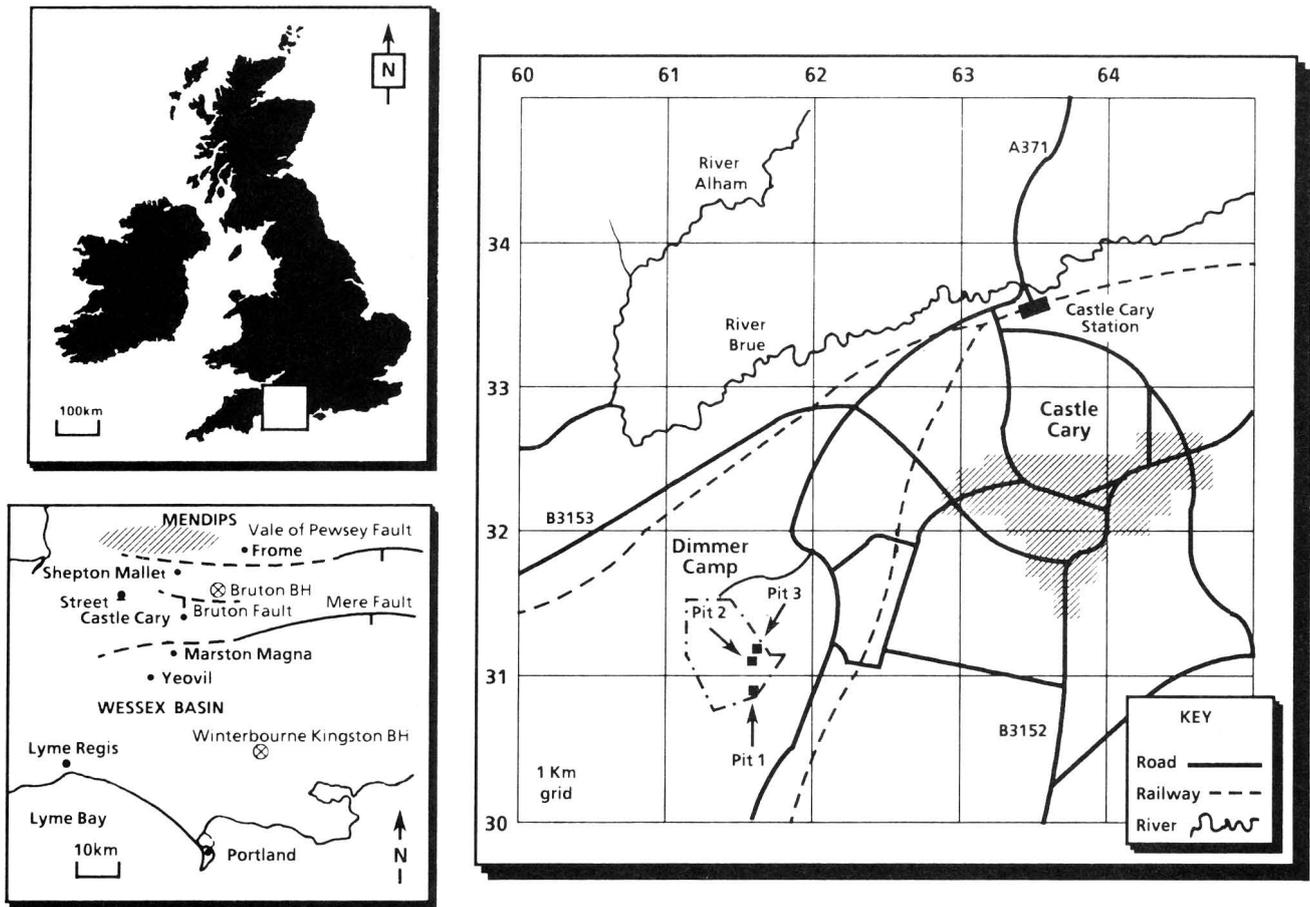
The higher zones of the Lower Lias in north Somerset are poorly exposed; only being found in river sections and temporary exposures (Donovan 1958, Kellaway & Wilson 1941). Intermittent outcrops of Liassic clays from the *Asteroceras obtusum* Zone to the *Productylioceras davoei* Zone are found in the bed and banks of the river Brue (ST 612 328-640 340). Since 1977; however, several pits have been excavated for waste disposal at Dimmer Camp (ST 615 314); formerly a military munitions depot, by Somerset County Council (Text-fig. 1). Large rectangular excavations (20 × 15 × 4 m deep) are made, filled with domestic refuse and capped with excavated spoil; known as the closed clay cell method. These pits reveal an almost continuous overlapping sequence of late Sinemurian clays from the *Asteroceras stellare* Subzone to the basal part of the *Echioceras raricostatoides* Subzone (see Text-figs 2, 3) which reaches a total thickness of 27 metres.

### STRATIGRAPHY

A composite section was produced from three pits which were excavated between April 1987 and August 1988 and are now being infilled. The exposure consists almost entirely of monotonous blue-grey blocky clays with six discontinuous calcareous mudstone horizons. In the lowest two pits (see Text-fig. 2), and the base of the third pit the clays were mostly unweathered, comprising the *obtusum* and *oxynotum* Zones. A localised patch of selenite rich, olive-green, friable clay was seen near the top of pit 3 containing ammonites diagnostic of the *raricostatum* Zone. The section has been divided into eleven main lithological units based on detailed field observation.

### QUANTITATIVE TECHNIQUES

To provide a quantitative faunal profile bulk samples were collected at key points in the succession and processed to 500µm (see Ward 1984). All identifiable macrofossils were counted and presented as numerical abun-



Text-fig. 1. Location of Dimmer Camp and other sites referred to in text.

dance bar charts. All of the results, for each bulk sample collected from individual beds, were pooled on a cumulative basis to eliminate small scale, ecologically insignificant lateral and vertical heterogeneities which would otherwise have produced a biased faunal profile. Although faunal abundances are represented by numbers of individuals, this is by no means a representation of their original biological equivalence and are used here for the purposes of comparison. All of the major faunal elements described from individual horizons are illustrated in Plates 1-4 and have been deposited in the collections of the British Museum (Natural History) whose registration numbers are quoted.

#### FAUNAL PRESERVATION

A large proportion of the biota collected are preserved as internal or external pyrite casts. Ammonites form the most abundant elements at outcrop and are usually preserved uncrushed. Larger specimens commonly have crushed body chambers. Few individuals are overgrown with late-stage diagenetic pyrite in contrast to pyritized ammonites described from the Oxford Clay by Hudson and Palframan (1969) and Hudson (1982). No ammonites and bivalves with original aragonitic shells were found, although near the base of the *oxynotum* Zone, localised ammonite plasters were preserved as thin organic films, probably representing periostracal remains. Pyrite is a common replacement mineral of aragonite shells in the mudstone horizons except for the bivalves *Plagiostoma* and *Gryphaea*, which are preserved as calcite casts.

#### EXPOSURE DETAILS

Pit 1 (ST 615 308) is topographically below pits 2 and 3 and exposes the highest beds of the *obtusum* Zone. This pit was in the last stages of refuse infill and no detailed measurements could be made. In one face an outcrop of 3m of dark blue-grey blocky clay contained large septaria, up to 1m diameter, yielding large and crushed specimens of *Asteroceras stellare*. Few other macrofossils were found in the clays, apart from the occasional belemnite and pyritised *Asteroceras* (Plate 1, fig. 13).

Pit 2 (ST 615 311) forms the base of the measured section and contains large pyritised specimens of the zonal ammonite *Oxynoticeras oxynotum*. Quantitative faunal abundances are presented in Text-fig. 4 from Bed 3. Most of the sequence in Pit 2 consists of blue-grey blocky clay with one thin discontinuous calcareous mudstone band. This yielded several large uncrushed calcitic *O. oxynotum* encrusted by oysters and small serpulids. No bioturbation was evident throughout the sequence. Pyrite was abundant in the form of small homogeneous blebs. Of particular note *Bifericeras* was not recorded from beds 1-4 and only found in abundance near the top of Bed 5. Belemnites, although infrequent, were found throughout the Pit 2 clay. A bulk sample from the base of Bed 3 (Text-fig. 4) contained a low diversity benthic macrofauna comprising nuculoid bivalves, serpulids and small complete pyritized tests of the echinoid *Eodiadema minuta* (Plate 4, fig. 4). Disarticulated ossicles of the benthic crinoid *Balanocrinus quiaiosensis* were locally abundant (Plate 4, figs 1, 2). Brachiopods were rare and represented by a single individual of *Spiriferina verrucosa* (Plate 3, fig. 8a-c) and several specimens of *Rhynchonelloidea cynica*, Plate 3, figs. 9a-c.

The base of Pit 3 (ST 616 312) overlaps the top of Pit 2. Bed 5 passes upwards with a sharp break into a nodular mudstone (Bed 6) crowded with the bivalve *Plagiostoma* (Plate 4, fig. 7). Nuculids were relatively common as were small rhynchonellid brachiopods. Bed 7 consisted of a blue-grey blocky clay with a rich ammonite fauna (Text-fig. 6). When unweathered they were preserved as brilliant metallic pyrite internal casts. A large bulk sample (210 kg) from the base of Bed 7 yielded the following ammonite species; *Bifericeras bifer* (Plate 2) *Bifericeras nudicosta*, *Cheltonia acceptris*, *Gleviceras glevense* and *Oxynoticeras oxynotum*. The majority of the ammonites were *Bifericeras bifer*, scattered throughout the clay although often in small clusters. Both large tuberculate and small smooth specimens were found. The small smooth examples are presumed to be the microconch. This supposition is supported by the observation that the ultimate interseptal distance is usually 70% of that of the penultimate. Some larger specimens of *B. bifer* were found associated with articulated specimens of the bivalve *Modiolus*. Belemnites, gastropods, echinoids and bivalves were relatively rare except for *Oxytoma*, *Plectula* and nuculoids with elongate posterior margins. A thin mudstone band near the top of Bed 7 yielded a few scattered specimens of *Bifericeras*. *Oxynoticeras* was not found above a thin crinoid-rich horizon 3.5m below the top of Bed 7.

Above Bed 8 echioceratids were abundant, usually preserved as flattened limonitic casts, whereas below Bed 8, only *Palaeoechioceras spirale* was recorded. A persistent nodular limestone, Bed 10, outcropped along the entire face of Pit 3 and contained large individuals of *Gleviceras*, up to 25 cms in diameter. In common with *O. oxynotum* from Bed 4, these were encrusted by oysters and serpulids. Above Bed 10 belemnites and *Gryphaea* sp were abundant along with bivalves, serpulids and brachiopods.

The base of the *raricostatum* Zone is usually defined by the first occurrence of *Crucilobiceras densinodulum*, specimens of which were found 30cm above the base of Bed 11 (Pl. 1, fig. 1). A horizon containing bored phosphatic nodules in Bed 11 yielded well preserved examples of *Crucilobiceras ?cheltiense* (Plate 1, fig. 2, 3) Bivalve fragments and rolled reworked belemnites were abundant. The results of the bulk sample taken from Bed 11d are presented in Text-figure 8.

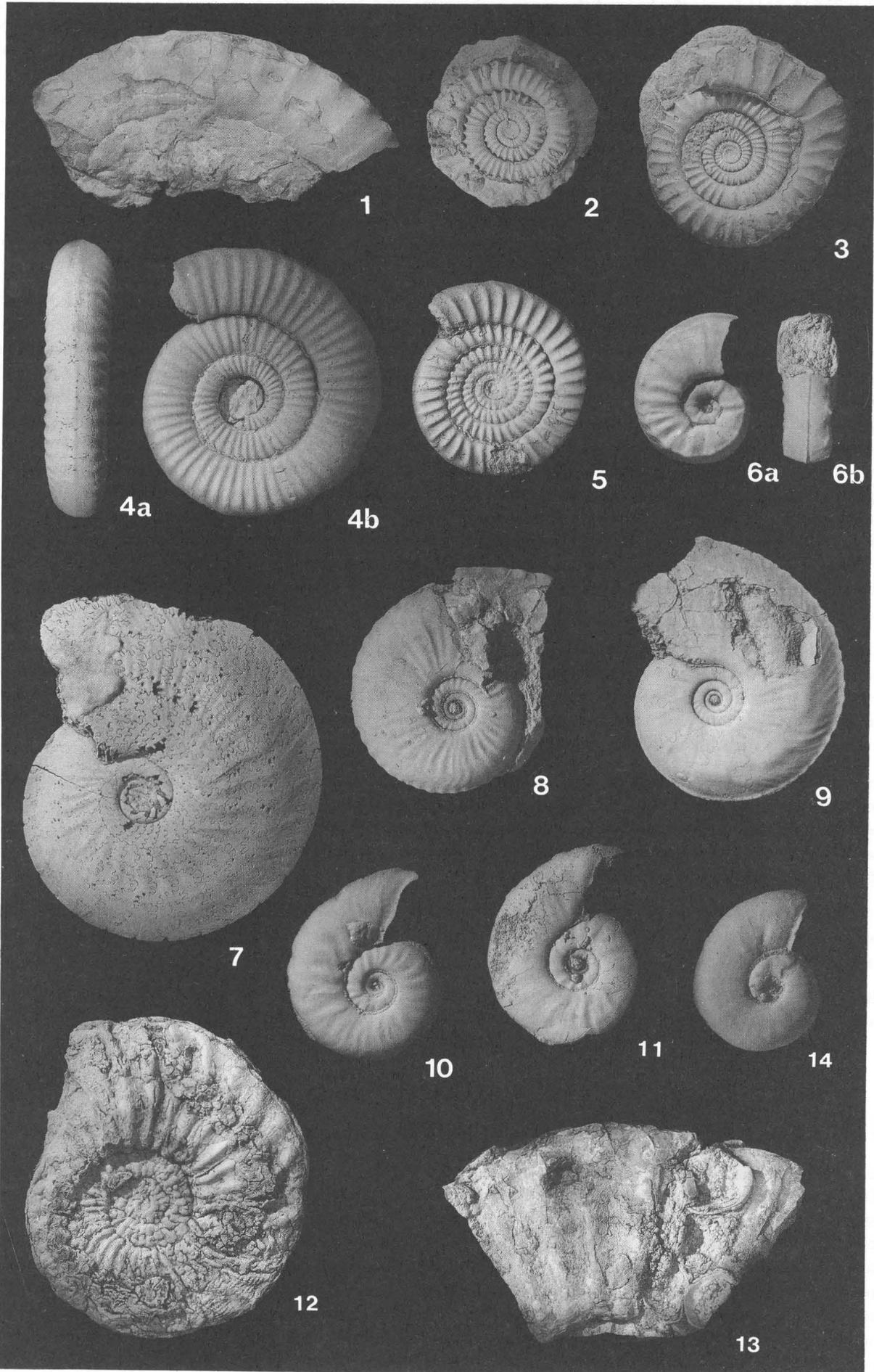
The occurrence of *Echioceras raricostatoides* 28cm below the top of Bed 11 indicated the succeeding *raricostatoides* Subzone of the *raricostatum* Zone. The section above Bed 11 becomes increasingly weathered with abundant selenite crystals.

In Bed 13, other than ?*Bifericeras subplanicostata*, ammonites were too poorly preserved to identify. Serpulid encrusted belemnites, brachiopods and *Gryphaea* were relatively common. The uppermost 2m of Bed 13 were too weathered to retain any identifiable macrofossils.

### PALAEOECOLOGY

The assemblages seen in the lower parts of the section, beds 2-5, are indicative of low levels of faunal diversity.

The entire sequence exposed at Dimmer camp contains a relatively low diversity fauna and is dominated by epifaunal taxa and planktonic elements. Beds 1 to 7 are dominated volumetrically by ammonites and bivalves. Gastropods and brachiopods form a small proportion of the total biota. The benthic elements comprise epibyssate and deposit feeding bivalves, pedunculate brachiopods, small gastropods and echinoids. Infaunal bivalves are rare and are represented by the lucinoid? *Mactromya* and deposit feeding nuculoids. *Mactromya* like its modern counterpart probably constructed a mucus lined tube in the soft sea bed (Allen 1958) and filtered organic detritus from the sediment water interface. The nuculoids *Ryderia doris* (d'Orbigny) (Plate 4, fig. 5, 6) possess elongate posterior margins and lived as vagile deposit feeders with the posterior margin protruding above the sediment water interface.



AGE		ZONES	SUBZONES
LOWER JURASSIC	LATE SINEMURIAN	<i>Echioceras raricostatum</i>	<i>Paltechioceras aplanatum</i>
			<i>Leptechioceras macdonelli</i>
			<i>Echioceras raricostatoides</i>
			<i>Cruciloboceras densinodulum</i>
		<i>Oxynoticeras oxynotum</i>	<i>Oxynoticeras oxynotum</i>
			<i>Oxynoticeras simpsoni</i>
		<i>Asteroceras obtusum</i>	<i>Eparietites denotatus</i>
			<i>Asteroceras stellare</i>
			<i>Asteroceras obtusum</i>

Text-fig. 2. Sinemurian ammonite zones and subzones after Cope *et al.* 1980.

The intense burrowing activity of protobranch bivalves probably destroyed all evidence of primary lamination in the sequence, although the presence of pyritised *Chondrites* burrows in Bed 5 and localised pyrite tubes in some of the calcareous mudstone horizons indicates the presence of other burrowers. It is quite likely that the sea floor during early *oxynotum* times was too soft for successful colonisation by a more diverse epifauna. Epifaunal suspension feeders such as *Oxytoma* may have been attached to floating wood or to weed in a fashion similar to epibyssate biotas described from the Oxford Clay by Duff (1975). *Oxytoma* also possesses a relatively thin shell and may have been an advantage in colonising a soft soupy substrate supported by a thin shell (Aller 1977). The association of *Modiolus* sp. with shells *Bifericeras* in Bed 7 indicates that dead ammonite shells lying on the sea floor may have provided suitable substrates for attachment. Ammonite shells forming benthic islands have been described from the Upper Lias of Germany by Kauffman (1978) and from the Yorkshire coast by Morris (1980). Faunal diversity increases in the higher beds exposed in Pit 3 and epifaunal suspension feeders are more numerous, particularly pectinids and oysters. *Gryphaea* is common from Bed 11 upwards and was a

## PLATE 1

- Fig. 1. *Cruciloboceras densinodulum* S.S. Buckman 1923, C. 93384, Bed 11, × 1.  
 Fig. 2. *Cruciloboceras? cheltiense* S.S. Buckman 1923, C. 93385, Bed 11, × 1.  
 Fig. 3. *Cruciloboceras? cheltiense* S.S. Buckman 1923, C. 93386, Bed 11, × 1.  
 Fig. 4a, b. *Palaeoechioceras typus* (Trueman & Williams 1927), C. 93387, Bed 7 (upper part), × 2.  
 Fig. 5. *Palaeoechioceras spirale* (Trueman & Williams 1927), C. 93388, Bed 7, × 2.  
 Fig. 6. *Gleviceras glevense* S.S. Buckman 1918, C. 93389, Bed 5, × 2.  
 Fig. 7. *Oxynoticeras oxynotum* (Quenstedt 1843), Bed 5, C. 93390, × 2.  
 Fig. 8. *Oxynoticeras oxynotum* (Quenstedt 1843), Bed 5, C. 93391, × 2.  
 Fig. 9. *Oxynoticeras oxynotum* (Quenstedt 1843), Bed 5, C. 93392, × 2.  
 Fig. 10. *Cheltonia acciptrix* S.S. Buckman 1923, C. 93393, Bed 5, × 2.  
 Fig. 11. *Cheltonia acciptrix* S.S. Buckman 1923, C. 93394, Bed 5, × 2.  
 Fig. 12. *Asteroceras stellare* (J. Sowerby 1815), C. 93395, unlocalised in Pit 1, × 2.  
 Fig. 13. *Asteroceras stellare* (J. Sowerby 1815), C. 93396, unlocalised in Pit 1, × 2.  
 Fig. 14. *Paracymbites denneyi* (Simpson 1843), C. 93397, Bed 7 (upper part), × 2.

AGE	ZONE	SUB-ZONE	DIMMER BED No.	m.	BRUE LETTER
LATE SINEMURIAN	<i>Echioceras raricostatum</i>	<i>E. raricostatatooides</i>	13		
			12		I
		<i>C. densinodulum</i>	11		H
	<i>Oxynoticeras oxynotum</i>		8-10		G
			7		F
			6		?B
			5		
			4		
			3		
			2		
			1		
			Gap in section of 2 to 4 metres		
	<i>Asteroceras obtusum</i>	<i>Asteroceras stellare</i>	SEEN BUT NOT LOGGED		

Text-fig. 3. Late Sinemurian zones and subzones in relation to the Dimmer Camp and River Brue sections.

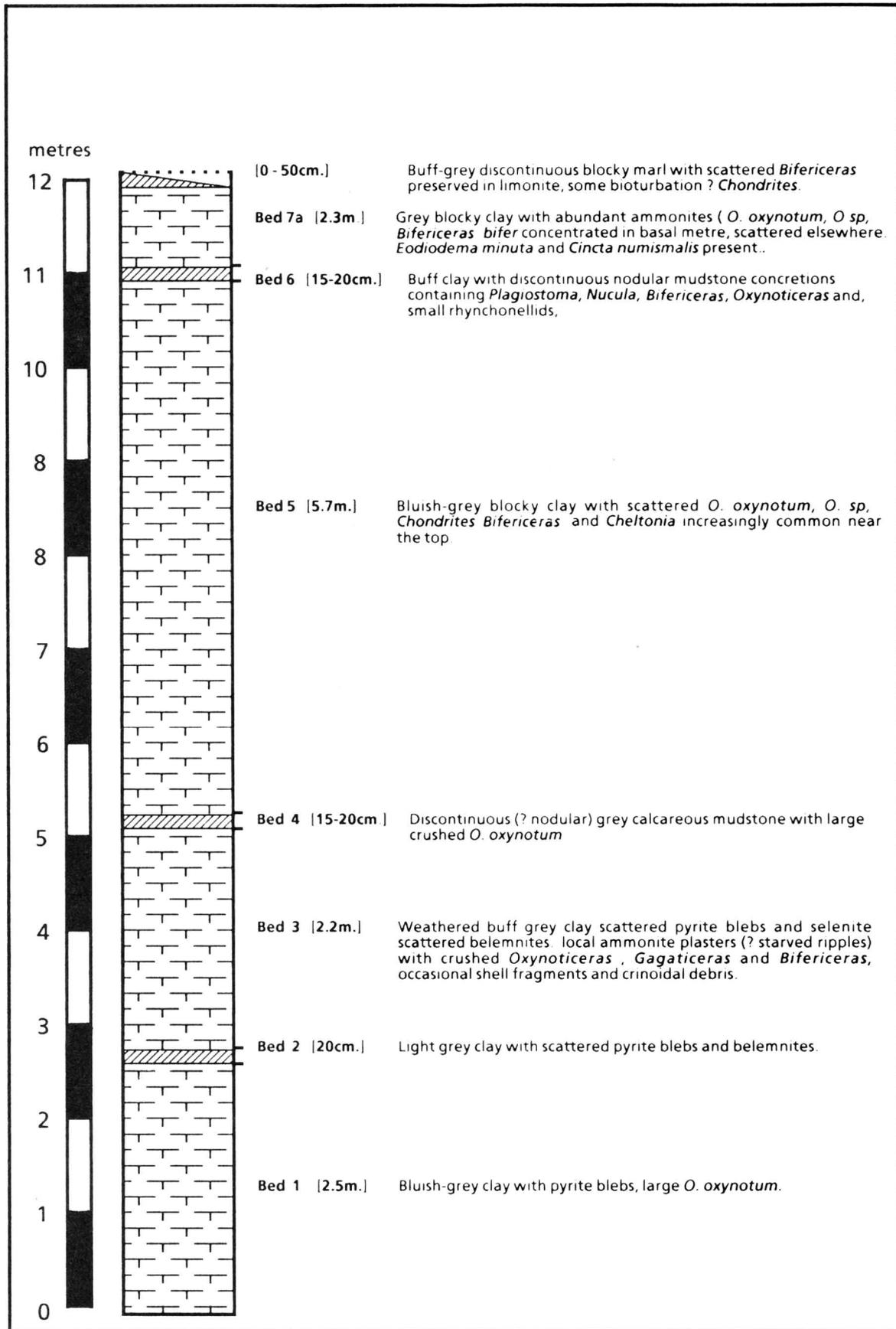
free living form during later stages of ontogeny (Plate 3, figs 7a, b). Abundant serpulid encrusted belemnites in beds 11, 12 and 13 indicated either reduced sedimentation rates and/or minor sediment reworking (Plate 3, figs 5, 6). It is also probable that in the *raricostatoides* Subzone time the sea floor was more stable and this is indicated by a more diverse epifauna than from the underlying sequence. Based on inferred life modes the fauna corresponds broadly with the restricted clay community described by Sellwood in McKerrow (1978) and the restricted facies described by Morris (1979; 1980).

The presence of benthic organisms throughout the measured sequence indicates that the sea floor during *oxynotum* and *raricostatum* times was oxygenated, although some of the biota may have been tolerant of low oxygen conditions. Ammonites and belemnites are the most abundant nektonic elements and occupied the water column above the sediment surface. The sediments lack evidence of primary lamination probably indicating destruction through intense sediment surface bioturbation by protobranch bivalves. Pyrite is abundant, particularly in Bed 7 and it is probable that beneath a thin reworked upper sediment layer the muds become rapidly anoxic with early pyritisation of most of the aragonitic shelled biota by anaerobic bacteria. Faunal elements with calcitic shells, such as brachiopods, were rarely found replaced by pyrite.

The lack of ripple lamination and scour structures in the *oxynotum* Zone clays also indicates that the sediment accumulated at depths which were below storm wave base. In contrast the reworked uncrushed belemnites from Bed 11 and presence of bored phosphate nodules containing *Crucilobicerus* suggests there was either; 1) a hiatus in sedimentation, leading to attrition of shelly debris which was encrusted by oyster and serpulids, or 2) increased current activity leading to sediment reworking and winnowing of shell remains on the sea floor.

#### CORRELATION WITH OTHER OUTCROPS

Natural exposures of Late Sinemurian clays and shales are mainly confined to a few intermittent exposures in the banks and bed of the River Brue (Text-fig. 9) where bluish clays and mudstones of the *obtusum* and *oxynotum* zones, found over a two kilometre section, yield a similar fauna to the Dimmer section. An annotated sequence by one of the authors (P.C.) is presented in Text-fig. 10.



Text-fig. 4. Measured section and composite faunal profile compiled from observations made in Pit 2.

*Oxynotum* and *raricostatum* zone clays and limestones was described from Cannards grave railway cutting by Donovan (1958), but the cutting has since been infilled (Prudden pers. comm.). Stiff blue clays and calcareous mudstones containing *Oxynoticeras* was recorded by Woodward 1893 from Evercrech station and Priestleigh about 10km north of Dimmer. Although no thicknesses were quoted a well shaft sunk near Alhampton, Castle Cary (Woodward op cit) yielded *Echioceras* sp. and *Oxynoticeras* sp.

According to Kellaway and Wilson (1941) no evidence of the *oxynotum* and *raricostatum* zones are known south of Sutton about 2.5km north of Dimmer Camp (Text-fig. 1) until the Vale of Marshwood in Dorset. Here the upper part of the *oxynotum* and *raricostatum* zones (Lang 1932) is represented by blue clays and nodular limestones which contain *Bifericeras*, *Gleviceras*, *Cruciloboceras* and echioceratid-type ammonites. On the Dorset coast the upper part of the *stellare* Subzone and lower part of the *oxynotum* Zone is represented by a condensed sequence (Hallam 1969).

Although the Lower Sinemurian is superbly exposed on the North Somerset coast, the succession seen in the cliffs extends no higher than the *semicostatum* Zone. No permanent exposures of Upper Sinemurian strata are known in North Somerset, Avon and Gloucestershire so temporary exposures are especially important. Despite difficulties in compiling stratigraphic sequences and ammonite faunas from patchy records, observations by one of the authors (M.J.S.) have enabled a reconstruction of the Upper Sinemurian succession in the Severn basin with reasonable confidence. Since this differs significantly from the most recent published account by Cope *et al.* (1980) it is worthwhile recording these observations here.

In the central part of the Severn basin near Gloucester, the *obtusum* Subzone incorporates some paper shales and laminated mudstone nodules comparable with the equivalent part of the succession on the Dorset coast. North east from Gloucester the *obtusum* Zone has not been observed though this may reflect the paucity of exposures of the subzone. The *stellare* Subzone comprises pyritic, shelly mudstones with several bands of large limestone nodules. The ammonite fauna includes *Asteroceras stellare*, *Aegasteroceras*, *Epophioceras*, *Xiphoceras*, *Pro-microceras*, *Cymbites* and *Eparnioceras*. There is a rich benthic fauna of bivalves, notably *Gryphaea* and *Hippodidium*, as well as crinoids, belemnites, gastropods, rhynchonellid brachiopods and nautiloids.

The succeeding *denotatus* Subzone has not been recorded and the *simpsoni* Subzone at the base of the *oxynotum* Zone is definitely not proven. The *oxynotum* Subzone is intermittently exposed in drainage trenches of active gravel pits near Gloucester and comprises a monotonous sequence of dark pyritic mudstones up to 10 metres in thickness, *Oxynoticeras oxynotum* and *Cheltonia acciptris* are common throughout. In the lower part *Gagaticeras* and *Slatterites* are rare but possibly indicate the *simpsoni* Subzone. *Angulaticeras* and a bituberculate species of *Eoderoceras* are also restricted to the lower part of the *oxynotum* Subzone while *Palaeoechioceras* and *Bifericeras bifer* are abundant at two distinct levels near the top of the subzone.

The *densinodulum* Subzone at the base of the *raricostatum* Zone comprises several metres of pyritic mudstones with thin silt bands. *Cruciloboceras* and *Bifericeras* of the *subplanicostata* group are abundant, together with rarer *Gleviceras glevense* and *Paracymbites dennyi*. There is a fairly rich benthic fauna, the most prominent element com-

## PLATE 2

1-12 *Bifericeras bifer* (Quenstedt 1845), all from Bed 7, × 2.

Fig. 1. C. 93398, large macroconch.

Fig. 2a, b. C. 93499, internal macroconch cast showing sutures S.S. Buckman 1923.

Fig. 3. C. 93400, macroconch.

Fig. 4. C. 93401, unusually smooth macroconch.

Fig. 5. C. 93402, macroconch.

Fig. 6. C. 93403, microconch.

Fig. 7. C. 93404, microconch.

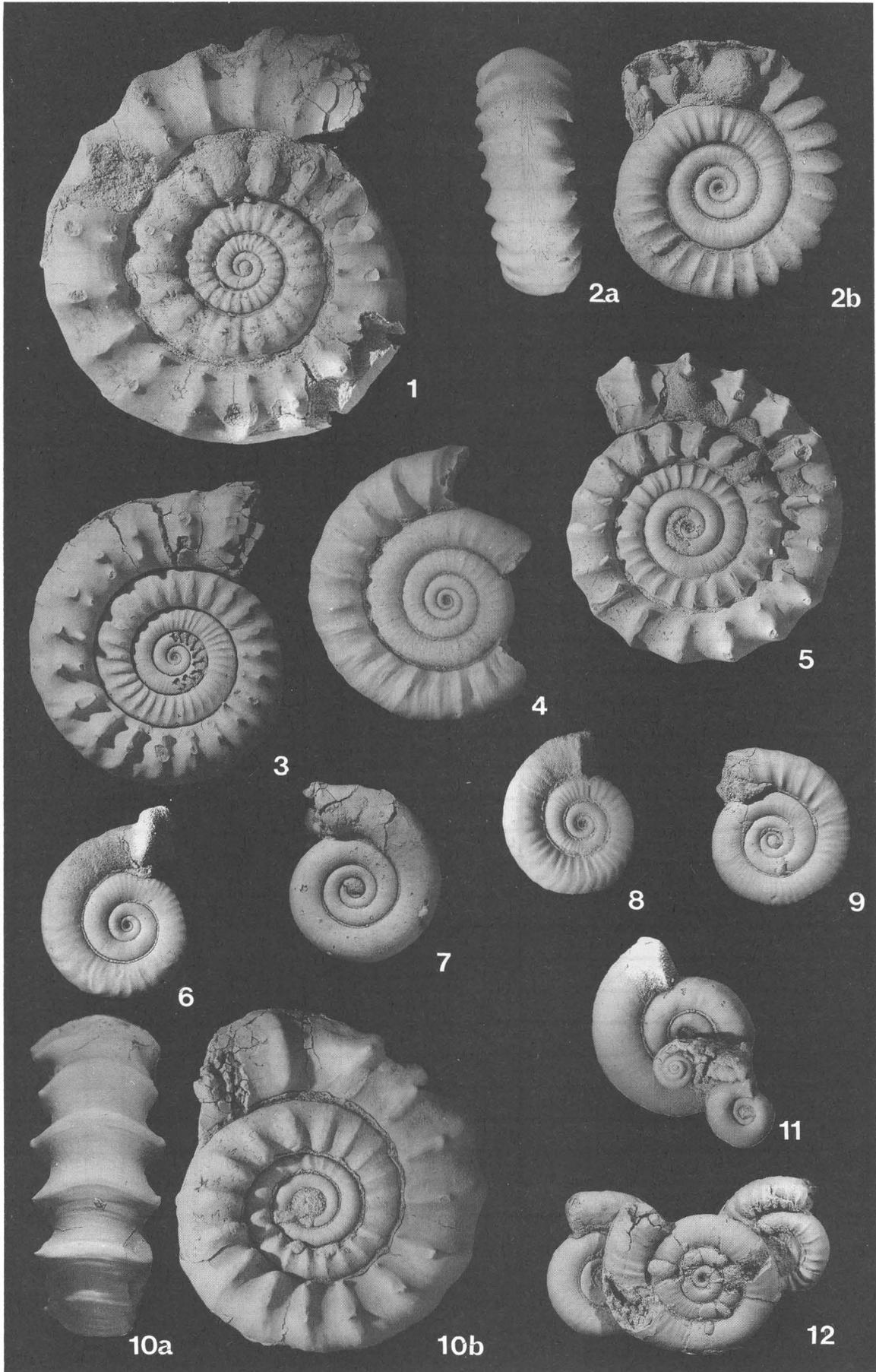
Fig. 8. C. 93405, microconch.

Fig. 9. C. 93406, microconch.

Fig. 10a, b. C. 93407, external macroconch mould showing ribs.

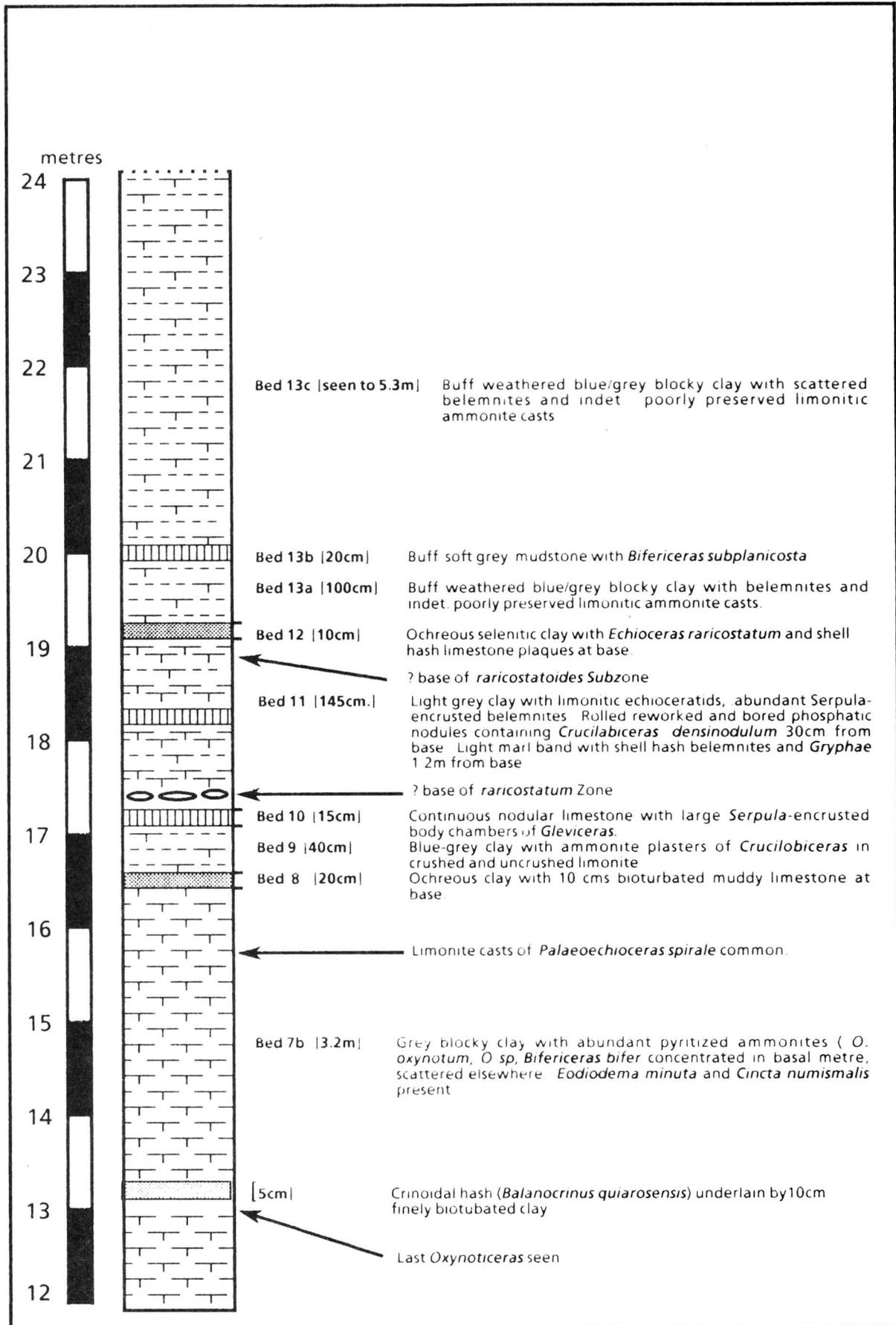
Fig. 11. C. 93408, aggregation of microconchs.

Fig. 12. C. 93409, aggregation of microconchs.

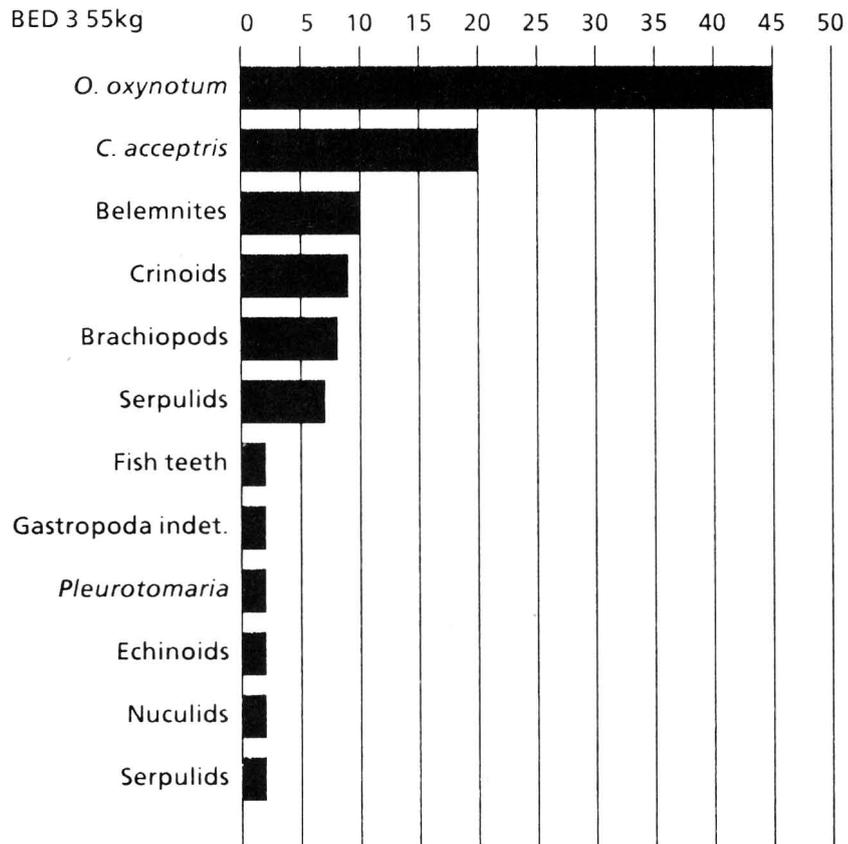


Species	Dimmer Bed Number													
	1	2	3	4	5	6	7a	7b	8	9	10	11	12	13
<i>Agaleus dorsetensis</i>												X		
<i>Palaeospinax</i> sp												X		
indet. fish remains			X		X		X	X				X		
indet. crustacean remains			X		X		X					X		
<i>Bifericeras bifer</i>					X	X	X	X						
<i>Bifericeras nudicostata</i>					X		X	X						
<i>Biferiferas</i> sp					X	X	X							
<i>Cheltonia acciptris</i>		X	X	X	X		X	X						
<i>Crucilbiceras densinodulum</i>												X		
<i>Crucilbiceras cheltiense</i>												X		
<i>Gleviceras glevense</i>			X		X	X	X							
<i>Oxynoticeras oxynotum</i>	X		X	X	X	X								
<i>Oxynoticeras</i> sp	X													
<i>Palaeoechioceras spirale</i>					X	X	X	X		X		X	X	
<i>Palaeoechioceras typus</i>												X		
Belemnites undet.	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cidaroid indet												X		
<i>Eodiodema minuta</i>			X				X	X						
<i>Isocrinus</i> sp			X				X					X		
<i>Balanocrinus quiaiosensis</i>			X	X			X	X				X		
<i>Ryderia doris</i>			X		X		X							
<i>Gryphaea</i> sp.			X		X		X				X	X	X	X
Lucinoid indet. -? <i>Mactromya</i>			X		X	X								
<i>Plagiostoma</i> sp.					X	X								
<i>Oxytoma inequivalvis</i>			X		X	X	X	X	X	X	X	X		
Pectinid indet.			X		X	X	X	X	X	X	X	X		
Rhynchonellids			X	X	X	X	X	X		X	X	X		
<i>Zeilleria perforata</i>				X	X	X								
<i>Cincta numismalis</i>			X		X	X	X					X		
<i>Spiferina varrucosa</i>			X											
Turbinid gastropods			X		X									
Spired gastropods			X	X	X		X							
Pleurotomarids			X			X	X							
Serpulids undet											X	X	X	X

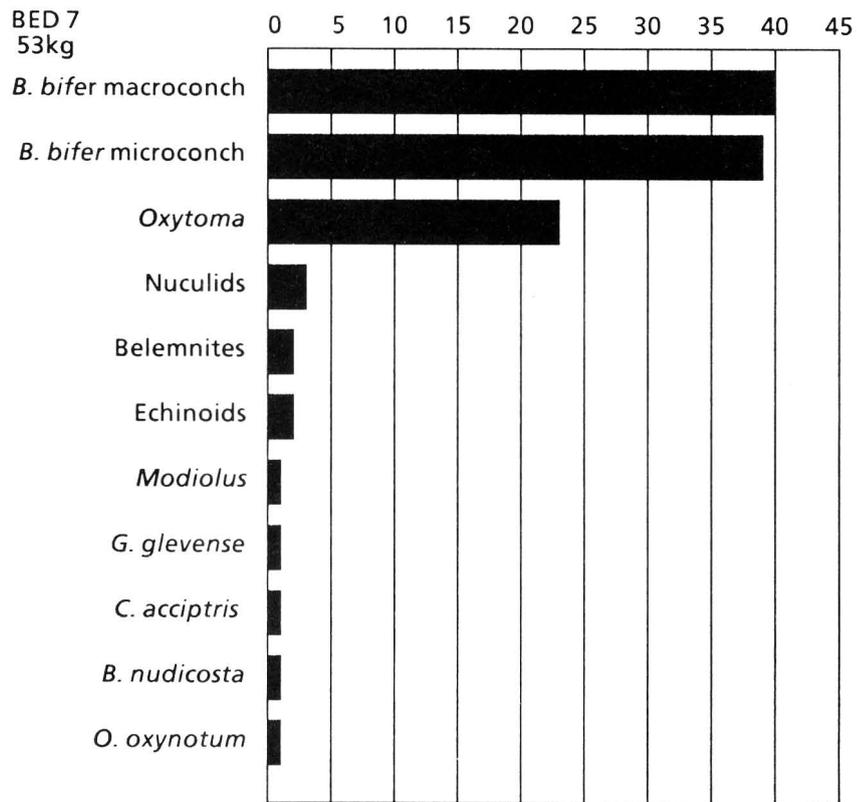
TABLE 1 Distribution of macrofossils in Pits 2 and 3.



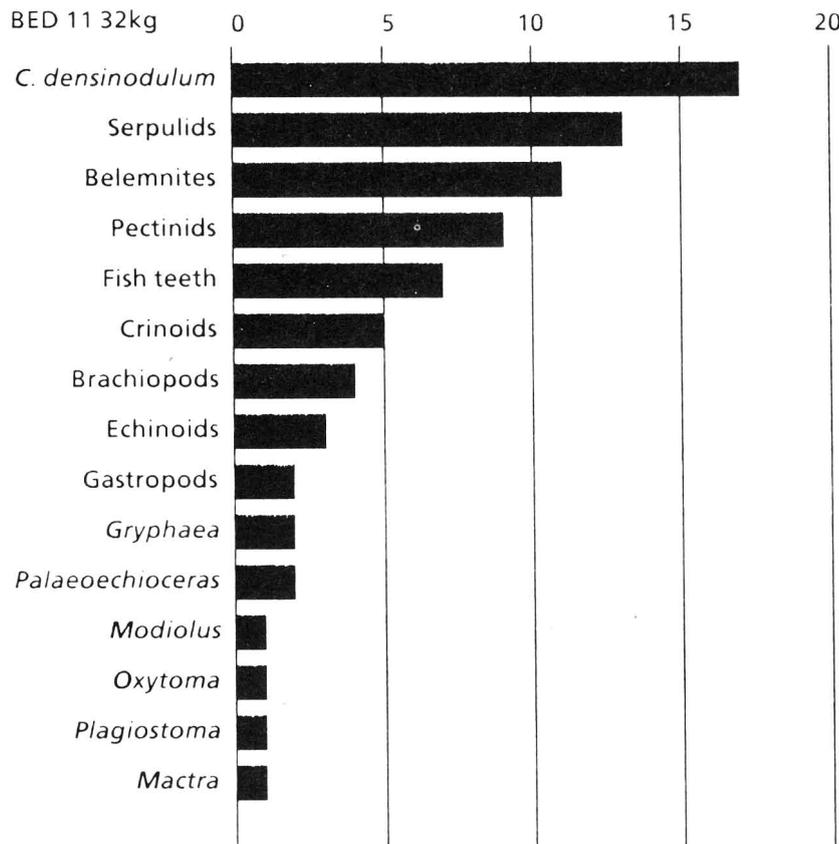
Text-fig. 5. Measured section and composite faunal profile compiled from observations made in Pit 3.



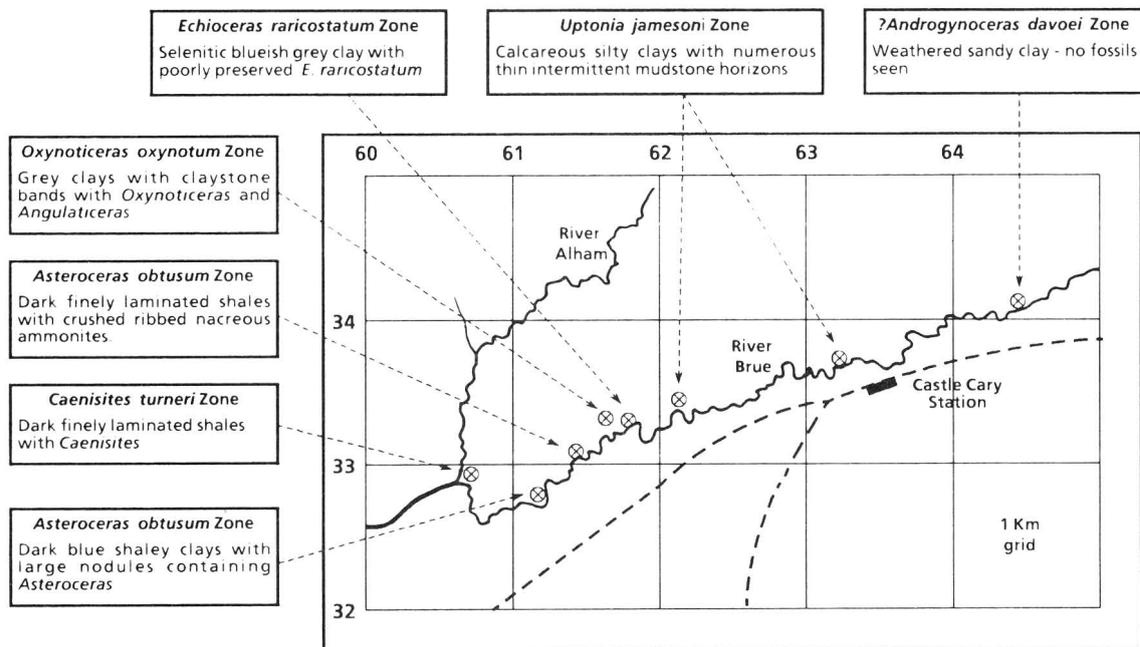
Text-fig. 6. Numerical abundance of faunal elements collected from Bed 3, Pit 2, at Dimmer Camp.



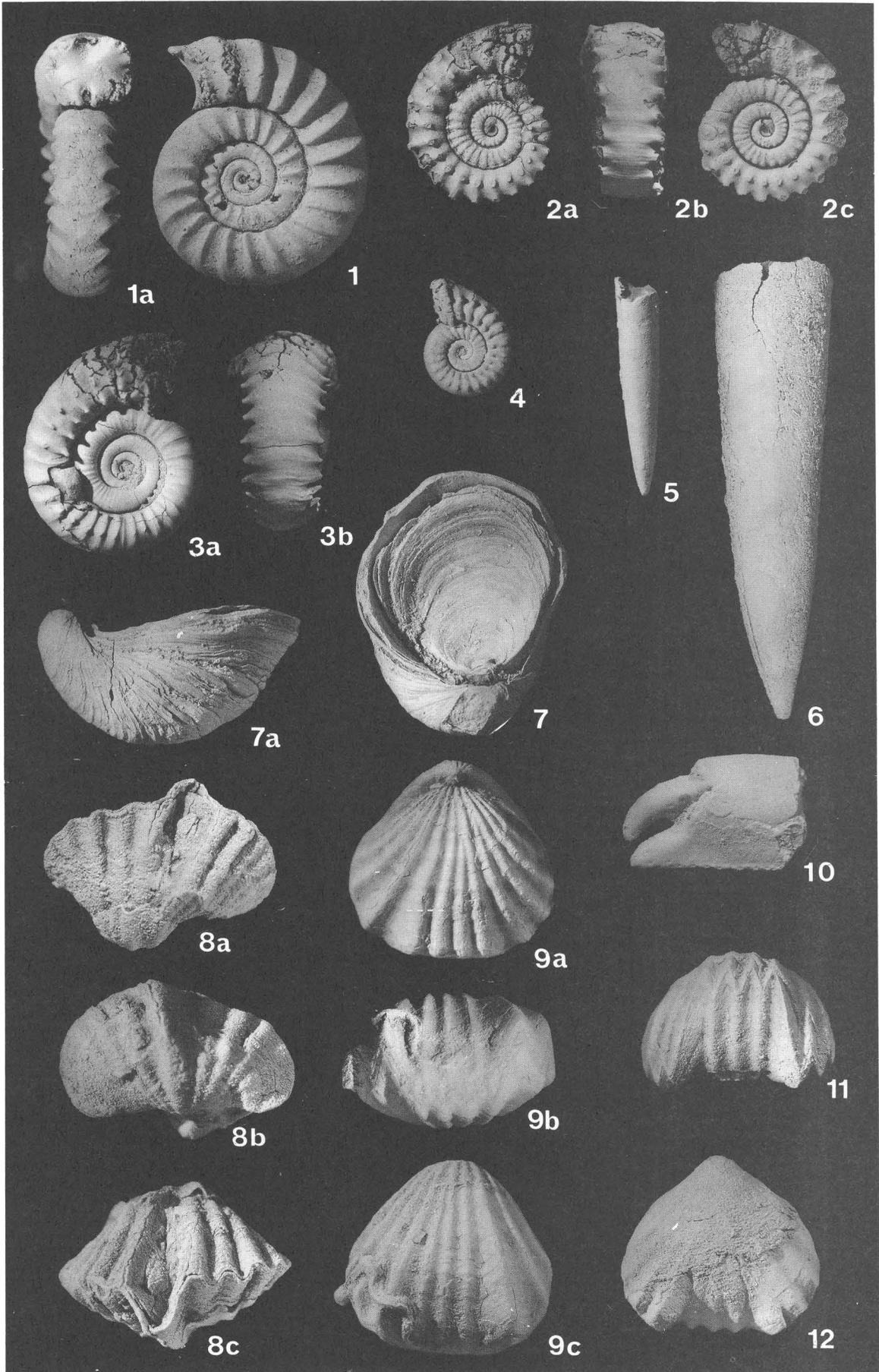
Text-fig. 7. Numerical abundance of faunal elements collected from Bed 7, Pit 3, at Dimmer Camp.



Text-fig. 8. Numerical abundance of faunal elements collected from Bed 11, Pit 3, at Dimmer Camp.



Text-fig. 9. Location of outcrops of Sinemurian clays in the banks and bed of the River Brue.



prising the bivalves *Cardinia* and *Hippopodium* in the top 3m. The junction with the overlying *raricostatooides* Subzone is taken at the Coral bed, a 2cm thick pale grey mudstone containing abundant examples of the solitary coral *Styllophylloopsis rugosa* encrusting abraded belemnites and *Gryphaea*. The mudstones above contain abundant shell debris and *Gryphaea*, passing upwards into pyritic mudstones. The *raricostatooides* Subzone contains abundant *Echioceras* and *Paltechioceras delicatum*. In the upper part of the subzone the fauna is dominated by *Leptechioceras*, *Neomicroceras*, and *Paltechioceras planum*. The *aplanatum* Subzone at the top of the Sinemurian is characterised by large *Eoderoceras* and *Paltechioceras aplanatum*.

### CONCLUSIONS

The *oxynotum* Zone is atypically thick at Dimmer Camp reaching over 13 metres and extends its known outcrop further south than was previously estimated. The *oxynotum* and *raricostatum* zones are, however, not known south of Marston Magna (Kellaway and Wilson 1941) and it is probable that Dimmer Camp represents the southernmost exposure of the *oxynotum* and *raricostatum* zones in Somerset. North of Dimmer Camp the *oxynotum* and *raricostatum* zones are well represented although near Shepton Mallet the Lower Lias is condensed and displays considerable facies variation and lateral thickness changes with several non sequences. For example the Lias in the Bruton borehole (Holloway and Chadwick 1984) is 161.1m thick and considerably thinner than further south where it reaches 646.4m thick in the Winterbourne Kingston Borehole, Holloway and Chadwick (1984) also demonstrated that the Lias at Bruton was deposited on a basement high north of the Bruton fault which was probably active during the Mesozoic. The Dimmer section is south of the Bruton fault (Fig. 12) but north of the Mere fault (Chadwick and Kirby 1982) and it is probable that differential subsidence with marked southwards stratigraphic thickening of late Sinemurian sediments may be attributable to deposition in a rapidly subsiding area south of a major growth fault at the north edge of the Wessex basin in the Castle Cary half graben. Rapid attenuation of the *oxynotum* and *raricostatum* zones southwards from Dimmer may reflect the position of another basement high, south of Castle Cary.

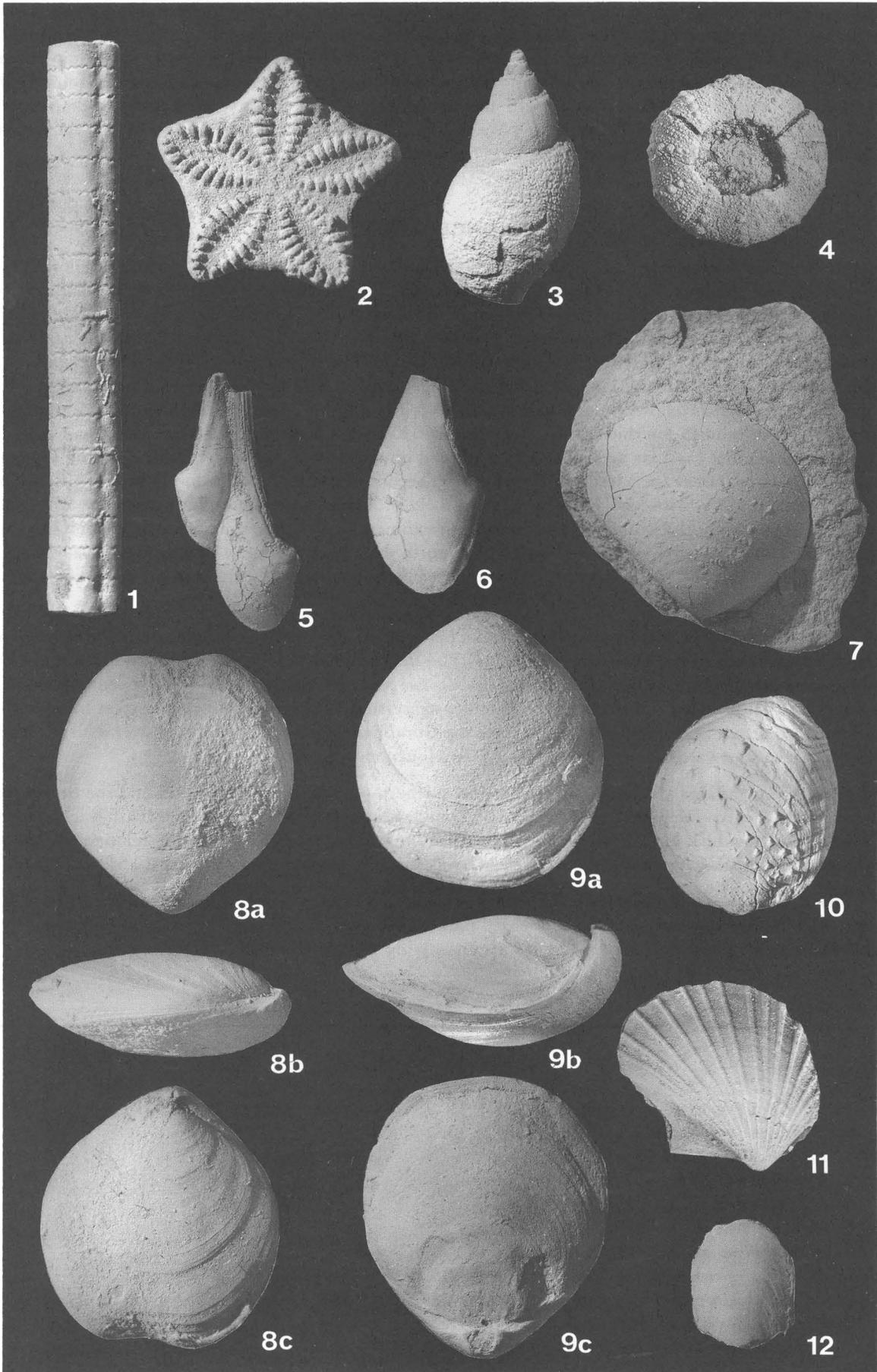
North of the Mendips several differences are evident between the succession documented at Dimmer and inferred from observations of the Gloucestershire Lias. The *stellare* Subzone in Gloucestershire has a much richer benthic fauna than Dimmer while the succeeding *oxynotum* and *raricostatum* zones lack the cementstone bands which form such a prominent element of the Dimmer succession. The only significant marker band in the *oxynotum* and *raricostatum* zones of the Severn basin is the Coral Bed which has been traced over a large area from Gloucester, northeastwards for more than 40 km to Honeybourne.

The *oxynotum* Zone attains a similar thickness in the northern part of the Wessex basin and the Severn basin, whereas there is a clear difference in the *raricostatum* Zone, with the *densinodulum* Subzone 1.5 m thick at Dimmer but over 6-7 metres thick in Gloucestershire. The most notable faunal difference is the relative abundance of the distinctive bivalve genus *Hippopodium* in the Gloucestershire succession and its total absence at Dimmer.

The differences between the successions in the two areas is a consequence of deposition in separate basins separated by the Mendip high, but the condensed nature of the *densinodulum* and *raricostatooides* subzones in both basin and more widespread outcrop, implies an underlying eustatic control.

### PLATE 3

- Fig. 1a, b. *Bifericeras nudicosta* (Quenstedt 1845), C. 933410, upper metre of Bed 7,  $\times 2$ .  
 Fig. 2. *Bifericeras* or *Eoderoceras* sp. 1, C. 933411, Bed 5,  $\times 2$ .  
 Fig. 3. *Bifericeras* sp. 2, C. 933412, Bed 5,  $\times 2$ .  
 Fig. 4. *Bifericeras* sp. 2, C. 933413, Bed 5,  $\times 2$ .  
 Fig. 5. *Cylindroteuthis* sp. C. 59566, Bed 3,  $\times 2$ .  
 Fig. 6. *Cylindroteuthis* sp. C. 59567, Bed 11,  $\times 2$ .  
 Fig. 7a, b. *Gryphaea* sp. LL. 28245, Bed 11,  $\times 2$ .  
 Fig. 8a, b, c. *Spiriferina verrucosa* Von Buch 1915, BB 86880, Bed 3,  $\times 3$ .  
 Fig. 9a, b, c. *Rhynchonelloidea cynica* (S.S. Buckman 1895, BB 86881, Bed 7,  $\times 3$ .  
 Fig. 10. Crustacean claw sp. indet., Bed 11,  $\times 5$ .  
 Fig. 11b, 12. *Rhynchonella* sp. BB 86882, Bed 7,  $\times 3$ .



## ACKNOWLEDGMENTS

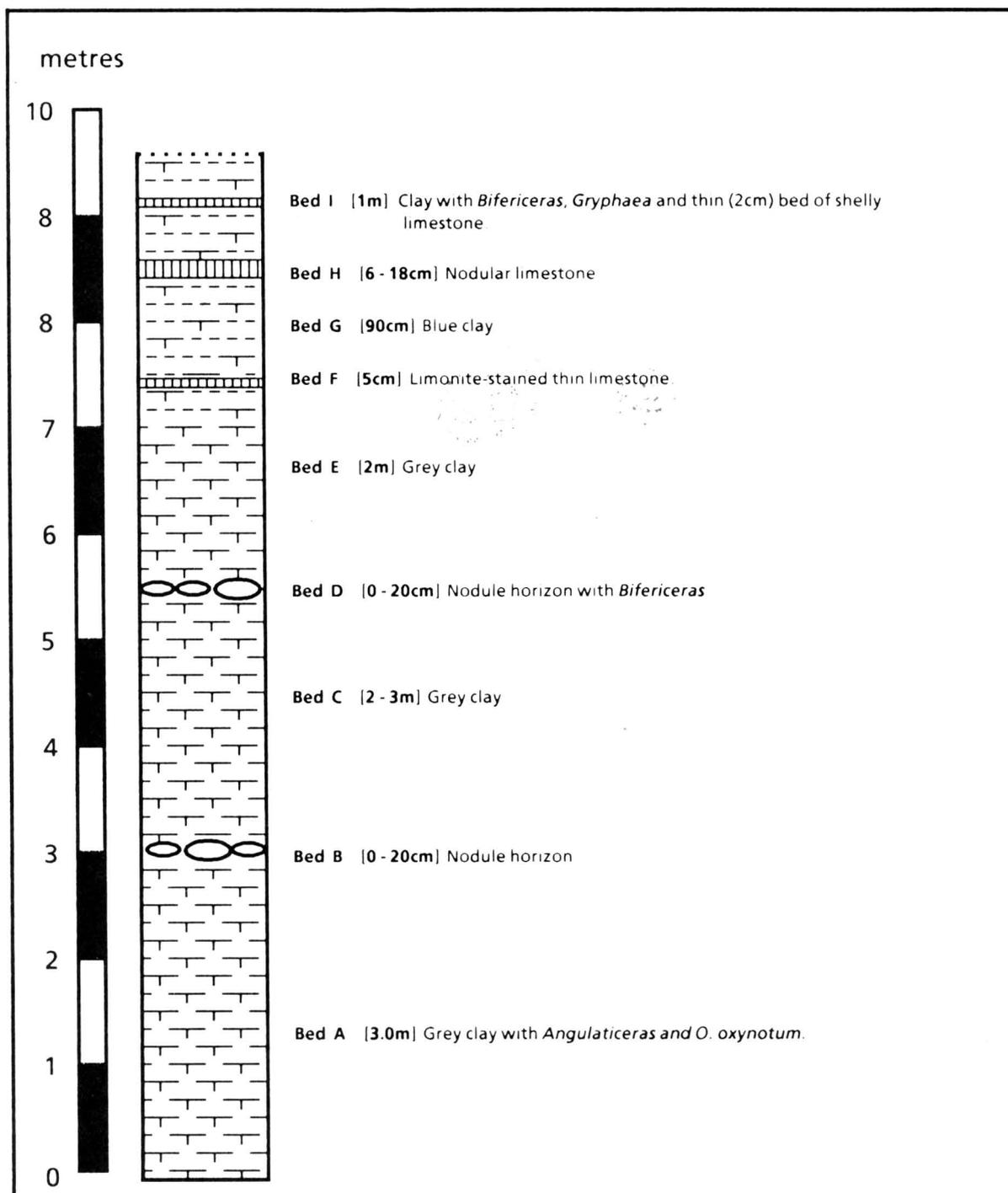
The authors are grateful to Mr Trevor Tuck and his colleagues from Somerset County Council for permission to visit the Dimmer Camp site. Dr Michael Howarth kindly assisted in the determination of the ammonites and Drs Noel Morris and Ron Cleevely, the molluscs. Mrs Alison Ward helped type the manuscript.

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## PLATE 4

- Fig. 1. *Balanocrinus quiaiosensis* Loriol 1891, E. 71487, Bed 7, × 5.
- Fig. 2. *Isocrinus* sp., E. 71488, Bed 7, × 5.
- Fig. 3. ?*Acteonina* sp., internal mold, GG. 9440, Bed 7, × 5.
- Fig. 4. *Eodiadema minuta* (Buckman 1845), E. 83524, Bed 5, × 3.
- Fig. 5. *Ryderia doris* (d'Orbigny 1850), LL. 28246, Bed 7, × 2.
- Fig. 6. *Ryderia doris* (d'Orbigny 1850), LL. 28247, Bed 7, × 2.
- Fig. 7. *Plagiostoma* sp., LL. 28248, Bed 6, × 2.
- Fig. 8a, b, c. *Zeilleria perforata* (Pietter 1856), BB 86883, Bed 7, × 2.
- Fig. 9a, b, c. *Cincta numismalis* (Lamarck 1819, BB 86884, Bed 7, × 2.
- Fig. 10. *Plicatula* sp., LL. 28249, Bed 11, × 2.
- Fig. 11. *Oxytoma inequivalvis* (J. Sowerby), LL. 28250, Bed 7, × 5.
- Fig. 12. *Lingula* sp., BB 86885, Bed 7, × 5.



Text-fig. 10. Composite lithological profile of late Sinemurian clays compiled from intermittent exposures in the banks and bed of the River Brue.

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