THE STRATIGRAPHY, PALAEONTOLOGY, AND PALAEOECOLOGY OF THE CAMPANIAN CHALK OF NORFOLK

Thesis submitted in accordance with the requirements of the University of Liverpool for the degree of Doctor of Philosophy by

Andrew John Pitchford, July 1989.

To my father

John Douglas Pitchford

ABSTRACT

THE STRATIGRAPHY, PALAEONTOLOGY, AND PALAEOECOLOGY OF THE CAMPANIAN CHALK OF NORFOLK

Andrew John Pitchford (Liverpool University)

Logging of extant sections within the Campanian Chalk of Norfolk, noting, especially, the position, nature, strength, and spacing of flint bands and the occurrences of layers of harder chalk has enabled correlations between exposures. In particular, those between the cliff section on the north Norfolk coast at Weybourne and inland quarries at Eaton and Keswick about 50 km to the south. Equivalent faunal variations at similar levels strengthened the correlation. Samples from boreholes drilled through currently unexposed beds containing fossils with narrow and well defined stratigraphic ranges enabled further tie-ups with existing exposures.

A varied macrofauna, of about 2700 individuals, dominated by belemnites, brachiopods, bivalves, echinoids, and sponges was identified, whilst the "mesofauna", from borehole and bulk samples, comprised, in addition to common fragments of larger taxa, numerous brachiopods, serpulids, sponges, echinoderms, and bryozoans. Many belemnites and echinoids supported epifauna, usually of small brachiopods, bivalves, serpulids, and bryozoans, and were bored by sponges.

The Norfolk Campanian Chalk was deposited on a tectonically stable shelf, mostly at depths between 150 and 200 m at temperatures around twenty degrees Celcius at a rate of up to 1 mm per year during periods of deposition. Current activity was rare and then only weak, of insufficient strength to reorientate fauna.

At most levels the macrofauna occurred in fairly low numbers. Remains that lay exposed for any length of time were often colonised by epifauna and bored. The sediment whilst firm enough to support belemnite guards, ammonite shells etc., was too soft for the many smaller taxa which existed only as epifauna, and were restricted to the relatively rare hard substrates provided by belemnites, echinoids, and ammonites etc. Rarely, when the sea-floor was firmer, certain taxa, particularly oysters, were able to spread out over the sediment in considerable numbers.

ACKNOWLEDGEMENTS

I thank Mr. C.J. Wood (London), Mr. N.B. Peake (Norwich), and Dr. A.S. Gale (Thames Polytechnic) for their help with faunal identifications. Mr. P.S. Whittlesea (Norwich) aided greatly in locating, measuring, and logging several sections, and with the taxonomy of many fossils, especially the bryozoans. I am grateful to Mr. J. Fery (Anglian Water Authority, Norwich) for the information regarding, and the chalk samples from, the boreholes drilled by the Water Authority at Norwich and Whitlingham, and likewise to the Department of Transport for the material from the boreholes drilled along the line of the Wymondham bypass.

I am appreciative of the access granted to me by numerous farmers and landowners to quarries on their property, in particular Mr. W.M. Howes and the employees of the Frettenham Lime Company, also to Miss A. Griffiths (Liverpool University) and Mr. C.J. Veltkamp (Liverpool University) for their help in producing the plates for this thesis. I am indebted to my supervisor, Dr. C.R.C. Paul (Liverpool University), for his valuable and helpful advice as to lines of research that might be explored, constructive criticisms regarding the content, composition, and layout of this thesis, and support throughout the duration of the project.

Finally, I wish to thank my parents for putting up with all my chalky clothes and allowing me to fill the garage with bags of borehole chalk, and most of all my father, Mr. J.D. Pitchford, for the use of the facilities of the Highways Laboratory of Norfolk County Council in Norwich, his wise counsel, and his unwavering interest, enthusiasm, and guidance throughout the last three years.

This research project was funded by grant number GT4/86/GS/120 from the Natural Environment Research Council.

CONTENTS

CHAPTER ONE - STRATIGRAPHY

CHAPTER TWO - BOREHOLE MATERIAL

CHAPTER THREE - FOSSIL BORINGS AND EPIFAUNA

CHAPTER FOUR - STRATIGRAPHIC RANGES OF COLLECTED FOSSILS

CHAPTER FIVE - CAMPANIAN CHALK AND FOSSIL GROUP ECOLOGY

<u>CHAPTER SIX - CONCLUSIONS AND REFERENCES</u>

APPENDICES

TABLES

FIGURES

following page:

PLATES

CHAPTER ONE

STRATIGRAPHY

1.1 INTRODUCTION

All known working chalk pits and former workings in the Campanian Zones of *Gonioteuthis* and *Belemnitella mucronata* in Norfolk (some 110 in all) were visited between September 1986 and the autumn of 1988. The 24 existing, accessible, sections (Figure 1.1 and Appendix 1) were logged and fossils collected accurately (their positions measured to the nearest 5 cm vertically with respect to marker flint bands in the chalk).

The log for each extant section was produced by measuring the vertical spacing between recognisable bands of flint, which occur in all but a few of the smallest exposures. The shape, size, form, colour, and spacing of flints and the presence/absence, colour, and thickness of cortices (skins on the surfaces of flints) were all carefully noted. Characteristic flints in each band were sketched and redrawn at a 1:50 scale when sections were drafted.

A five-metre wide section of chalk was drawn for each locality. Each drawn flint band was, as far as possible, an accurate representation of the equivalent band visible in the chalk face and hence, an idealised "typical" section of chalk exposed at each locality was

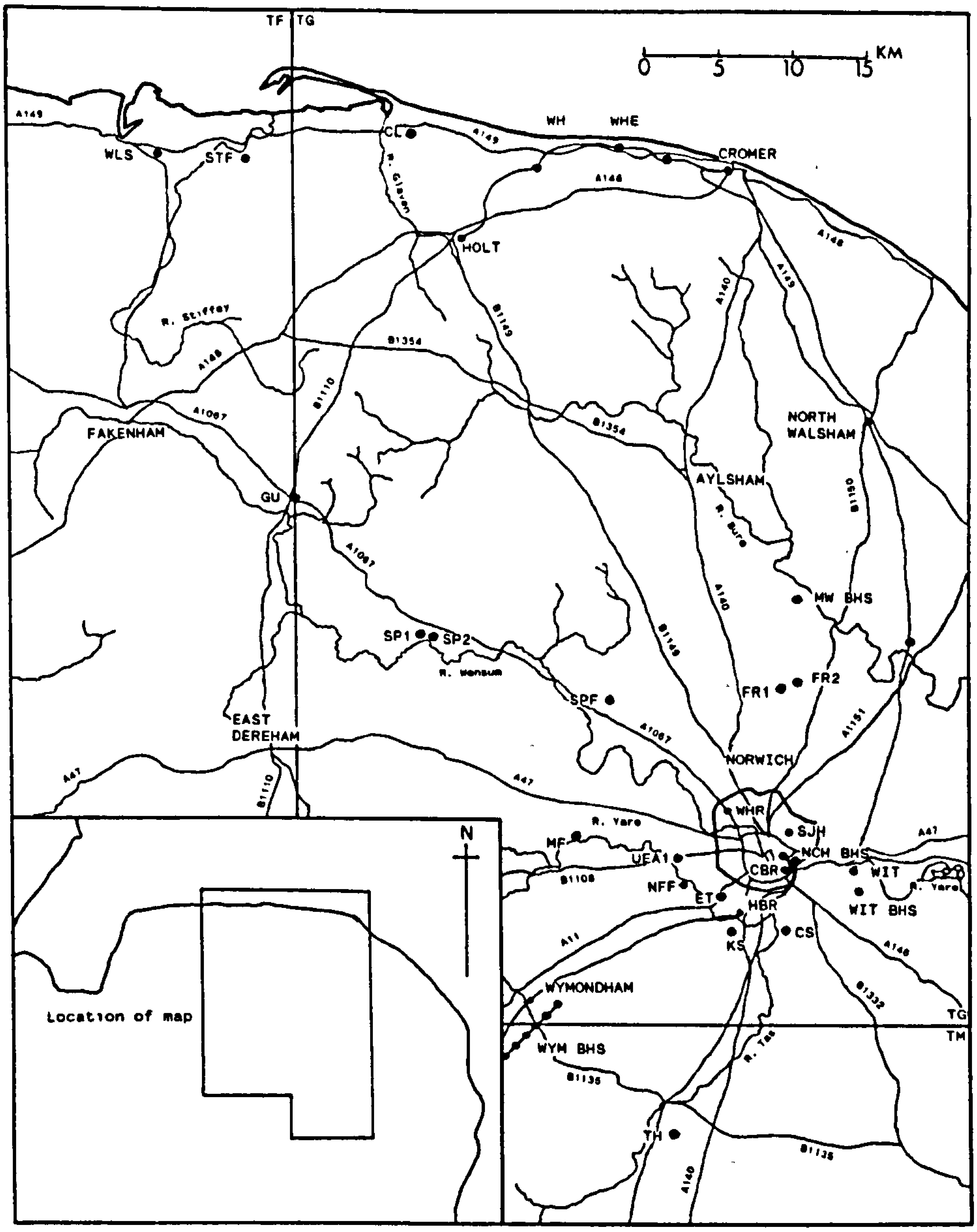


FIGURE 1.1 Approximate geographical locations of the existing, accessible, sections described in chapter one, and of the boreholes described in chapter two. Grid lines represent 100 kilometre National Grid Lines. Abbreviations: CBR=Colmans, Bracondale; CL=Cley-next-the-sea; CS=Caistor St. Edmund; ET=Eaton; FR1=Frettenham (J.S.S. Aggregates); FR2=Frettenham (W. M. Howes); GU=Guist; HBR=Harford Bridges; KS=Keswick; MF=Marlingford; NFF=Newfound Farm, Cringleford; SJH=St. James's Hollow; SPF=Spring Farm, Attlebridge; SP2, SP1=Sparham; STF=Stiffkey; TH=Tharston; UEA1=University of East Anglia; WH=Weybourne Hope-Old Butts Gap; WHE=Weybourne Hope East; WHR=Whiffler Road, Hellesdon; WIT=Whitlingham; WLS=Wells; MW BHS=Mayton Wood boreholes; NCH BHS=Norwich boreholes; WIT BHS=Whitlingham boreholes; WYM BHS=Wymondham boreholes.

produced. The colour and nature of the chalk and the presence of hard/soft bands was noted.

Several terms were used to describe the shapes of individual flints. Most fall into one of four shape categories, which grade into each-other. The two end-member forms are "nodular" (irregularly shaped flints with numerous protuberances) and "tabular" (regular flints with smooth faces). Two intermediate shape forms, "semi-nodular" and "semi-tabular" are recognisable, these having some characteristics of both end member forms. Two other terms were used to describe specifically shaped flints; "sheet" for laterally continuous (up to 5 m) tabular flints, and "spindle" for small "rod-like" flints. In places, particularly in the Paramoudra Chalk division of the Belemnitella mucronata Zone (q.v.) very large barrel shaped flints (paramoudras) are very common.

Bulk samples of chalk (usually about 2 Kg in weight) were taken at regular intervals from all accessible sections and sieved to obtain the "mesofauna". This is composed of fragments of larger fossils (particularly spines of cidarid echinoids, fragments of Echinocorys, brachiopods, and bivalves) and smaller faunal elements which were dominated by bryozoans (>50 genera), serpulids (>10 genera), asteroids (identified from disassociated ossicles), ophiuroid plates, and some of the larger foraminifera.

Some of this chalk was sufficiently hard to necessitate the use of a supersaturated solution of Glaubers salt ($Na_2SO_4.10H_2O$) to break it down so that it could be passed through sieves. This is achieved by repeated freezing and thawing (16-18 times) of a chalk sample which has been covered with the salt solution in a plastic container. The solution is made up by dissolving the sodium sulphate in water at 40°C until supersaturation occurs (the temperature is important as the salt is most soluble at that value). The chalk is broken up by the large crystals that form every time that the salt solution is frozen.

Several monographs were used to identify most of the collected fossils, including those by Davidson (1854, 1874) and Woods (1903, 1913) for the brachiopods and bivalves, respectively, Jäger (1983) for the serpulids, and Withers (1935) for the cirripede plates found in the bulk sample residues.

The daunting task of identifying the large bryozoan fauna was aided by the four catalogues of the bryozoa in the department of Geology of the British Museum (volumes 1 and 2 by Gregory (1899, 1909), volumes 3 and 4 by Lang (1921, 1922)), the bryozoan section of the treatise on invertebrate palaeontology (part G, Bassler (1953)), and Larwood's 1962 account of the morphology and systematics of some of the Cretaceous cribimorphs.

Some of the borings, especially those observed in belemnite guards, were recognised from the descriptions and figures in the paper by Mägdefrau (1937), others from the treatise, part W (Moore, 1962).

From sections where a sufficiently large number of fossils were collected (at Caistor St. Edmund, Keswick, and between Weybourne Hope and Old Butts Gap on the north Norfolk coast) calculations of volumetric abundance per cubic metre of chalk were performed for common fossils and important groups collected over measured horizontal distances. The formula of McKinney (1986, p. 80) was used to produce faunal distribution patterns throughout the sections.

Localities within both zones will be described (in stratigraphic order) along with a brief summary of the fauna obtained from bulk samples (in which the bryozoan content will be described separately from the remainder of the identified fauna) and from macro-fossils collected in the field.

1.2 GONIOTEUTHIS ZONE

1.2.1 INTRODUCTION

This zone contains all the chalk between the top of the *Marsupites* Zone and the base of the *Belemnitella mucronata* Zone (Table 1.1) and is characterised in Norfolk by the regular occurrence of forms of the belemnite _Gonioteuthis_ (belonging to the _granulata_ - _quadrata_ evolutionary sequence). Due to the paucity of exposure which has limited precise biostratigraphical work, it is convenient to refer all beds within the zone to an " Undivided _Gonioteuthis_ Zone" (introduced as a local zone in Norfolk by Peake and Hancock, 1961, p. 313). However, it is possible (Peake and Hancock 1970, p. 339C) to recognise sections in Norfolk that lie in both the _Offaster pilula_ and _Gonioteuthis quadrata_ Zones of southern England which together are equivalent to the undivided zone in Norfolk.

STAGE	ZONE
MAASTRICHTIAN	_Belemnella lanceolata_
CAMPANIAN	_Belemnitella mucronata_
	Gonioteuthis quadrata
	Offaster pilula
SANTONIAN	_Marsupites testudinaris_
	Uintacrinus socialis
	Micraster coranguinum (pars)

Table 1.1 Zonation of the Upper Chalk (Santonian - Maastrichtian) stages in England (after Rawson _et al_., 1978, p. 27-29).

The chalk of this zone is generally soft, and with a tendency to break along bedding-planes. The lower part is very white, with flint occurring fairly freely - generally in bands. Higher up the chalk is often yellowish, and the flints more scattered. Fossils are usually rare, and correlation between exposures is difficult.

The only extant sections found in the "Gonioteuthis" Chalk were at Wells, Guist, Sparham, Stiffkey, and Marlingford and have been placed in ascending stratigraphic order (Figure 1.20). This was determined by comparing the geographic positions of the localities with reference to the approximate north-south strike of the chalk and then by considering differences in topographic level between the sections i.e. for strike sections (unless large scale faulting or distinct faunal correlation is apparent) those at higher topographic levels are assumed to expose higher levels of chalk.

The palaeontology and lithology of each locality will be described in turn.

1.2.2 WELLS (TF 9280 4290)

This large quarry beside the A149 east of Wells lies in the lower part of the Gonioteuthis Zone (Figure 1.20). It was worked for many years by the Leicester Lime Company. More than 15 m of very white chalk with common flint bands is exposed, with a 10 cm thick marl band occurring in the middle of the section (Figure 1.2). The bottom part of the face (below the marl seam) contains several bands of black nodular flints (3, 4, 5, and 6). The lowest two flints (1 and 2) are of different form with laterally continuous, very thin (<2 cm thick) sheets of black flint. The white chalk in

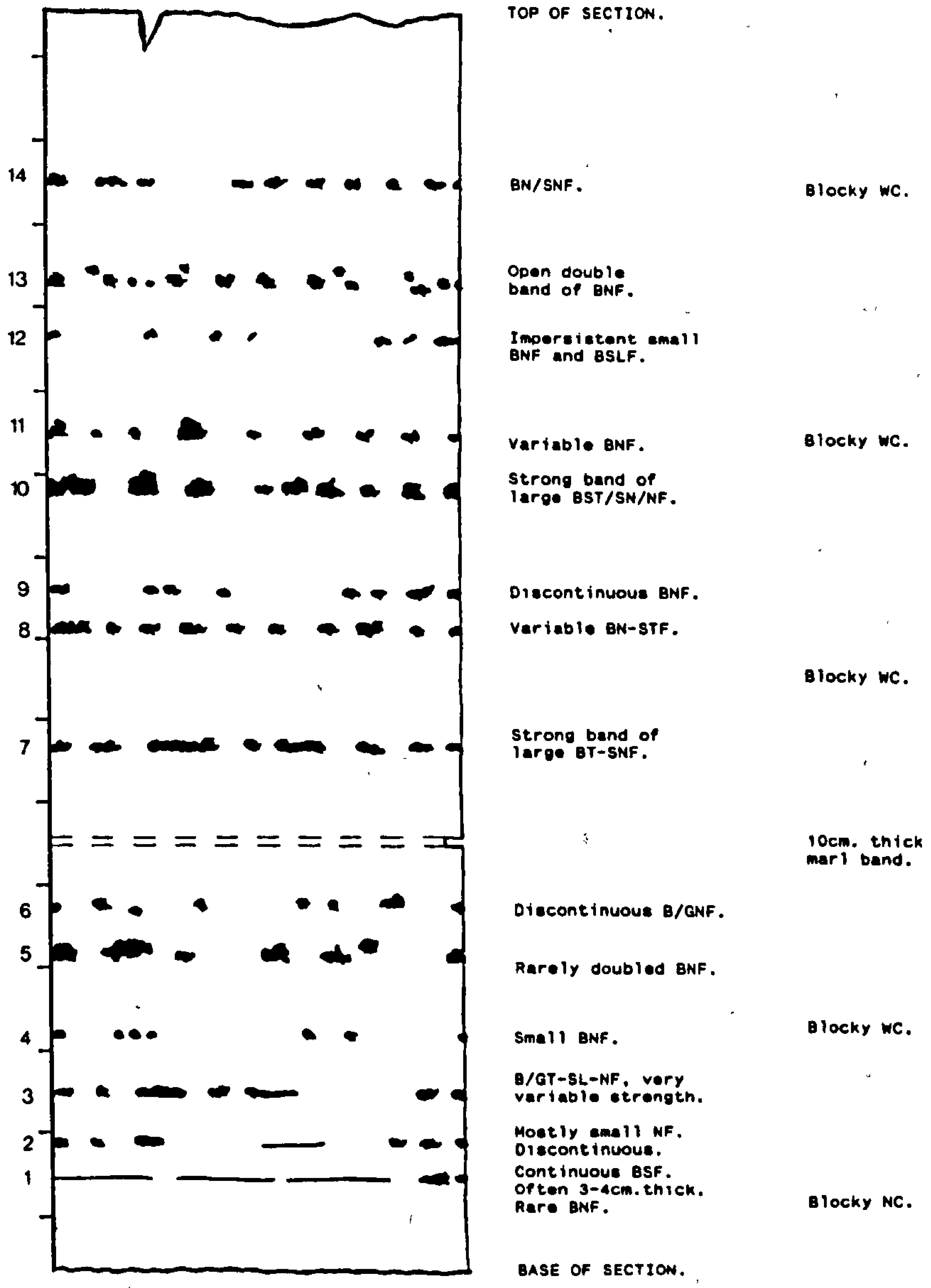


FIGURE 1.2 Diagrammatic five-metre wide section of the chalk at Wells (TF 9280 4290). Scale bars on left side in metres. Numbers on left-hand side indicate flint band notation used in the text. Flints are solid black (except where carious). SWC=soft white chalk; HNC=hard nodular chalk; B/W/O/YC=brown/white/orange/yellow chalk; BNF=black nodular flints; GNF=grey nodular flints; BSNF=black semi-nodular flints; BSTF=black semi-tabular flints; BTF=black tabular flints; BSLF=black spindle-like flints; BSF=black sheet flints.

this part of the section is quite firm and blocky and breaks along bedding surfaces. The marl band is a prominent marker within the quarry face and is much softer than the surrounding chalk. Above it a succession of flint bands (7-14) is present within the chalk. Most of these bands contain black nodular flints although band 12 has common spindle-like forms within it. As lower down in the section, the chalk is very white and somewhat blocky.

The only fossils collected from the section were fragments of an inoceramid bivalve from beneath flint band 12 and a well preserved *Echinocorys* sp. in band 9. However, 6 bulk samples of chalk taken from Wells yielded a varied (albeit largely fragmentary and somewhat abraded) fauna.

This fauna comprised common fragments of the brachiopods *Kingena pentangulata* S. Woodward and *Terebratulina* spp., the bivalves *Inoceramus* spp. (numerous), *Ostrea* spp., and *Neithea* cf. *sexcostata* (S. Woodward). The serpulids *Filogranula cincta* (Goldfuss), *Neomicrorbis crenatostriatus* (Münster), and *N. subrugosus* (Münster), and the sponges *Porosphaera globularis* (Phillips), *P. sessilis* Brydone, and *P.* sp. (fusiform), a possibly undescribed form of *Porosphaera* with fusiform (adnate) shape, were recognised. Echinoderms included columnals of the crinoid *Bourgueticrinus* sp., spines of cidarid echinoids, ossicles of the starfish Pycinaster sp., ?Astropecten sp., and ?Chomataster sp., as well as plates of the ophiuroids Ophiomusium granulosum (Roemer), Ophiura hagenowi Rasmussen, and Ophiura sp. The cirripedes Brachylepas fallax (Darwin) and ?Scalpellum sp., fragments of aseptate corals, and a solitary coral (Coelosmilia granulata (Duncan)) were also identified.

The remainder of the non-bryozoan fauna comprised several indeterminate ostracod carapaces, and foraminifera referable to Dentalina sp., Vaginulina sp., Frondicularia sp., ?Tentifrons sp., Gavelinella sp., and globigerinelloidinae.

The bryozoan fauna included examples of the anascans "Biflustra" argus d'Orbigny and Woodipora disparilis d'Orbigny (both common), Coscinopleura lamourouxi (Von Hagenow), Onychocella inelegans Lonsdale, O. cf. rowei Brydone, O. sp., Quadricellaria grania (Brydone), and "Membranipora" sp. An ascophoran ?Porina sp., an articulatan (Berenicea sp., the only specimen collected), the cancellatans Crisina sp. and Sparsicavea sp., the rectangulatan Disporella irregularis (d'Orbigny), the salpinginans Meliceritites spp. and Meliceritella sp., and the tubuloporinans Clinopora lineata Beissel, C. sp., Siphoniotyphlus tenuis (Von Hagenow), and Spiropora sp. were also identified within the sieved residues.

1.2.3 GUIST (TG 0000 2570)

Guist lies almost along strike from Wells but about 30 m higher topographically, and therefore probably exposes higher levels in the chalk (Figure 1.20). A small exposure (2 m high) of very soft, weathered, orange/brown/white chalk is visible (beneath tree roots) at the top of the old quarry just north of the A1067. No fossils were found, but a bulk sample yielded fragments of a rhynchonellid (*Cretirhynchia* spp.) and a single valve of the long ranging craniacean brachiopod *Isocrania costata* (Sowerby) as well as pieces of *Inoceramus* sp. and *Ostrea* sp. The sponges *Porosphaera globularis*, *P. sessilis*, and *P.* sp. (fusiform), and fragments of *Echinocorys* sp. were identified, along with cidarid spines and a plate of ?*Ophiura* sp. The only bryozoans recognised were the common salpinginans *Meliceritella* sp. and *Meliceritites* spp.

1.2.4 SPARHAM (1) (TG 0580 1890)

This small section lies somewhere in the middle of the *Gonioteuthis* Zone (Figure 1.20) although its exact position is not clear. In 1988 a small patch of soft, orange/brown, iron-stained chalk was visible at the base of the old pit and contained a single band of scattered generally small, black/grey nodular flints with very thin white cortices.

Fauna (entirely collected from a bulk sample) included fragments of *Terebratulina* sp., *Ostrea* sp., *Inoceramus* spp. (numerous), the sponges *Porosphaera globularis* and *P. sessilis*, and *Echinocorys* sp., ossicles of ?*Chomataster* sp., and plates of the ophiuroids *Ophiomusium granulosum* and *Ophiura* cf. *hagenowi*. The remaining identified faunal elements were aseptate corals, ostracod carapaces, and the bryozoan *Meliceritites* sp.

1.2.5 SPARHAM (2) (TG 0650 1900)

This old quarry is about 500 m east of Sparham (1) and stratigraphically slightly above it (Figure 1.20). It lies just south of a sharp bend on the road to Sparham from the A1067. Two and a half metres of soft, orange brown, iron-stained chalk with a scattered band of mostly small, black nodular flints with white cortices <3 mm thick are exposed in the long low face (Figure 1.3).

A single ossicle of ?*Teichaster* sp. was collected from the section and a bulk sample yielded fragments of the bivalves *Inoceramus* sp., *Ostrea* sp., and *Spondylus* ?*dutempleanus* d'Orbigny, and the sponges *Porosphaera globularis* and *P.* sp. (fusiform). The echinoderm content included spines of cidarid echinoids, fragments of *Echinocorys* sp., a marginal ossicle of the starfish *Metopaster* sp., and plates of the ophiuroids

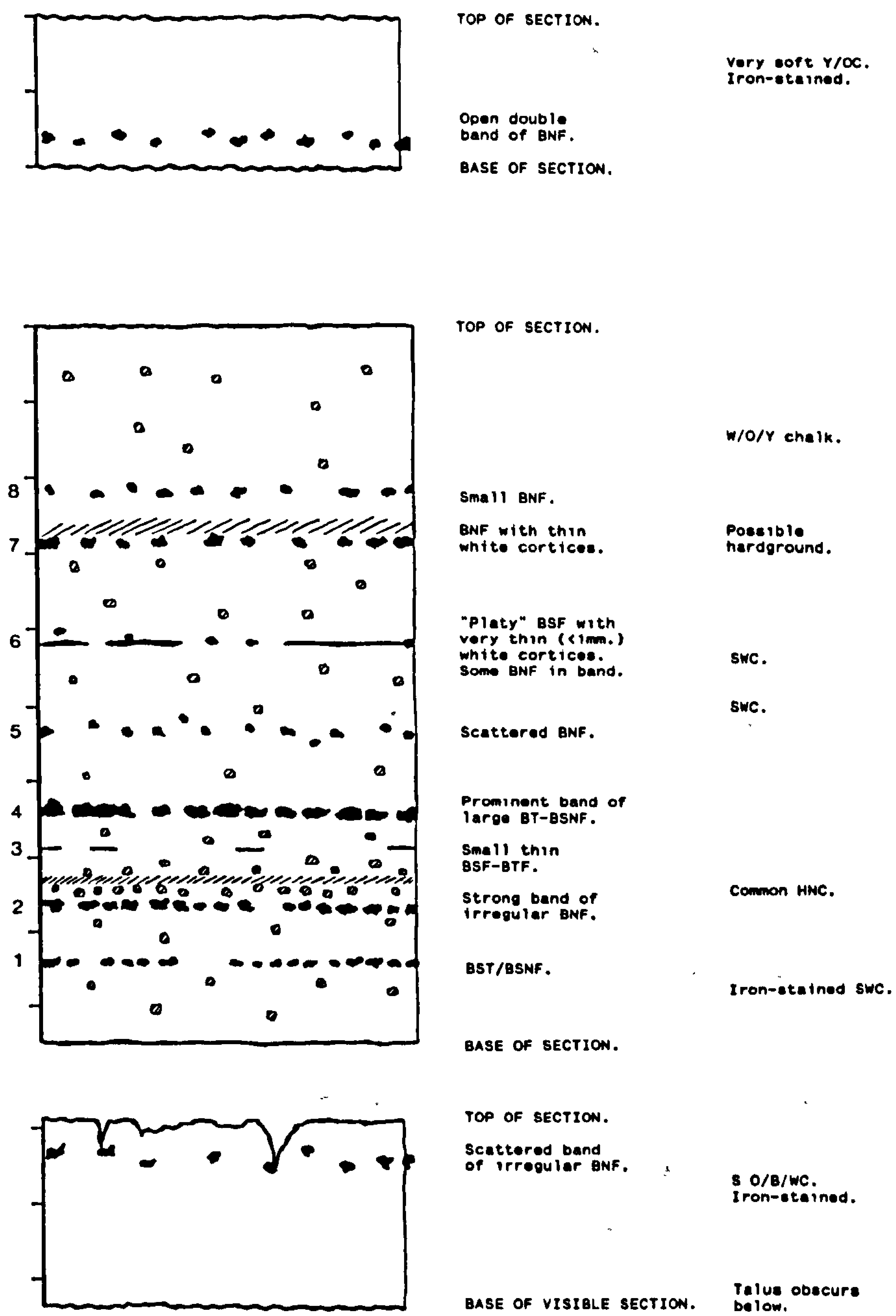


FIGURE 1.3 Diagrammatic five-metre wide sections of the chalk at Sparham (2) (TG 0650 1900) (bottom figure), Stiffkey (TF 9780 4310) (middle figure), and Marlingford (TG 1370 0930) (top figure). Symbols and abbreviations as in Figure 1.2.

Ophiomusium granulosum and *Ophiura hagenowi*. Remaining non-bryozoan faunal elements included ostracod carapaces, and foraminifera of *Gavelinella* sp. and globigerinelloidinae. The bryozoan fauna consisted of the common and long ranging anascan *Onychocella inelegans* and fragments of *Clinopora lineata* and *Crisina* sp.

1.2.6 STIFFKEY (TF 9780 4310)

This section (Figure 1.3) in the upper part of the *Gonioteuthis* Zone (Figure 1.20) contains 9.5 m of white chalk with several bands of (mostly) black nodular flints and forms a cliff in the farm-yard 200 m south of the church. The cliff probably represents a former (?pre-Pleistocene) coast-line. The lowest two flint bands (1 and 2) are formed by, mostly small, black nodular - semi-tabular flints with thin white cortices. Between these and flint 3 (a laterally impersistent band of small "platy" black forms) is a thin (~20 cm) zone of harder white chalk. Flint band 4, the best developed in the section, is characterised by large, black tabular - semi-nodular flints with thin cortices. Above this level are 3 bands of small, black nodular flints (5, 7 and 8) and another "platy" flint (6). Above 7 there may be a hardground (the upper part of the face is inaccessible), the rest of the chalk is mostly soft and white, although somewhat iron-stained.

As at Wells, no macrofossils were found in the field but two bulk samples gave a large and varied "mesofauna" including fragments of the brachiopods Isocrania egnabergensis (Retzius) and Terebratulina spp., the bivalve Lyropecten sp., the serpulids Glomerula gordialis var. ilium (Goldfuss) and Orthoconorca tubinella (Sowerby), and the sponges Porosphaera globularis, P. sessilis, and P. sp. (fusiform). Columnals of the crinoid Bourgueticrinus spp., cidarid spines, an ossicle of the starfish ?Pycinaster sp., plates of Ophiomusium ?granulosum and the cirripede Cretiscalpellum sp. were also identified. Fragments of aseptate corals, the coral Stephanophyllia clathrata (Von Hagenow), ostracod carapaces, and foraminifera including examples of Dentalina sp., Tentifrons sp., Gavelinella sp., and globigerinelloidinae were collected from the sample residues.

The bryozoan fauna included the stratigraphically restricted anascan Vincularia supercilium Brydone (only collected from the Upper Gonioteuthis Zone). This species was also recognised in several samples of equivalent age collected from boreholes in the Wymondham area (see chapter two, section 2.2). The common longer ranging anascans "Biflustra" argus, "Membranipora" spp., Onychocella inelegans, O. matrona (Von Hagenow), O. cf. rowei, and Woodipora disparilis, and the tubuloporinans *Clinopora lineata*, *Entalophora* sp., *Siphoniotyphlus tenuis*, and *Spiropora* sp. were identified, along with forms of *Coscinopleura lamourouxi*, *Disporella irregularis*, *Meliceritites* spp., ?*Porina* sp., and *Pustulopora* sp.

1.2.7 MARLINGFORD (TG 1370 0930)

This pit lies very close to the top of the zone (Figure 1.20) and was originally placed in the overlying zone of *Belemnitella mucronata* by Rowe, but later by Brydone into the *Gonioteuthis* Zone. The section (Figure 1.3) exposes about 2 m of very soft yellow/orange iron-stained chalk above talus. No fossils were found but a bulk sample contained valves of *Terebratulina* spp., examples of the serpulids *Glomerula gordialis* (Schlotheim), *G. g.* var. *ilium*, and *Pentaditrupa subtorquata* (Münster), and the common sponges *Porosphaera globularis* and *P. sessilis*. Also identified were *Bourgueticrinus* sp. columnals, cidarid spines, fragments of *Echinocorys* sp., ossicles of the starfish *Teichaster* sp. and ?*Nymphaster* sp., a plate of the cirripede *Scalpellum fossula* (Darwin), indeterminate ostracod carapaces, a specimen of the coral *Moltkia* sp., and globigerinelloidinae.

The bryozoan fauna comprised the anascans *Coscinopleura lamourouxi*, *Lunulites* sp., *Onychocella matrona*, and *Woodipora disparilis*, a rectangulatan

(Disporella irregularis), the tubuloporinan Pustulpora sp., and the salpinginan ?Meliceritella sp.

1.2.8 SUMMARY

Due to the paucity of exposures within the Gonioteuthis Zone it is difficult to draw detailed conclusions from the faunal data, but some general statements can be made.

The chalk is largely devoid of macro-fossils and the zonal fossil was not recorded from bulk or borehole samples (the latter from Wymondham, see chapter two, section 2.2) or collected in the field. In contrast to the rarity of large fossils bulk samples contained a large and varied mesofauna. A good example of this occurred at Stiffkey where two and a half hours of careful collecting yielded no fossils, but two bulk samples contained 22 different identified genera. Most of the taxa within the samples occur commonly throughout the zone and up into the overlying mucronata chalk.

These include sponges of the genus Porosphaera, the serpulid Glomerula gordialis var. ilium, spines of cidarid echinoids, plates of the ophiuroids Ophiomusium spp. and Ophiura spp., and columnals of the crinoid Bourgueticrinus spp. Ossicles of the starfish Pycinaster spp. were commonly recorded (especially towards the top of the zone) but are very rare above, only a single specimen being recorded in the very bottom of the overlying Belemnitella mucronata Zone.

Amongst the bryozoans, the anascans Onychocella matrona, O. inelegans, and Woodipora disparilis are very common, as are the salpinginans Meliceritites spp. and Meliceritella spp. The anascan Vincularia supercilium was only recorded in the upper part of the zone (at Stiffkey and in chalk of a similar age from boreholes at Wymondham) and appears to be a good indicator of upper Gonioteuthis age.

The chalk in the lower part of the zone is blocky and firm (Glauber's salt was needed to break down the bulk samples from Wells prior to their being sieved) with common flint bands. The localities higher in the zone (Sparham, Stiffkey, and Marlingford) expose mostly soft, yellow/white chalk with flints.

In conclusion, the lack of exposure and the rarity of stratigraphically restricted fauna means that it is not possible, at present, to sub-divide the zone and will remain so, until and, unless further sections become available.

1.3 *BELEMNITELLA MUCRONATA* ZONE

1.3.1 INTRODUCTION

Chalk of this zone, the highest Campanian stage (see Table 1.1, p. 5), has long been famed for the abundance, and often exceptional preservation quality, of the fauna, and is the classical "Norwich Chalk" of early authors, collectors having been active since the first part of the nineteenth century.

The boundaries at the top and bottom of the zone are uncertain as neither is exposed, although the lower may have been present in old sections (where chalk was not visible in 1987) at Bawburgh (TG 1610 0906) and between Ringland (TG 1300 1460) and Taverham Park (TG 1474 1386). The upper boundary is nowhere exposed (the easterly dip of the chalk having taken its surface below ordnance datum level east of Cromer). Chalk of definite Maastrichtian age has only been found in glacially transported erratics on the north Norfolk coast and elsewhere inland (Peake and Hancock, 1961, p. 324-330). However Maastrichtian chalk has been recognised on faunal grounds in borehole samples collected from Wroxham (Whittlesea in preparation).

The chalk of the *mucronata* Zone has been divided into different units by workers using various criteria (see Wood, 1988 for a resume of research history). Dr.

A.W. Rowe was active in the early part of the twentieth century and although he did not attempt to divide the lower part of the mucronata Zone, he did recognise two "lines" (which he could trace between localities), the "Tharston Line" and the "Cley Line", based on the occurrence of particular faunas. Higher up he noted the bed of hard chalk near the top of Attoe's pit (TG 2310 1110) now recognised as the Catton Sponge Beds.

R.M. Brydone (1930, 1932, 1938) worked in the Norfolk Chalk for more than forty years and referred to five horizons in the zone based upon broad faunal divisions. More recently, Peake and Hancock (1961, p. 314-318) introduced a six-fold division (based mainly upon Brydones horizons). Wood (1988, p. 31-39) has suggested a modified version of this, replacing the lowest two divisions with a "Pre-Weybourne" unit which has been split into five sections on faunal grounds (see Table 1.2).

	Peake and Hancock (1961)	Wood (1988)
(highest)	Paramoudra Chalk	Paramoudra Chalk
	Beeston Chalk	Beeston Chalk
	Catton Sponge Beds	Catton Sponge Beds
	Weybourne Chalk	Weybourne Chalk
	Eaton Chalk	Pre-Weybourne Chalk
(lowest)	Basal mucronata Chalk	

Table 1.2 Sub-divisions of the Belemnitella mucronata Zone after Peake and Hancock (1961) and Wood (1988).

The base of the Weybourne Chalk division has been placed at the top of the local range of Echinocorys ex gr. conica by Wood (1988, p. 33), which he considers to be at the level of flint band X of Peake and Hancock's (1961, p. 315) section at Weybourne, whereas they put the base at the level of flint band Z of the section several metres below band X.

It is proposed herein to use Wood's scheme to divide the mucronata chalk, but to place the base of the Weybourne Chalk at the level suggested by Peake and Hancock (1961, p. 317).

1.3.2 PRE-WEYBOURNE CHALK

This unit (poorly exposed in Norfolk) is characterised by the occurrence of bands of chalk containing the anascan bryozoan Volviflustrellaria taverensis (Brydone) and by particular shape variants of Echinocorys spp. (Peake and Hancock, 1961, p. 314). The chalk is, mostly, soft and white or yellow (due to iron-staining) in colour and contains common flint bands. Wood (1988, p. 31-32) has sub-divided this chalk into five units ("Pre-Weybourne 1-5" respectively). However, at the representative localities for at least three of these, chalk is no longer visible, or was only exposed in temporary sections during building work. Hence, it is not possible to recognise some, if not all, of Woods units and all described exposures will be referred to an undivided Pre-Weybourne Chalk division.

Sections in this chalk were visited (in ascending order (Figure 1.20)) at Spring Farm (Attlebridge), Cley-next-the-sea, Tharston, University of East Anglia (groundsman's huts on the university playing fields), and Newfound Farm (Cringleford). Each will be described in turn.

1.3.2.1 SPRING FARM (ATTLEBRIDGE) (TG 1550 1600)

This pit (Figure 1.20) was considered by Brydone to lie very close to the base of the zone but may be cut in a "raft" of glacially transported chalk (Wood, 1988, p. 14). About 1 m of very soft white chalk is exposed at the bottom of an old pit in a field 200 m south-east of the farm buildings. No fossils were found but a bulk sample of chalk contained a single valve of the craniacean brachiopod Isocrania costata, a partial specimen of Magas sp., fragments of the bivalves Ostrea sp., Inoceramus spp. (numerous), Spondylus dutempleanus, and S. spinosus (J. Sowerby), and the serpulids Glomerula gordialis var. ilium and Neomicrorbis crenatostriatus. A fusiform Porosphaera was also recognised. Echinoderms included fragments of Echinocorys sp., spines of cidarid echinoids, and columnals of Bourgueticrinus sp., together with ossicles of the asteroids Astropecten sp. and Pycinaster sp., and ophiuroid plates of Ophiomusium granulosum and Ophiura hagenowi. Examples of the foraminifera Dentalina sp., Gavelinella sp., and globigerinelloidinae were collected from the sample residues.

The bryozoan fauna comprised a single specimen of Vincularia aff. hecamede Brydone (the only one recognised), the lowest recorded specimen of "Membranipora" flabelliformis (d'Orbigny), and examples of common and long ranging forms such as the anascans Woodipora disparilis, "Biflustra" argus, Coscinopleura lamourouxi, Onychocella inelegans, O. matrona, and Quadricellaria grania, and the tubuloporinans Clinopora lineata, Pustulopora sp., and Spiropora verticillata (Marsson). Specimens of Sulcocava sp., Meliceritites spp., and Porina sp. were also noted.

1.3.2.2 CLEY-NEXT-THE-SEA (TG 0540 4400)

This small exposure of soft, yellow/brown chalk in the old quarry (now a carpark) just east of the village lies little above the level of Rowe's "Cley Line" (characterised by the presence of the anascan bryozoan "Volvolunulites" [Volviflustrellaria] taverensis) which he identified in the pit at Cley Green (TG 0480 4330) (Wood, 1988, p. 21), inaccessible in 1988, about 500 m west of the car park.

A bulk sample yielded a fauna consisting of a valve of Isocrania costata and fragmentary remains of the rhynchonellid Cretirhynchia spp., the bivalve Inoceramus spp., the serpulid Pentaditrupa subtorquata, the sponges Porosphaera globularis and P. sessilis, and echinoderms including Bourgueticrinus sp. columnals, cidarid spines, fragments of Echinocorys sp., and an ossicle of the starfish Recurvaster sp. Foraminifera referable to Gavelinella sp. and globigerinelloidinae, and the common anascan bryozoans Onychocella matrona and Woodipora disparilis also occurred.

1.3.2.3 THARSTON (FURZE HILL) (TM 1940 9560)

The exact stratigraphic position of this pit is uncertain. Rowe placed it at the base of the mucronata Zone, but Wood (1988, p. 78) considers, on faunal grounds, that it lies at a higher stratigraphic level within the Pre-Weybourne Chalk, below the level of the chalk exposed behind the groundsmans huts at the University of East Anglia (Figure 1.20). A 60 cm high exposure of weathered soft yellow chalk in the otherwise completely overgrown pit yielded no fossils and a bulk sample gave an undiagnostic fauna comprising Belemnitella (the lowest record), Isocrania costata, fragments of the serpulids Filogranula cf. cincta and Pentaditrupa subtorquata, the sponge Porosphaera globularis, cidarid spines, and the foraminifera Gavelinella sp. The only bryozoans recognised were common "Biflustra" argus, Lunulites sp., and Disporella irregularis, a Sparsicavea sp., and the lowest recorded occurrence of Onychocella nysti (Von Hagenow).

1.3.2.4 UNIVERSITY OF EAST ANGLIA (UEA 1) (TG 1870 0840)

This small chalk exposure behind the groundsman's huts on the University playing fields lies just west of Newfound Farm. This locality is important because of the common occurrence of Volviflustrellaria taverensis (which characterises parts of the Pre-Weybourne Chalk (Figure 1.20)). About 2.5 m of soft, yellow chalk is present in two small faces with a band of large, black/grey nodular flints at the top and another at the base of the section (Figure 1.4). Two large cidarid spines were collected, each with an attached juvenile of the oyster Pycnodonte vesiculare (Lamarck).

From two bulk samples a valve of the craniacean brachiopod Isocrania costata and a specimen of the terebratulid ?Argyrotheca sp., fragments of the bivalves Inoceramus spp., Ostrea spp., and Neithea sexcostata, and the serpulids Glomerula gordialis, G. g. var. ilium, Hamulus sexangularis (Münster), and Pentaditrupa subtorquata were recognised. The common and long ranging sponges Porosphaera globularis and P. sessilis, and echinoderms including spines of cidarid echinoids and ossicles of the asteroids Metopaster sp., Astropecten sp., and ?Recurvaster sp. were also

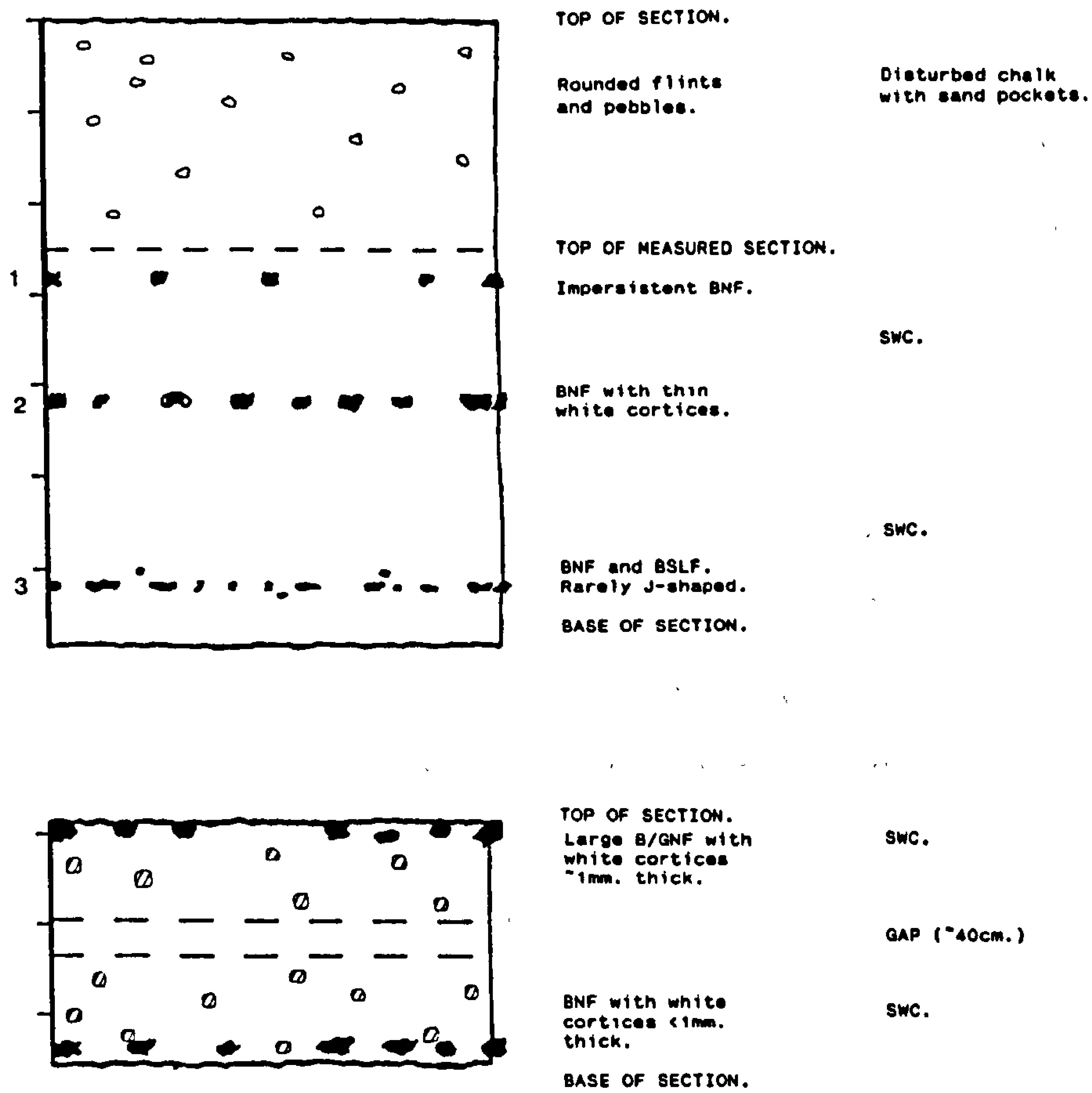


FIGURE 1.4 Diagrammatic five-metre wide sections of the chalk at University of East Anglia (UEA1) (TG 1870 0840) (lower figure) and Newfound Farm, Cringleford (TG 1892 0692) (upper figure). Symbols and abbreviations as in Figure 1.2.

collected together with a plate of the cirripede *Scalpellum* sp., and the foraminifera *Dentalina*, *Vaginulina*, *Gavelinella*, and globigerinelloidinae.

The diverse bryozoan fauna included (in addition to *Volviflustrellaria*) common anascans such as *Onychocella inelegans*, *O. matrona*, *Quadricellaria grania*, *Lunulites* sp., *Woodipora disparilis*, and the lowest recorded occurrence of *Latereschara galeata* Von Hagenow. The tubuloporinan *Clypeina rosula* (Von Hagenow), the ascophoran ?*Beisselina* sp., the cancellatans *Bicavea* sp., *Homoeosolen* sp., and *Sparsicavea* sp., the dactylethratan *Clausa globulosa* d'Orbigny, the salpinginans *Meliceritites gothica* Levinsen and *M*. sp., and the rectangulatan *Disporella irregularis* were also identified.

1.3.2.5 NEWFOUND FARM CRINGLEFORD (TG 1892 0692)

This pit lies west of the track leading to the University Broad and is largely overgrown, but a section of 4.35 m was cleared in the south-east corner of the old workings. The section exposed lies stratigraphically at about the same level as UEA 1 (Figure 1.20) and probably overlaps with it, although correlation between the two sections was not obvious.

Three bands of black nodular and spindle-like flints are visible in the soft chalk (Figure 1.4).

Above the top flint there is intense cryoturbation with rounded flint pebbles incorporated into the disturbed chalk. Fossils are scattered through the section and several Belemnitella, fragments of the brachiopods Isocrania costata, I. paucicostata (Bosquet), and Cretirhynchia spp., an unidentified terebratulid, pieces of Ostrea sp., the serpulids Glomerula gordialis and Proliserpula ampullacea (Sowerby), a partial specimen of Echinocorys sp., and cidarid spines were collected.

A diverse fauna was obtained from four bulk samples taken at ~1 m intervals. This included the brachiopod Magas sp., the bivalves Mimachlamys cretosa (Defrance) and Pseudolimea granulata, and numerous serpulids comprising Glomerula gordialis, G. g. var. ilium, Hamulus sexangularis, Neomicrorbis crenatostriatus, N. subrugosus, Pentaditrupa subtorquata, Proliserpula ampullacea, Sclerostyla sepentaria Regenhardt, and Vermiliopsis fluctuata (Sowerby). The sponges Porosphaera globularis and P. sessilis, ossicles of the asteroids Astropecten sp., Metopaster sp., ?Nymphaster sp., ?Ophryaster sp., and ?Recurvaster sp., plates of the ophiuroid Ophiura hagenowi, a partial specimen of the coral Molkia sp., and one of Stephanophyllia clathrata were also identified, as were ostracod carapaces, and foraminifera including Dentalina sp., Gavelinella sp., and globigerinelloidinae.

The varied bryozoan fauna included several examples each of the common anascans "Membranipora" flabelliformis, Onychocella inelegans, O. matrona, O. nysti, O. rowei, and Woodipora disparilis, and specimens of other anascans including "Biflustra" argus, Latereschara galeata, and a member of the "Membranipora" sevingtonensis Brydone group. Other forms recognised were the ascophoran Porina goldfussi Brydone, the tubuloporinans Clypeina rosula, Pustulpora benediana (Von Hagenow), Clinopora lineata, and Spiropora verticillata, the cancellatans Eohornera langethali (Von Hagenow), Petalopora spp., Sparsicavea spp., and Sulcocava spp., and the salpinginan Meliceritites gothica.

1.3.2.6 SUMMARY

The only fossil species recorded that is restricted to the Pre-Weybourne Chalk was the anascan bryozoan Volviflustrellaria taverensis (which occurs at certain stratigraphically restricted, but geographically widespread horizons) found only at UEA 1 and near the base of two 50 m deep boreholes drilled in Norwich for the Anglian Water Authority (see chapter two, section 2.3), but also known from a pit at Cley Green (see section 1.3.2.2).

Other faunal elements common throughout the division are Belemnitella, the brachiopods Isocrania costata and Cretirhynchia spp., the bivalves Inoceramus spp. and Ostrea spp., serpulids including Glomerula gordialis, G. g. var. ilium, and Pentaditrupa subtorquata, and the sponges Porosphaera globularis and P. sessilis. Echinoderms often found include spines of cidarid echinoids, test fragments of Echinocorys spp., ossicles of the asteroids Astropecten sp., Metopaster sp., and Recurvaster sp., and plates of the ophiuroid Ophiura hagenowi.

Bryozoans are numerous throughout the Pre-Weybourne Chalk, in particular, the long ranging anascans "Biflustra" argus, "Membranipora" flabelliformis, Onychocella inelegans, O. matrona, and Woodipora disparilis, the tubuloporinans Clypeina rosula and Pustulpora spp., and the salpinginan Meliceritites are common.

The chalk in this division is usually very soft, yellow/white in colour, frequently iron-stained, and contains common flint bands.

1.3.3 WEYBOURNE CHALK

1.3.3.1 INTRODUCTION

This division of the Belemnitella mucronata Zone is characterised by the common occurrence, particularly in the lower parts of the zone of the small rhynchonellid Cretirhynchia ?norvicensis (juv.) Pettitt (which has many characters of adult forms of C. norvicensis Pettitt). Belemnitella is common throughout, as are the echinoids Micraster ?glyphus Schlüter and M. gibba (Lamarck) which both apparently disappear at the top of the Weybourne Chalk. The central part of the division is marked by an abundant assemblage of oysters including numerous Pycnodonte vesiculare and Hyotissa semiplana (J. de C. Sowerby).

The chalk of this zone is mostly soft and yellow/brown in colour (due to iron-staining), but numerous hardgrounds occur, especially in the oyster-rich belt in the middle of the division. The type section is formed by the chalk exposed in the cliffs and along the foreshore on the north Norfolk coast between the western end of the cliffs at Weybourne Hope (TG 1115 4369) and Sheringham life-boat station (TG 1520 4355) (where the Catton Sponge Beds crop out). The base of the division has been placed at different levels by Peake and Hancock (1961, p. 317) and by Wood (1988, p. 33). (See the note accompanying Table 1.2., p. 17)

Apart from the type section, its upward continuation (Weybourne Hope East), and the inland localities at Keswick and Eaton which expose almost identical sections and correlate with the lower part of the coastal stratotype, small outcrops of chalk at Whiffler Road (in the lower part of the Weybourne Chalk) and Harford Bridges (in the oyster-rich belt) were visited.

During the course of research it became apparent that correlation could be made between inland localities at Keswick and Eaton Tunnels, just south of Norwich, and the lower part of the type section at Weybourne. Flint bands with similar morphologies occur in the same relative stratigraphic positions in all three exposures and faunal distributions could also be matched. The correlation is considered below.

1.3.3.2 CORRELATIONS BETWEEN THE CHALK EXPOSED AT WEYBOURNE HOPE, KESWICK, AND EATON TUNNELS

Two of the sections, those at Keswick and Eaton lie within a kilometre of each other almost along strike and appear to correlate well (Figure 1.5). All major flint bands occur at both localities and have identical spacings and similar morphologies. The harder chalk at

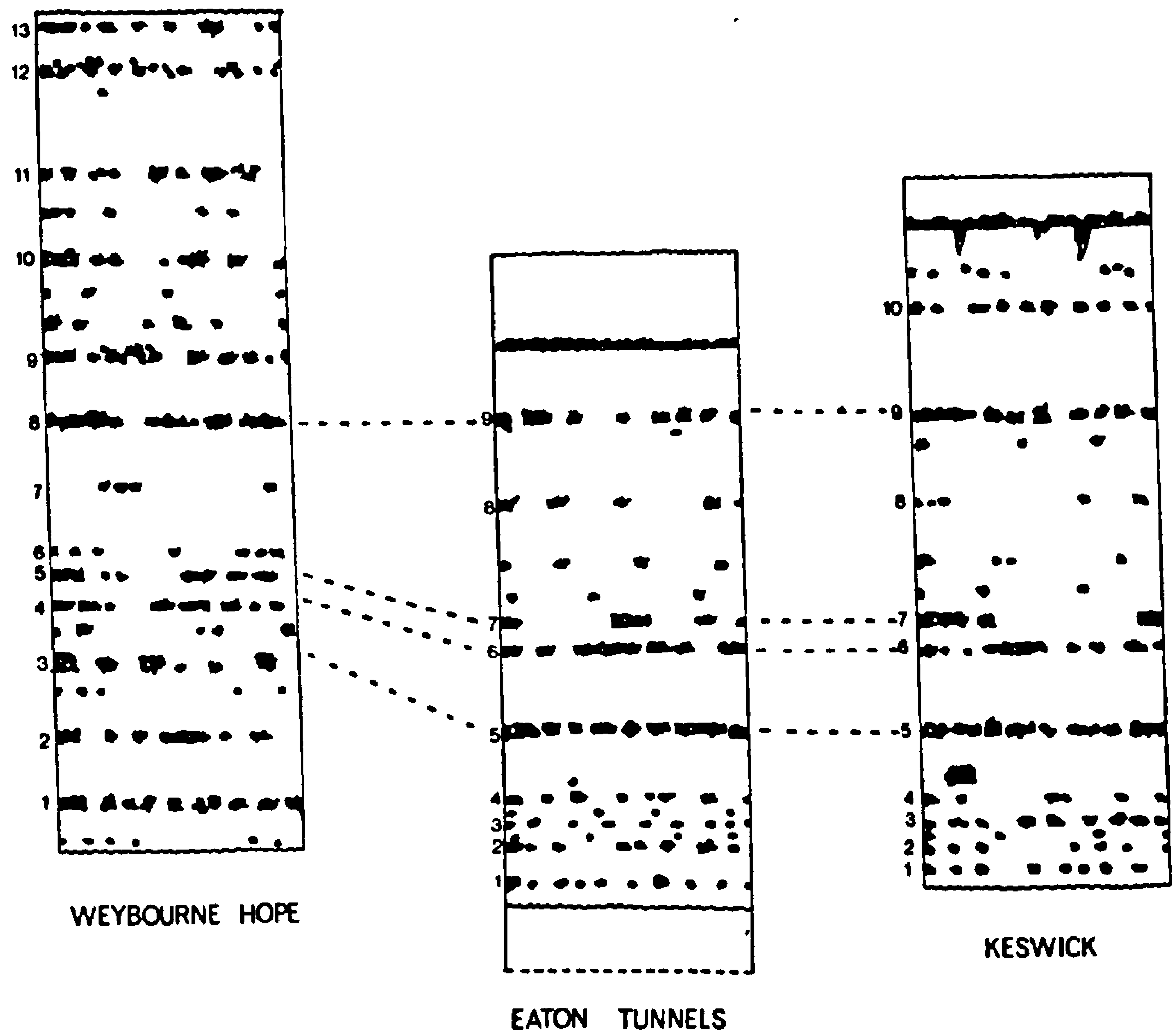


FIGURE 1.5 Correlation between the chalk sections visible at Eaton Tunnels, Keswick, and Weybourne Hope-Old Butts Gap. Numbers on left side of each section indicate the flint band notation used in the text.

Eaton (25 cm below flint 5) is in the same relative position at Keswick (25 cm below band 5). Matching these loclities with the coastal section at Weybourne Hope is less easy, but, although some of the laterally impersistent and smaller flint bands do not appear at both coastal and inland localities, all the major flint bands are present and have similar morphologies.

Flint band 9 (Eaton) which is equivalent to flint 9 (Keswick) matches with band 8 (Weybourne Hope) this being characterised by large, black tabular flints and black sheet-like forms. The best tie-up is probably that between bands 6 and 7 at Eaton (6 and 7 at Keswick) with flints 4 and 5 at Weybourne, the bands containing black tabular flints / black semi-tabular flints. The strong flint band below these (5 at Eaton and Keswick) also matches well (3 at Weybourne Hope) with its characteristic large, carious, black nodular flints and, locally hard, nodular chalk (with sponges) beneath it.

Faunal distribution patterns throughout the sections are very important in correlating the chalk between the localities, in particular, that of the oyster Pycnodonte vesiculare. This is rare at Keswick and Eaton as it is also at Weybourne up to a horizon just below flint 11 where it becomes very numerous. This level (stratigraphically above the top of Eaton and Keswick) has been recognised in a small section of nodular chalk at Harford Bridges (TG 2188 0576) (section 1.3.3.7), about 500 m north-east of Keswick, which is full of oysters including common <u>Pycnodonte</u>.

1.3.3.3 WEYBOURNE HOPE (TG 1115 4369) - OLD BUTTS GAP (TG 1236 4362)

The continuous section of chalk visible at the base of the Pleistocene cliffs between Weybourne Hope and Old Butts Gap, near Cromer on the north Norfolk coast, was taken as the type section of the Weybourne Chalk division of the <u>Belemnitella</u> <u>mucronata</u> Zone of the Upper Campanian chalk of Norfolk by Peake and Hancock (1961). Their section (1961, Figure 5, p. 315) has been remeasured (Figure 1.6) by determining the spacings between individual flint bands as they enter and leave the section due to the low angle easterly dip of the chalk. The chalk is dominated by several prominent, laterally continuous bands of large, black tabular - black nodular flints interspersed by impersistent bands of mostly small, black nodular flints. The chalk is often stained yellow in colour due to iron-staining from overlying Pleistocene sands and gravels.

The western end of the section at Weybourne Hope is very disturbed and disrupted due to major collapse and slumping within the chalk probably caused by pre-Pleistocene karstic erosion (N.B. Peake personal communication 1988). Some of the caves present in this

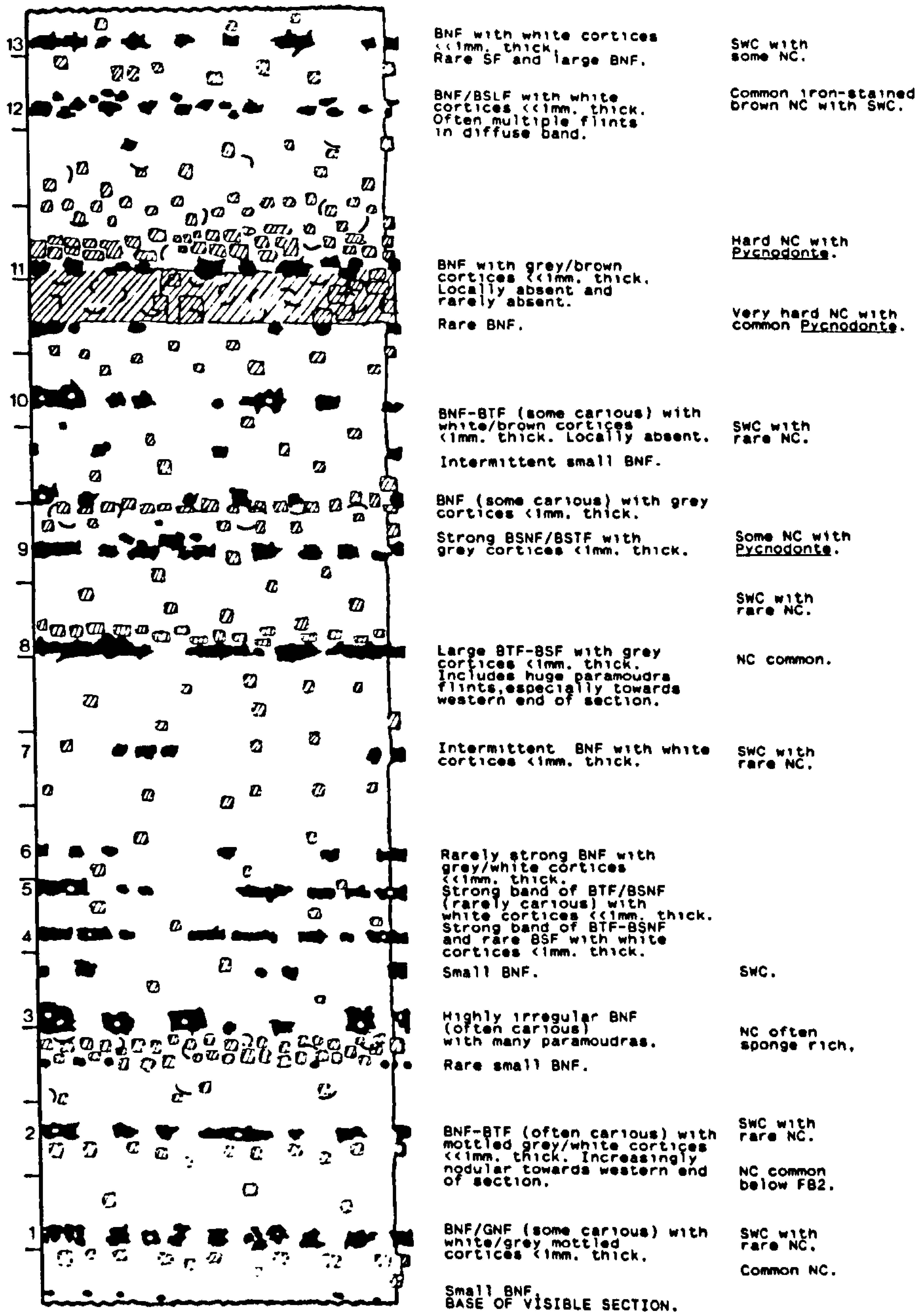


FIGURE 1.6 Diagrammatic five-metre wide section of the chalk exposed on the North Norfolk coast between Weybourne Hope (TG 1115 4369) and Old Butts Gap (TG 1236 4362). Symbols and abbreviations as in Figure 1.2.

area contain pockets of black carbonaceous material. As a result of this disturbance the lowest few metres of the section are very difficult to log and therefore are not as well understood as the rest of the section. For this reason it is generally easier to follow the section from Old Butts Gap (where flint bands 12 and 13 are both present within the cliff) westwards towards Weybourne Hope.

At the eastern end of the section near Old Butts Gap a pair of flint bands (12 and 13) occupy the section. The lower (12), in particular, has characteristic form with black nodular flints and numerous black spindle-like forms. The chalk around flint 11 is often quite hard and for about 75 cm below the band it is blocky and rich in the oyster Pycnodonte vesiculare.

To the west, the central portion of the section is dominated by two strong flint bands which are well exposed below and immediately to the east of the old coastguard cottages (TG 1167 4365). The lower of these (8) is very continuous with many large, black sheet-like flints. Generally the white chalk around these flint bands is very soft with only rare harder nodules although somewhat harder chalk occurs above band 9 and immediately below 8. Below band 8 is some 2.5 m of mostly soft white chalk with only rare flints, beneath which is a series of closely spaced flint bands. Of these, 5 and 4 are the strongest containing sometimes carious, black tabular / semi-tabular flints and together forming a useful marker for correlation.

The next major band (3) is very characteristic containing large, irregular, black nodular flints. Locally hard nodular chalk crops out below it. The basal part of the section (below 3) is very disturbed and flint bands are difficult to follow laterally. However, two bands (2 and 1) have been recognised although the lower (1) is often obscured by shingle as it crops out only at the base of the extreme western end of the cliff at Weybourne Hope. Flints in band 2 are variable, ranging from carious, black nodular forms (increasingly common towards Weybourne) to carious, black tabulates. Band 1 contains (rarely carious) large, black/grey nodular flints.

1.3.3.3.1 Palaeontology

(For ease of description palaeontology is described for the section from bottom to top).

No fossils were recorded below flint band 1 but a chalk bulk sample (weighing 2 Kg) from this level yielded a valve of the craniacean brachiopod Isocrania paucicostata and fragments of Magas sp. The bivalves Mimachlamys cretosa and Spondylus dutempleanus, and the sponges Porosphaera globularis, P. sessilis, and P.

sp.(fusiform) were recognised. An asteroid ossicle (Recurvaster sp.), spines of cidarid echinoids, and an arm plate of the ophiuroid Ophiura hagenowi were also noted. The bryozoan fauna included the anascans Coscinopleura lamourouxi, Latereschara galeata, Quadricellaria grania, and common Woodipora disparilis. Also found were a specimen of Beisselina sp., fragments of Petalopora sp., Porina goldfussi, Spiropora sp., and Disporella irregularis.

Between flints 1 and 3 Belemnitella is quite common (Figure 1.7) but the rhynchonellid Cretirhynchia spp. is rare (Figure 1.8), represented only by a single specimen of C. woodwardi (Davidson), one of C. ?norvicensis (juv.) (a small Cretirhynchia with many features of adult C. norvicensis), and four C. spp. A single specimen of the brachiopod Kingena pentangulata was collected. Bivalves, including the oyster Pycnodonte vesiculare are sporadically present (Figure 1.9) (usually in small groups of 3-4 individuals) particularly below band 2. Fragmentary remains of Mimachlamys cretosa and Echinocorys sp. were identified, and a specimen of Micraster ?glyphus was found 110 cm below band 2 and fragments of another 85 cm above.

A bulk sample taken between flints 2 and 3 furnished an unidentified terebratulid, fragments of the bivalves Pseudolimea granulata and Inoceramus sp.,

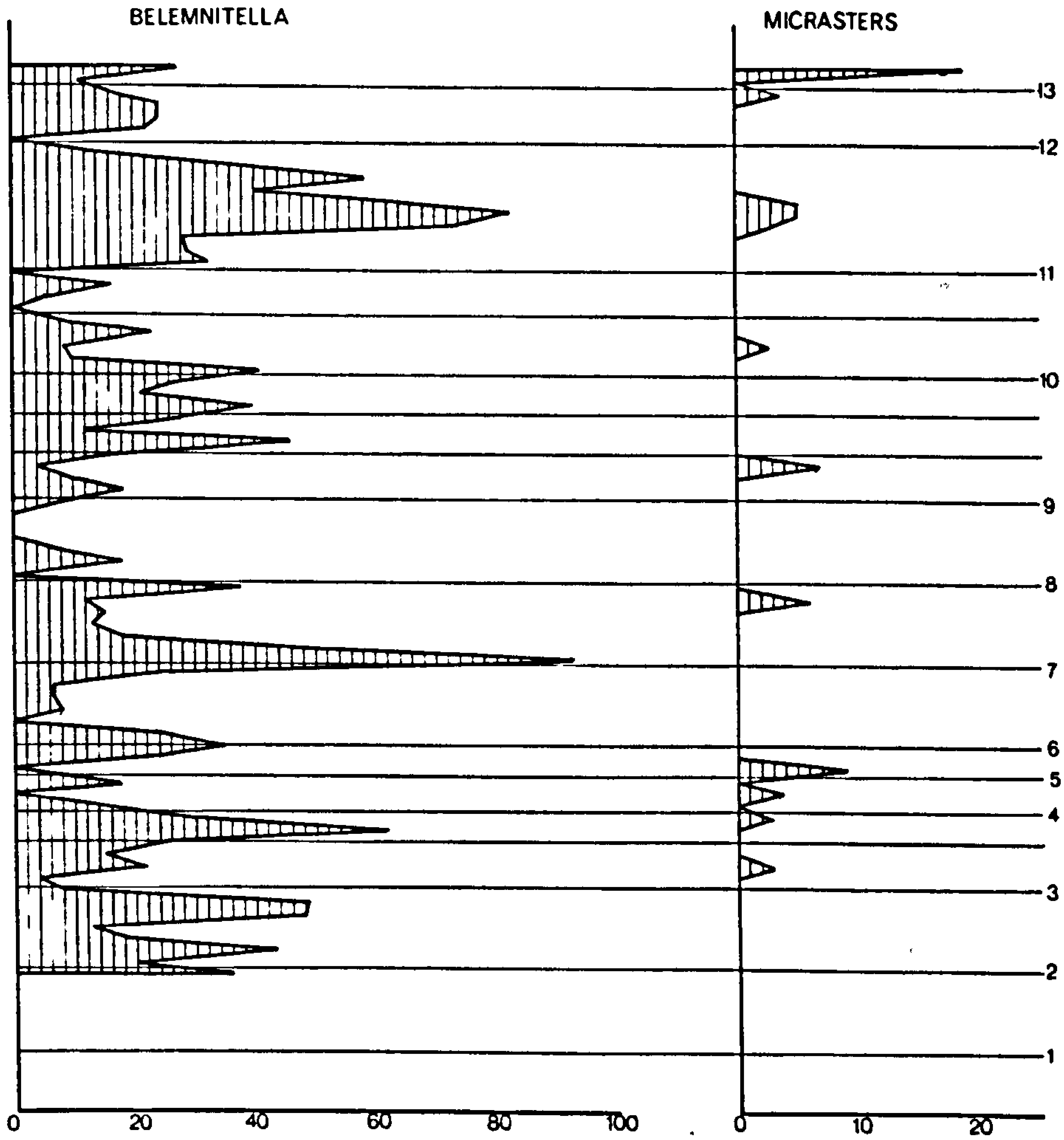


FIGURE 1.7 Volumetric abundances (per. cubic metre of chalk) for belemnites and micrasters collected from the cliff section at Weybourne. Numbers on right-hand side represent flint bands in the cliff.

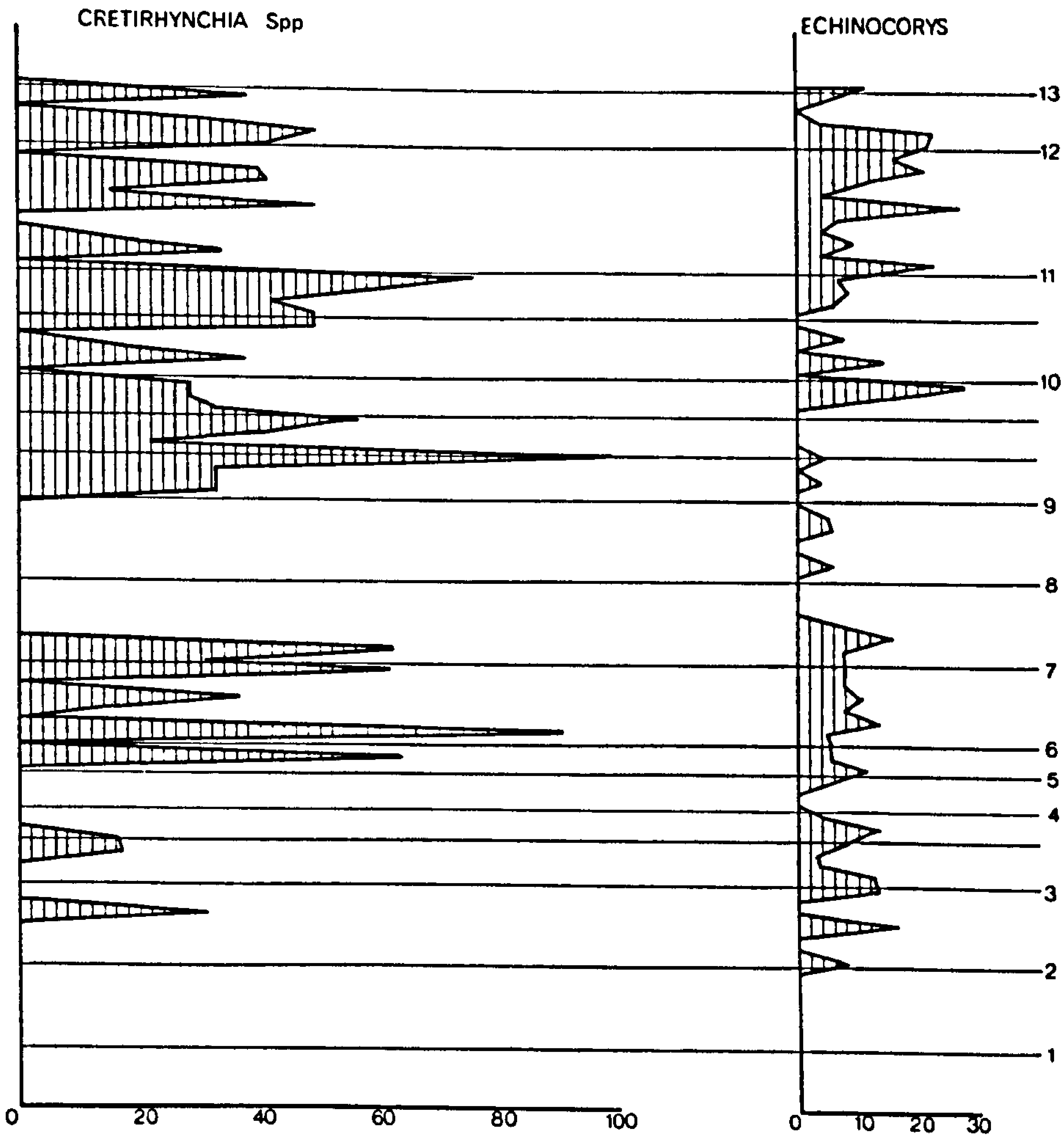


FIGURE 1.8 Volumetric abundances (per. cubic metre of chalk) for *Cretirhynchia* spp. and *Echinocorys* collected from the cliff section at Weybourne. Numbers on right-hand side represent flint bands in the cliff.

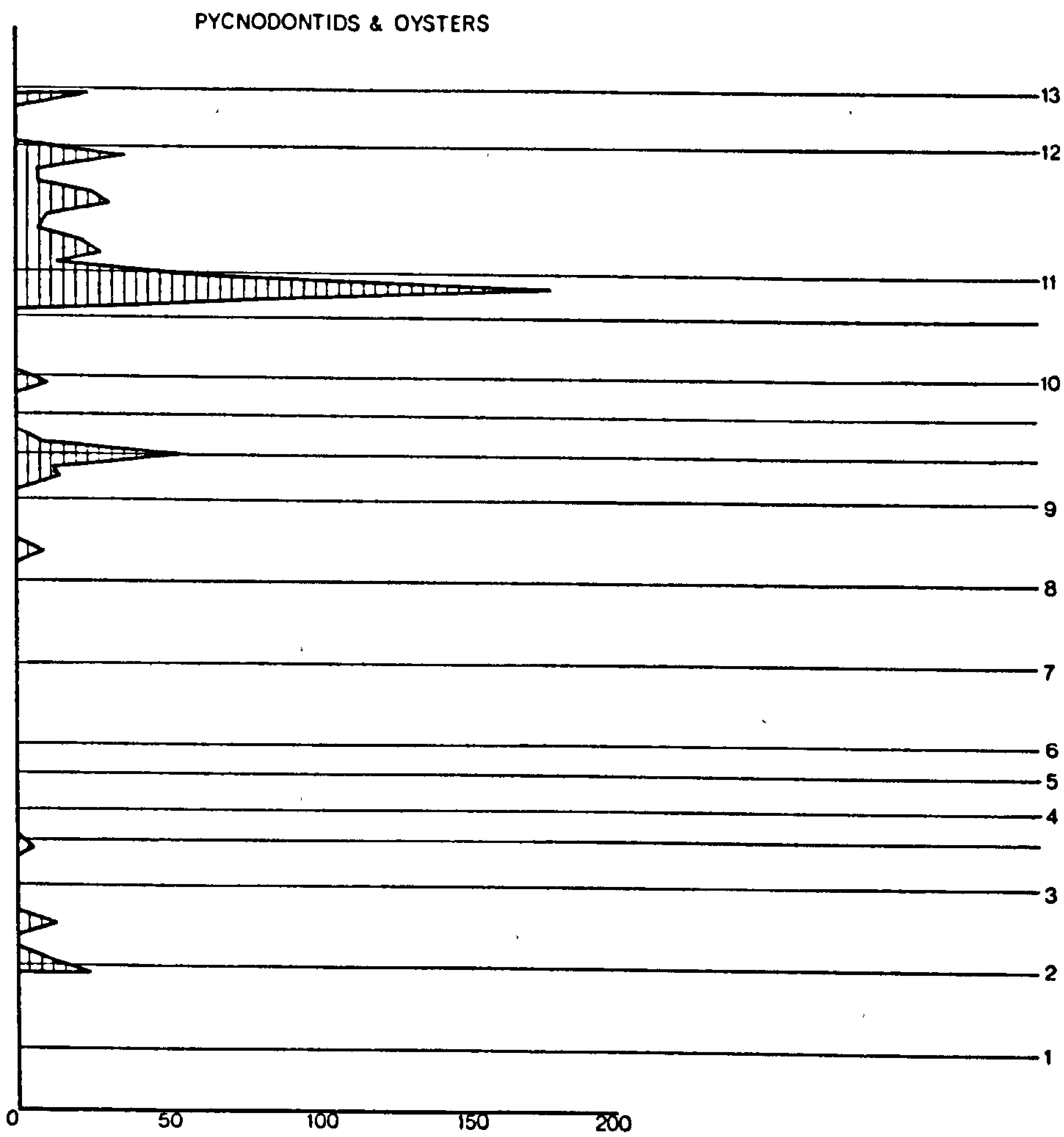


FIGURE 1.9 Volumetric abundances (per. cubic metre of chalk) for pycnodontids and oysters collected from the cliff section at Weybourne. Numbers on right-hand side represent flint bands in the cliff.

the serpulid Glomerula gordialis, and echinoderm remains including cidarid spines, and ossicles of the asteroids Astropecten sp. and ?Metopaster sp. Bryozoans included the anascans "Membranipora" flabelliformis, members of the "M". seafordensis Brydone and "M". sevingtonensis groups, common Onychocella matrona, O. inelegans, "Biflustra" argus, and Woodipora disparilis. The remainder of the fauna comprised specimens of Meliceritites ?gothica, Porina goldfussi, Pustulopora benediana, a ?Sulcocava sp., and Eohornera langethali.

Between bands 3 and 7 Belemnitella is common (Figure 1.7) (especially around flint 7) and Cretirhynchia spp. (mostly C. ?norvicensis (juv.) becomes increasingly common above flint 5 (Figure 1.8) and remains so until the top of band 7 above which it disappears. Echinocorys spp. (usually fragmentary) is scattered throughout this "zone" but not in great numbers, Micraster (?glyphus and sp.) is similarly distributed but was not found above flint 6. Oysters are extremely rare with only a fragment of Pycnodonte vesiculare recorded. Inoceramus sp. is occasionally present (usually as tiny pieces) and fragments of Pseudolimea granulata, Mimachlamys cretosa, and M. mantelliana (d'Orbigny) were found in addition to a crushed terebratulid (Neolithyrina obesa Sahni). Magas sp. nov. (see Wood 1988, p. 23) and a valve of Isocrania costata were collected, and a clump of 9 columnals (some associated) of Bourgueticrinus brydonei Rasmussen were found 25 cm below flint 6. A single specimen of the brachiopod Kingenella kongieli Popeil-Barczyk was discovered 80 cm below band 7, another just above the flint.

A bulk sample taken between flints 4 and 5 contained fragments of Neolithyrina obesa, cidarid spines, Porosphaera globularis, P. sessilis, and P. sp.(fusiform), and the serpulids Glomerula gordialis, Hamulus sexangularis, Pentaditrupa subtorquata, and Vermiliopsis fluctuata. The tubuloporinan bryozoan Clypeina rosula, the anascans "Membranipora" flabelliformis, Onychocella inelegans, and Woodipora disparilis, the ascophoran Porina goldfussi, Disporella irregularis, and a Sparsicavea sp. were also recognised.

The chalk between flints 8 and 9 is very barren with only a few belemnites, a single Pycnodonte vesiculare, and inoceramid and echinoid fragments collected.

Above flint band 9 Belemnitella is present at all levels and is particularly numerous between bands 11 and 12. Cretirhynchia spp. is common (Figure 1.8) with adult forms of Cretirhynchia norvicensis appearing more often although ?juveniles are still dominant. Echinoids (both Echinocorys spp. and Micraster spp.) (Figures 1.7

and 1.8) including a specimen of *M. gibba* occur throughout although not in great numbers. *Pycnodonte vesiculare* is common and is extremely numerous just below flint 11 (Figure 1.9). Fragments of the brachiopods *Magas* sp. and *Isocrania costata*, the bivalves *Mimachlamys cretosa*, *Pseudolimea granulata*, and *Spondylus dutempleanus*, the serpulids *Proliserpula ampullacea*, *Pentaditrupa subtorquata*, and *Sclerostyla* cf. *macropus* (J. Sowerby) cidarid spines, columnals of the crinoid *Bourgueticrinus* sp., and ossicles of the asteroid *Recurvaster* sp. were also collected.

A bulk sample (from 9-10) yielded fragments of *Cretirhynchia* spp. and *Isocrania paucicostata*, the serpulids *Glomerula gordialis* and *G. g.* var. *ilium*, an ossicle of *Astropecten* sp., and the bryozoans "*Biflustra*" *argus* and *Onychocella nysti*. Another sample taken between bands 11 and 12 contained fragments of *Terebratulina* sp., *Inoceramus* sp., and *Spondylus* sp., and arm plates of the ophiuroids *Ophiura* sp. and *Ophiomusium* cf. *granulosum*. Bryozoans included the common Weybourne form "*Membranipora*" *flabelliformis*, "*Biflustra*" *argus*, *Onychocella matrona*, *Woodipora disparilis*, and *Porina goldfussi*, also *Spiropora verticillata* and *Sparsicavea* sp.

Impressions of sponges are common throughout the section and are numerous below flint band 3, and between bands 8-9 and 10-11.

1.3.3.4 KESWICK QUARRY (TG 2120 0485)

This is a working quarry some three kilometres south of Norwich. The section (Figure 1.10) is a composite built up by measuring the faces in different parts of the quarry and matching them using flint bands to produce a "typical" five metre wide section of the chalk. The section is characterised by bands of black nodular - black semi-nodular flints interspersed with bands of laterally impersistent, small, black nodular flints. The chalk, particularly towards the top of the faces, is often stained yellow/orange/brown in colour by the downward percolation of iron-rich waters from the overlying sands and gravels.

The top of the chalk has been affected by cryoturbation with frost-wedging, frost-festooning, and solution pipes, filled with the overlying Pleistocene sands and gravels, well developed. The chalk is usually very soft containing only rare harder nodules. Two strong flint bands are visible in this portion of the section, the lower (9) being especially characteristic with many large, black nodular - black semi-tabular flints and some sheet-like forms.

Strong flint bands are absent in the middle of the section, the white chalk being mostly very soft and iron-stained on fractured surfaces. Below this is a double band of flints (7 and 6). The upper (7) is much

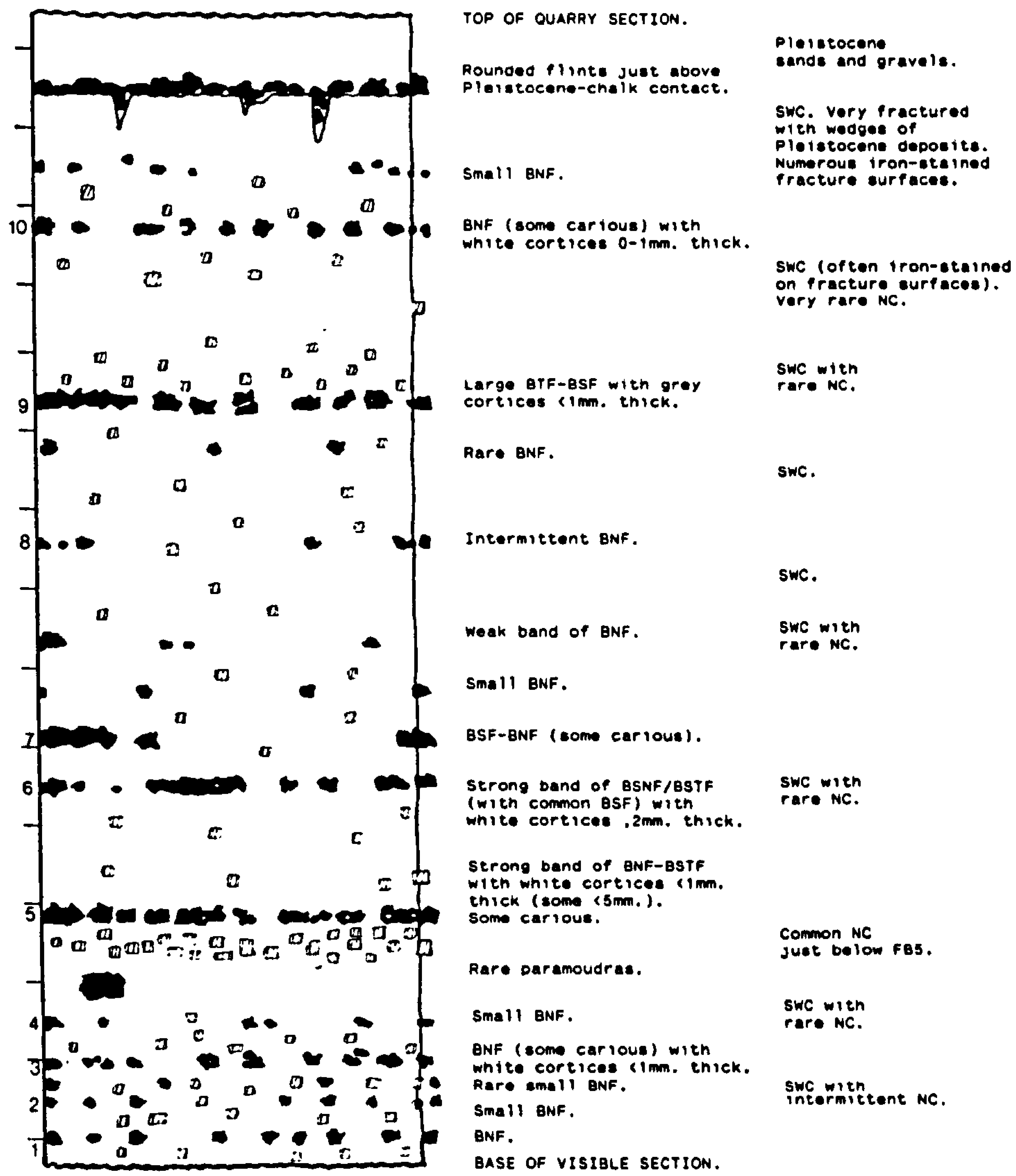


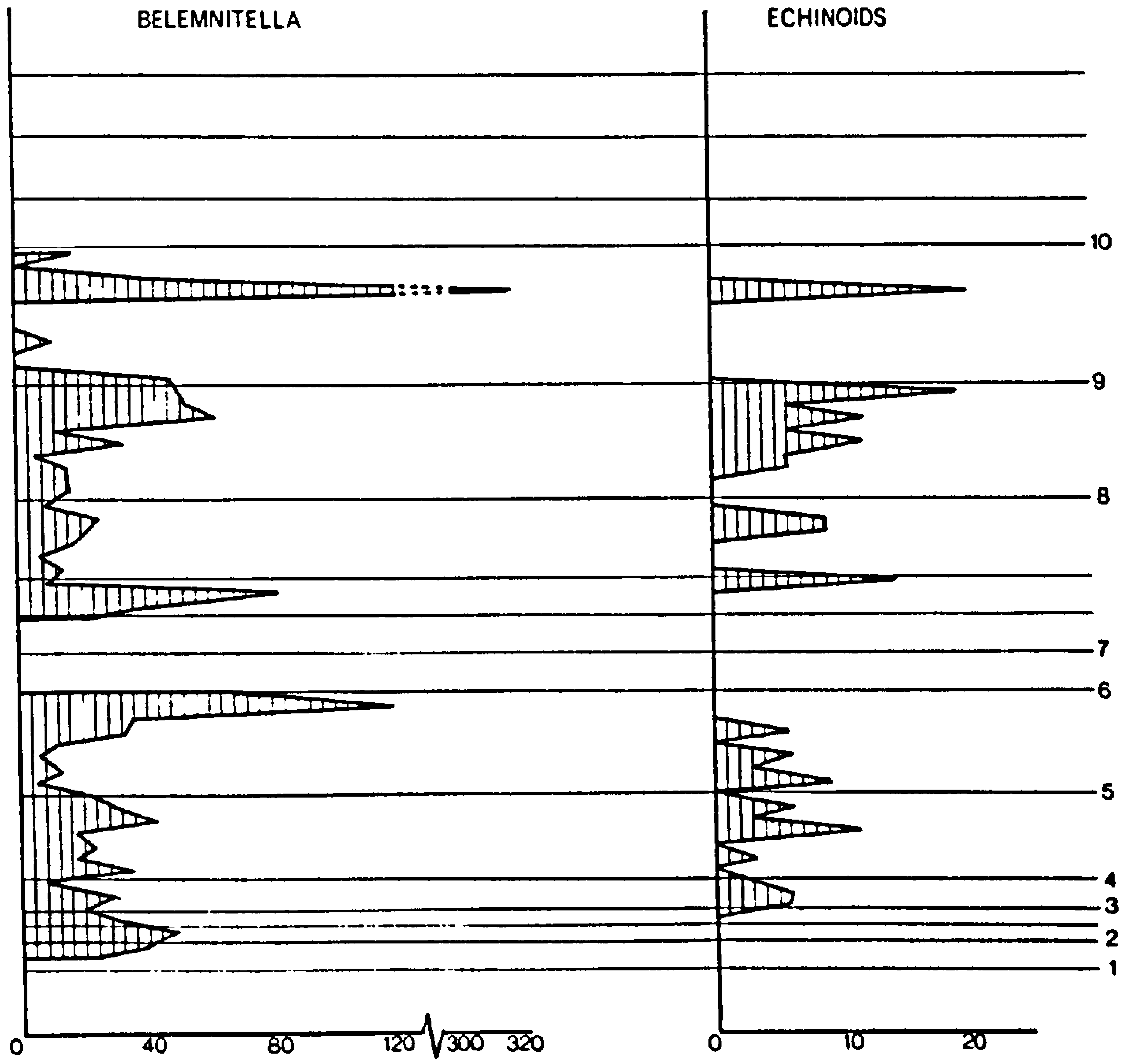
FIGURE 1.10 Diagrammatic five-metre wide section of the chalk at Keswick Quarry (TG 2120 0485). Symbols and abbreviations as in Figure 1.2.

weaker and is locally absent for >10 m. Both contain many large, black semi-tabular flints and relatively common, sometimes carious, black sheet-like flints.

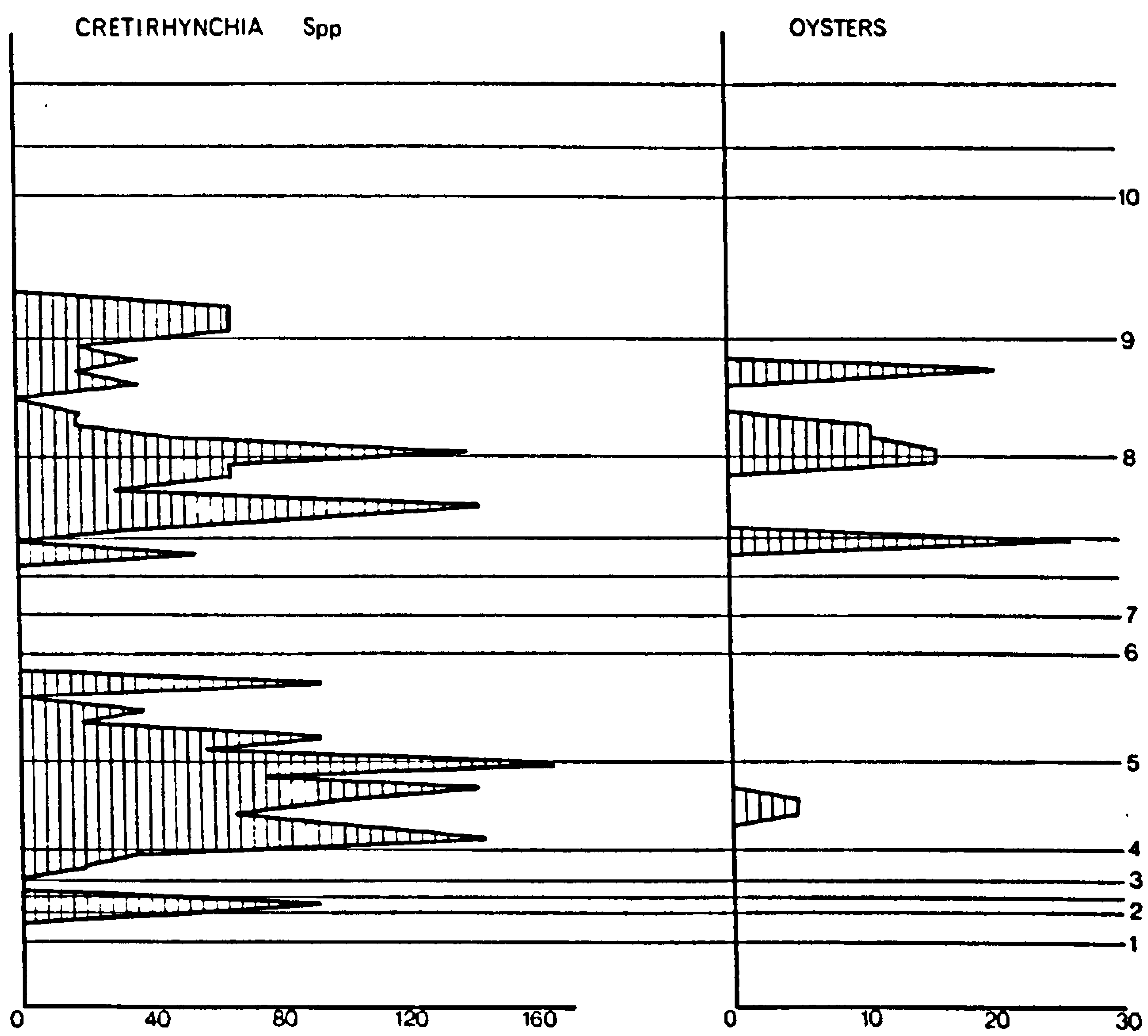
The base of the section is only exposed in one face of the quarry and is partially obscured by talus. It contains only one strong band (5) which is highly characteristic with very large, sometimes carious, black nodular - black semi-tabular flints. Below this band the chalk is often nodular, especially about 25 cm below the band. The lowest three metres of chalk contain diffuse bands of mostly small, black nodular flints in soft white chalk, although some parts of the face have a considerable nodular chalk content.

1.3.3.4.1 Palaeontology

The basal part of the section (below flint 6) contains relatively common Belemnitella (Figure 1.11), abundant Cretirhynchia ?norvicensis (juv.), and C. sp. (Figure 1.12). Collected brachiopods included a single specimen of Kingenella kongieli collected 5 cm below flint 5, two of Magas ?sp. nov., and a Terebratulina sp. Fragments of the bivalves Inoceramus sp., Mimachlamys cretosa, Spondylus dutempleanus, S. hystrix d'Orbigny (represented by a mould recovered from directly below band 4), and Pycnodonte vesiculare were found. The serpulids Hamulus sexangularis, Proliserpula ampullacea, and Pentaditrupa subtorquata, and a few



<u>FIGURE 1.11</u> Volumetric abundances (per. cubic metre of chalk) for belemnites and echinoids collected from Keswick. Numbers on right-hand side represent flint bands in the section. (Above flint 10 and between flints 6 and 7 collecting was not possible).



<u>FIGURE 1.12</u> Volumetric abundances (per. cubic metre of chalk) for <u>Cretirhynchia</u> spp. and oysters collected from Keswick. Numbers on right-hand side represent flint bands in the section. (Above flint 10 and between flints 6 and 7 collecting was not possible).

fragmented Echinocorys sp. and Micraster spp. including M. aff. glyphus were noted in the face. Sponge impressions are occasionally present in this lower part of the section, particularly directly below flint 5. A bulk sample from the basal metre of the section produced fragments of the bivalve Pseudolimea granulata, the serpulids Glomerula gordialis and G. g. var. ilium, cidarid spines, and a worn tubuloporinan bryozoan (Pustulopora sp.).

Between flint 6 and an intermittent band of small black nodular flints 60 cm above 7 the faces were inaccessible and no fossils were collected. From here until about band 9 the chalk is relatively fossiliferous although the fauna is less diverse than at lower levels. Belemnitella is quite common as is Cretirhynchia ?norvicensis (juv.) (Figure 1.12). Rare Pycnodonte vesiculare occur scattered through this part of the chalk (Figure 1.12) especially, around and below band 8 and Echinocorys sp. is present (Figure 1.11), but not abundant apart from just below flint 9. The only other fossils collected were a single specimen of Kingenella kongieli (from 110 cm below 8), two of Magas sp. and Isocrania costata, very rare Inoceramus spp. fragments, a specimen of the serpulid Glomerula plexus (Sowerby), and ossicles of Metopaster sp. and Recurvaster sp.

A bulk sample collected between flints 8 and 9 yielded fragments of *Terebratulina* sp., the bivalves *Gyropleura inequirostrata* (S. Woodward) and *Mimachlamys mantelliana*, the serpulids *Glomerula gordialis*, *G. g.* var. *ilium*, and *Vermiliopsis fluctuata*, and the sponge *Porosphaera sessilis*. Echinoderms included cidarid spines, ossicles of *Astropecten* sp., plates of *Ophiomusium granulosum* and *Ophiura*, and columnals of *Bourgueticrinus* sp. A plate of the cirripede *Brachylepas fallax* was also recorded. The common bryozoan *Woodipora disparilis* was found, as were *Clinopora lineata*, *Clypeina rosula*, *Meliceritites gothica*, and specimens of *Petalopora* sp., *Sparsicavea* sp., and *Sulcocava* sp.

The only fossils collected from the largely inaccessible beds above band 9 were five isolated belemnites, a group of 20 *Belemnitella* and a partial *Echinocorys* sp. all from a volume of 30 by 20 by 10 cm 65-75 cm below flint 10, a single crushed *Cretirhynchia* ?*norvicensis* (juv.), and a fragmented *C.* sp.

1.3.3.5 EATON TUNNELS SECTION (TG 2090 0640)

At Eaton, three kilometres south-west of Norwich, about twelve metres of chalk is exposed within and directly above the entrances to two tunnels of the old Eaton Limeworks which was active during the nineteenth and early twentieth centuries. Most of the chalk was quarried in a way that led to the formation of several large caves of which only two are now accessible, the other entrances having been blocked during the second World War.

The section was measured by Leeder and included in a paper by Hornby et al. (1973, Fig. 1, p. 6). A remeasured section (Figure 1.13) is given here.

The chalk above the tunnel entrances is highly fractured and although mostly white in colour it is often stained brown or yellow, especially on fracture surfaces, due to the percolation of iron-rich waters from the overlying Pleistocene sands and gravels. A prominent band of black nodular - black semi-tabular flints is visible some 3 m above the tunnel entrances as are much weaker, laterally impersistent, bands of mostly small, black nodular flints.

Within the tunnels the section is dominated by two very strong flint bands (5 and 6) which both have characteristic forms. The higher (6) is composed of black nodular - black semi-tabular flints (some

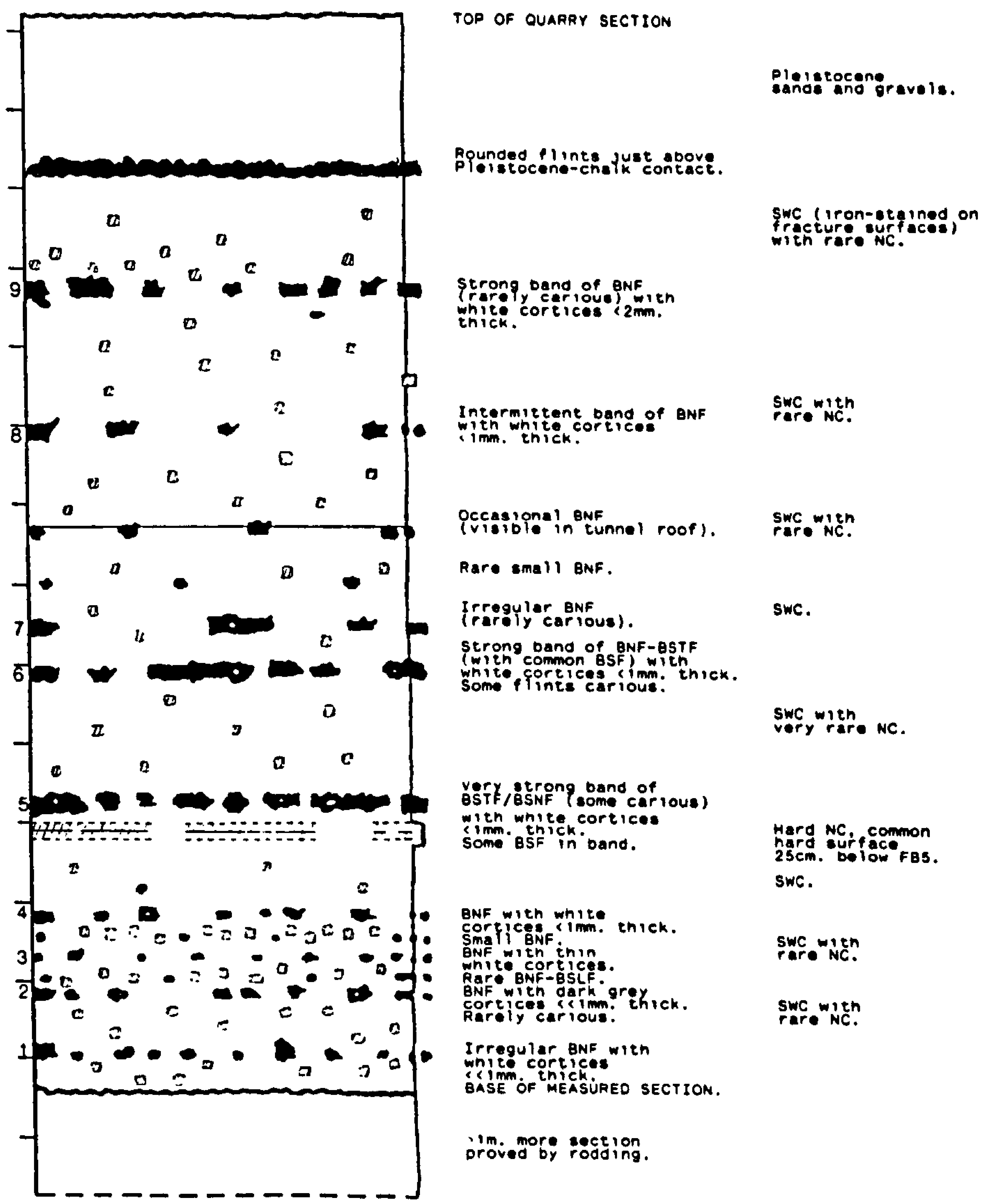


FIGURE 1.13 Diagrammatic five-metre wide section of the chalk at Eaton Tunnels (TG 2090 0640). Symbols and abbreviations as in Figure 1.2.

carious) and rarer, black sheet-like forms. Band 5 is very strongly developed with many very large, black semi-tabular / semi-nodular flints and black sheet-like forms. The chalk below 5 is locally hard with a parting often visible 25 cm below the flint band. Except for this level, the chalk is mostly soft and white on freshly exposed surfaces.

In places near the base of the visible section which contains several bands of mostly small, black nodular flints there is an increase in the amount of nodular chalk present in the tunnel walls, but nowhere does it's hardness approach that of the chalk below flint 5.

1.3.3.5.1 Palaeontology

Relatively few fossils were collected from this section, most of which suffers little (if any) weathering. Most of the fossils from the tunnels have been removed in the past by workers such as Leeder (see Wood (1988, p. 46-52) for detailed palaeontological description of this locality). The following were collected: common Belemnitella, and Cretirhynchia ?norvicensis (juv.), a juvenile Magas ?sp. nov., a single specimen of ?Hyotissa semiplana, two of Pycnodonte vesiculare, and fragments of Inoceramus sp., Mimachlamys cretosa, M. mantelliana, and Echinocorys sp. Several sponge impressions were noted, particularly just below flint band 5.

Bulk samples additionally gave the brachiopods Terebratulina sp., Isocrania costata, and a single juvenile Kingena pentangulata, bivalves including Pseudolimea granulata and Spondylus spinosus, the serpulids Glomerula gordialis, G. g. var. ilium, Hamulus sexangularis, Pentaditrupa subtorquata, and Vermiliopsis fluctuata, and the sponge Porosphaera globularis. Spines of cidarid echinoids, columnals of the crinoid Bourgueticrinus spp. (including B. brydonei), ossicles of Metopaster sp. and Astropecten sp., and plates of the ophiuroid Ophiura substriata Rasmussen were also recognised, along with the coral Stephanophyllia clathrata. The anascan bryozoans "Biflustra" argus, "Membranipora" spp., Onychocella inelegans, O. matrona, O. sp., and Woodipora disparilis, the tubuloporinans Clypeina rosula, Clinopora lineata, Pustulopora benediana, and Siphoniotyphlus tenuis, and forms of Meliceritites sp., Petalopora sp., and Crisina sp. were collected.

1.3.3.6 WHIFFLER ROAD (TG 2120 1070)

From its geographical position, this section seems to lie in the lower part of the Weybourne Chalk (Figure 1.21). About 4.5 m of white (occasionally nodular) chalk is exposed behind a factory on the industrial estate. Four flint bands are visible in the section (Figure 1.14), the lowest is a strong, open, double band of black nodular flints with white cortices <2 mm thick. Three closely spaced bands occur towards the top of the chalk, the bottom one in particular is prominent, containing large, black nodular/semi-nodular flints.

A typical "Weybourne" fauna was collected from the face comprising: *Belemnitella*, several specimens of *Cretirhynchia* ?*norvicensis* (juv.), and one of *Magas* sp., fragments of *Echinocorys* sp., and cidarid spines. Bulk samples additionally gave fragments of the bivalves *Inoceramus* spp. and *Ostrea* spp., the serpulids *Glomerula gordialis* and *G. g.* var. ilium, the sponges *Porosphaera sessilis* and *P.* sp. (fusiform), an ossicle of ?*Recurvaster* sp., *Bourgueticrinus* sp. columnals, a plate of *Ophiura* sp., and foraminifera including *Gavelinella* spp. and globigerinelloidinae. The common anascan bryozoans *Onychocella matrona* and *Woodipora disparilis* were identified, as were fragments of *Clypeina rosula*, *Pustulpora* sp., *Sparsicavea* sp., *Spiropora verticillata*, and *S.* sp.

1.3.3.7 HARFORD BRIDGES (TG 2188 0576)

This is a complex of largely overgrown pits (in the middle of the Weybourne Chalk (Figure 1.21)) situated to the north of the Norwich to Ely railway line and to

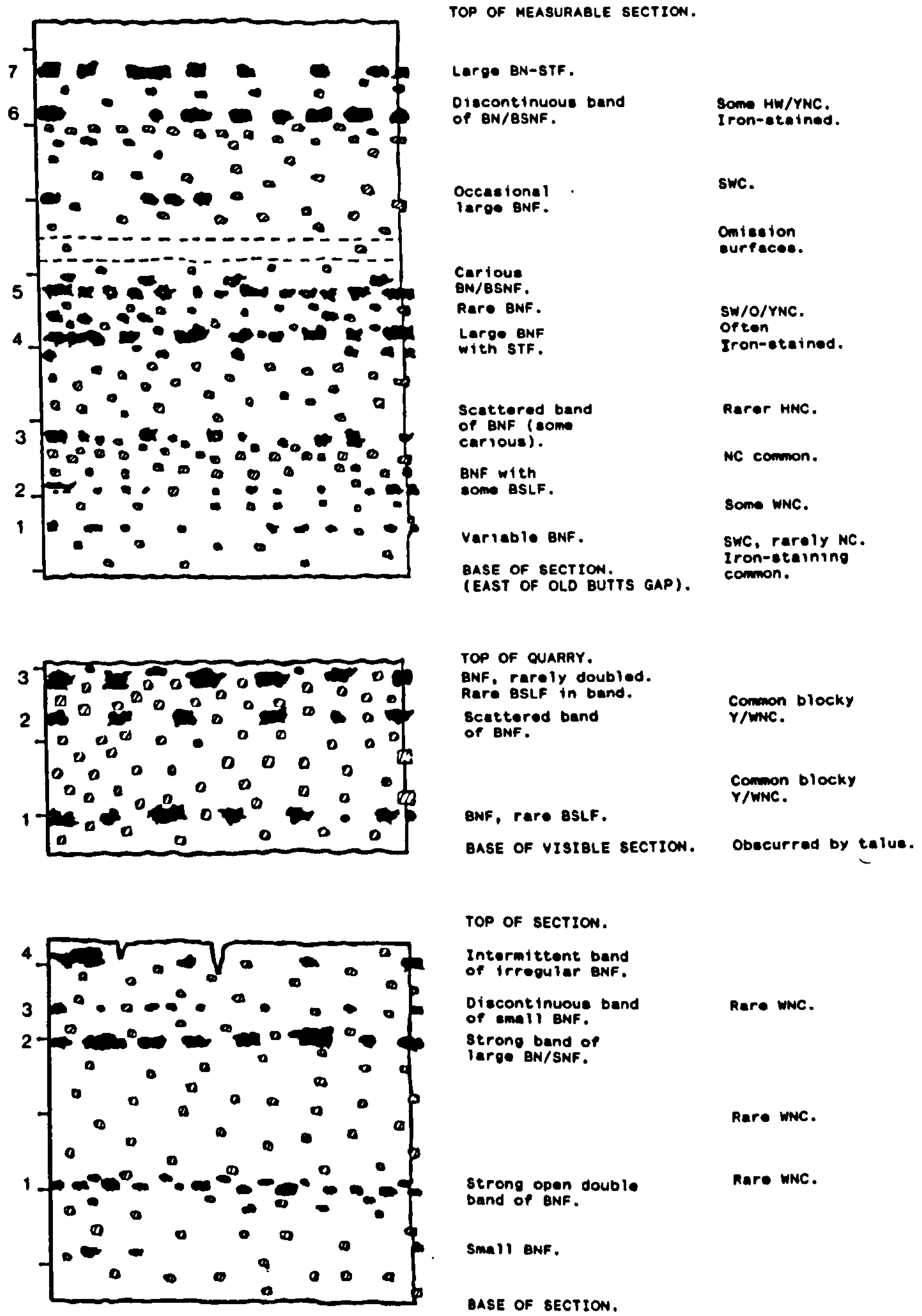


FIGURE 1.14 Diagrammatic five-metre wide sections of the chalk at Whiffler Road (TG 2120 1070) (bottom figure), Harford Bridges (HBR1) (TG 2188 0576) (middle figure), and Weybourne Hope East (TG 1290 4360 - 1390 4350) (top figure). Symbols and abbreviations as in Figure 1.2.

the west of the A140. Two separate chalk faces were found, the more westerly (HBR 1) the Eaton Golf Course Pit and HBR 2. (For a discussion of the identities of pits within the complex see Wood, 1988, p. 57.)

1.3.3.7.1 HBR 1.

A section of 2.25 m (Figure 1.14) (above a large heap of debris) is all that remains of a once deep pit. This contains scattered bands of black nodular flints. The chalk is commonly firm and blocky. Oysters (Ostrea spp., Pycnodonte vesiculare, and Hyotissa semiplana) are very common and are an important indicator of the correlation with oyster-rich chalk on the north Norfolk coast at an equivalent stratigraphic level. Belemnites of "Keswick" type are also abundant. Three specimens of Magas sp., a crushed specimen of Kingena pentangulata, fragments of Inoceramus spp., the serpulid Pentaditrupa subtorquata, Echinocorys spp., and ?Micraster sp. were collected.

From a bulk sample fragments of Cretirhynchia sp. and the bivalve ?Lyropecten sp., cidarid spines, and Bourgueticrinus spp. columnals were collected. The anascan bryozoans "Biflustra" argus, Onychocella nysti, and Woodipora disparilis were recognised, along with Porina socia Brydone, Pustulpora benediana, P. sp., and fragments of Meliceritites spp.

1.3.3.7.2. HBR 2.

A small tufa-encrusted face with an adit yielded a lump of nodular chalk which contained several small Carneithyris carnea (J. Sowerby). This is the lowest record of this terebratulid, which is characteristic of the mucronata chalk above the Catton Sponge Beds.

1.3.3.8 WEYBOURNE HOPE EAST (TG 1290 4360 - 1390 4350)

The section of about 7 m (Figure 1.14) was produced by measuring the vertical spacing between flint bands as they enter and leave the discontinuous chalk outcrop (with its low angle easterly dip) at the base of the Pleistocene cliffs between the second gap in the chalk east of Weybourne (TG 1290 4360) and a point 500 m west of Old Hithe (TG 1390 4350) where the chalk becomes so disrupted that it is not possible to measure any further section. This chalk lies immediately above that of the section between Weybourne Hope - Old Butts Gap (Figure 1.21).

The lowest two flint bands (1 and 2) are both intermittently developed and are formed by mostly small, black nodular flints (rarely spindle-like in 2) with white cortices. Chalk below flint 2 is soft and iron-stained. Band 3 is composed of variable, black nodular flints (some carious) with white cortices <1 mm thick. Between flints 2 and 3 the chalk is often nodular and heavily iron-stained as it is below flint band 2. About 1.5 m above flint 3 is a zone of scattered flints in irregular bands with two dominant central courses (4 and 5). Band 4 is characterised by large, black nodular - semi-tabular flints with thin, white/grey cortices, whilst 5 contains somewhat carious, black nodular/semi-nodular forms with similar cortices. The chalk between bands 3 and 5 is mostly soft. Above flint 5 there is about 2 m of chalk with occasional large, black nodular flints topped by two strong flints (bands 6 and 7) which lie at the top of the measurable section. Flints in band 6 are mostly black nodular/semi-nodular types with thin, grey/white cortices <1 mm thick, whilst those in band 7 are large and variable, ranging from black nodular - semi-tabular forms. The disturbed chalk in the upper part of the section consists of hard nodules set in a soft, iron-stained, orange/yellow/brown matrix.

A few fossils were collected from the section including several Belemnitella, a complete Terebratulina sp., fragments of Pycnodonte vesiculare, four Micraster spp., including M. gibba, a Bourgueticrinus sp. columnal, and a fragment of Echinocorys sp. Additional to these were (from 2 bulk samples) fragments of Cretirhynchia spp., the bivalves Inoceramus spp., Pseudolimea granulata, and Spondylus spinosus, the serpulids Glomerula gordialis and Neomicrorbis crenatostriatus, spines of cidarid echinoids, and plates of the ophiuroids Ophiomusium granulosum and O. sp. Identified foraminifera were Dentalina spp., Vaginulina sp., Gavelinella spp., and globigerinelloidinae. The bryozoan fauna included Latereschara galeata, "Membranipora" vertebralis Brydone, Onychocella matrona, O. sp., Woodipora disparilis, Clinopora lineata, and fragments of Meliceritites spp.

1.3.3.9 SUMMARY

The Weybourne Chalk is characterised by the complex of oyster-rich hardgrounds that crop out in the coastal stratotype and in equivalent inland localities at Harford Bridges. It is possible to split the chalk into units, since the chalk below and above the hardground complex rarely contains oysters. However other fossils which are common throughout the Weybourne division include the rhynchonellid Cretirhynchia spp. (mostly C. ?norvicensis (juv.), Belemnitella, Echinocorys spp., Micraster gibba, and M. ?glyphus (both of which apparently die out at the top of the division). The oysters Pycnodonte vesiculare and Hyotissa semiplana are abundant in the oyster-rich beds.

The mesofauna from this chalk is largely undiagnostic. Common elements include fragments of the long ranging brachiopods Magas sp. and Terebratulina spp., and the bivalve Inoceramus spp. The serpulid Glomerula gordialis, ossicles of the asteroid Astropecten sp., spines of cidarid echinoids, and plates of the ophiuroids Ophiomusium granulosum and Ophiura sp. are regularly collected. Amongst the bryozoans, long ranging forms of the anascans "Biflustra" argus, "Membranipora" spp., Onychocella inelegans, O. matrona, and Woodipora disparilis are very common, as is the cancellatan Sparsicavea spp.

The chalk is mostly soft, apart from the hardground complex in the oyster-rich belt and, locally hard, nodular chalk at other levels.

1.3.4 CATTON SPONGE BEDS

These hardgrounds (Figure 1.21) are preserved in the site of special scientific interest (SSSI) at Catton Grove (TG 2289 1094) in Norwich. No chalk is visible at present, the small extant face of the original workings being completely degraded. The same beds are very rarely visible beneath the shingle cover at Sheringham life-boat station (TG 1520 4355) on the north Norfolk coast, but were not evident during fieldwork. See Wood (1988, p. 61-66) for a description of the sponge beds and their distinctive fauna.

1.3.5 BEESTON CHALK

1.3.5.1 INTRODUCTION

This chalk lies above the Catton Sponge Beds and below the Paramoudra Chalk (Table 1.2, p. 17). The division is characterised by the development of "ring flints" and by belts of chalk rich in large fragments of Inoceramus spp. shell. The fauna is characterised by common and distinctive brachiopods including the rhynchonellids Cretirhynchia norvicensis and C. arcuata Pettitt and the terebratulid Carneithyris carnea. Belemnites are numerous throughout, as is the echinoid Echinocorys spp., which often occurs in groups of up to 15-20 individuals.

Exposures within this subdivision of the zone are visible (in ascending stratigraphic order) at Caistor St. Edmund, Bracondale (Norwich), Frettenham (two localities), and St. James's Hollow (Norwich).

1.3.5.2 CAISTOR ST. EDMUND (TG 2390 0466)

This quarry lies in wooded ground east of the Lakenham-Caistor road, 750 m north of Caistor Hall, and is one of the best exposures of mucronata chalk in the Norwich area. This chalk must lie not far above the Catton Sponge Beds (Figure 1.21) as they were formerly exposed in a now obliterated section at Stoke Holy

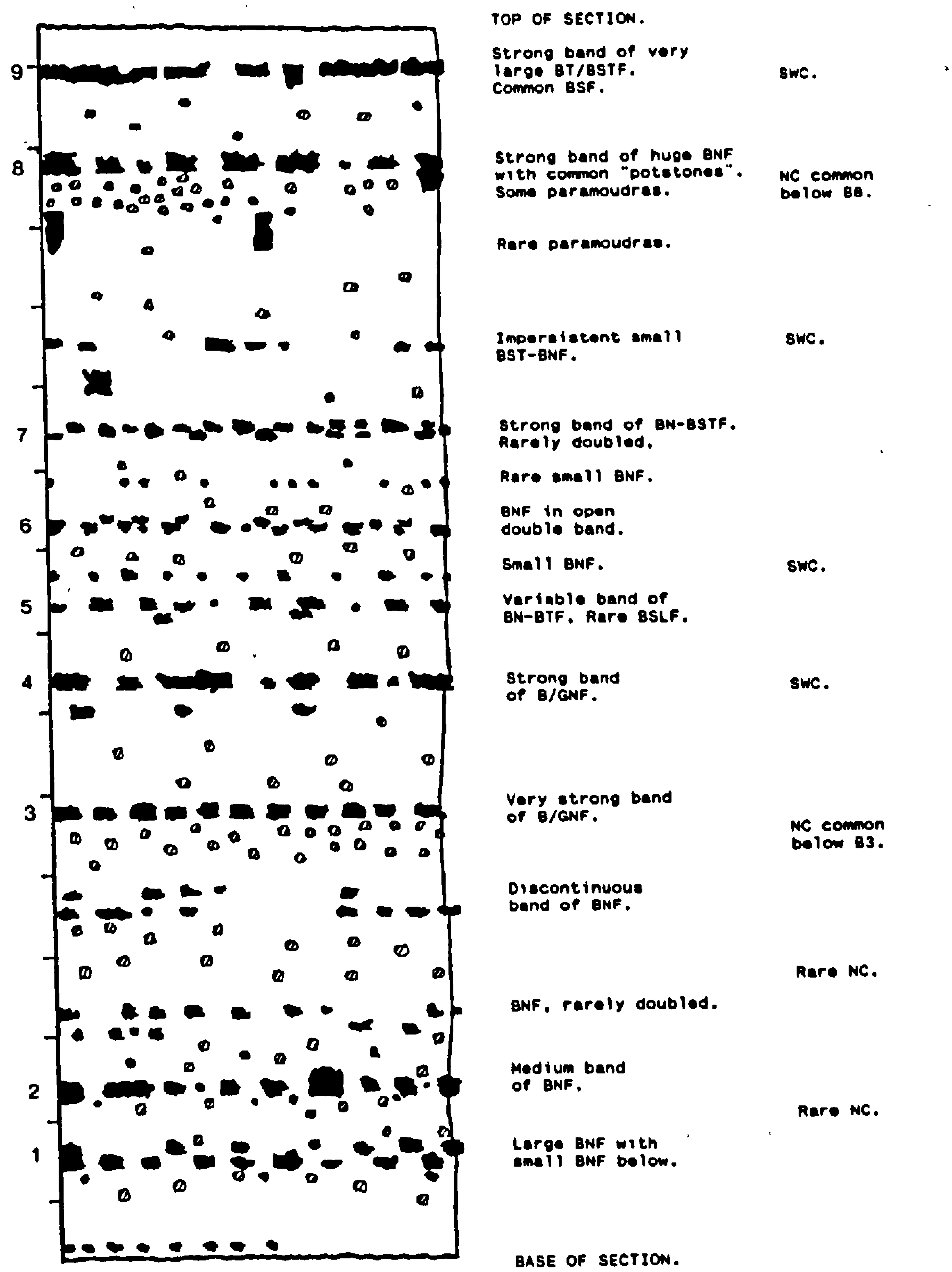


FIGURE 1.15 Diagrammatic five-metre wide section of the chalk at Caistor St. Edmund Quarry (TG 2390 0466). Symbols and abbreviations as in Figure 1.2.

Cross (TG 2536 0140) 1.5 km south-east of, and almost along strike from, Caistor. However, there was no evidence of them even at the deepest extent of working at Caistor in the late 1960s (Wood, 1988, p. 68). A section 15.10 m high was logged in 1987 (Figure 1.15) and more than 1300 fossils were collected or noted, their positions measured to the nearest 5 cm vertically with respect to flint bands within the face.

The lowest flint band visible (1) is composed of black nodular flints (doubled in places) with very thin white cortices. Flint band 2 contains large, black nodular/semi-nodular forms with very thin white cortices. (A single paramoudra was visible in September 1986 between bands 1 and 2.) The next strong band (3) is 3.45 m above 2 and marked the base of the pit in 1960 (Peake and Hancock, 1961, Figure 3, p. 316). This is very continuous, containing characteristic, black/dark grey tabular flints (with flat upper surfaces) with white cortices ~ 1 mm thick.

Flint band 4 (1.65 m above 3) is formed by large, grey/black nodular flints with thin white cortices <1 mm thick. Between bands 4 and 7 (3.10 m) is a zone of chalk with scattered flints (usually small, black nodular types). Band 7 itself is a moderately strong, open, double band of irregular, nodular - semi-tabular dark grey/black flints with white cortices commonly 2-3 mm thick. Above this is 3.25 m of chalk with occasional paramoudras capped by band 8 which is a very prominent line of huge, black nodular flints ("potstones") with thick, often >3 mm, white iron-stained cortices. The top flint band, just contained within the section, is formed by very large, black tabular/semi-tabular flints with thin white cortices. In places the flints coalesce to produce "sheet-like" forms.

The chalk is mostly soft and white on freshly exposed faces (with iron-staining on joint surfaces) and is broken up into small cubes of a few cm across due to periglacial effects. Hence, most of the macrofossils of any size are shattered. Blocky chalk is sometimes present between flint bands 1 and 2A (see Figure 1.15) and below band 3, although it is not usually particularly hard. However, a band of locally hard chalk occurs intermittently for about 75 cm below flint 8.

1.3.5.2.1 Palaeontology

In the basal part of the section (below flint band 1) Belemnitella is common (Figure 1.16) as are relatively small Carneithyris carnea (Figure 1.17). A single specimen of Cretirhynchia norvicensis and an Orbirhynchia sp. (? undescribed) were collected, as were fragments of the bivalve Spondylus dutempleanus, Echinocorys spp., and a Bourgueticrinus sp. columnal. (This level includes the "Orbirhynchia Bed" of Wood

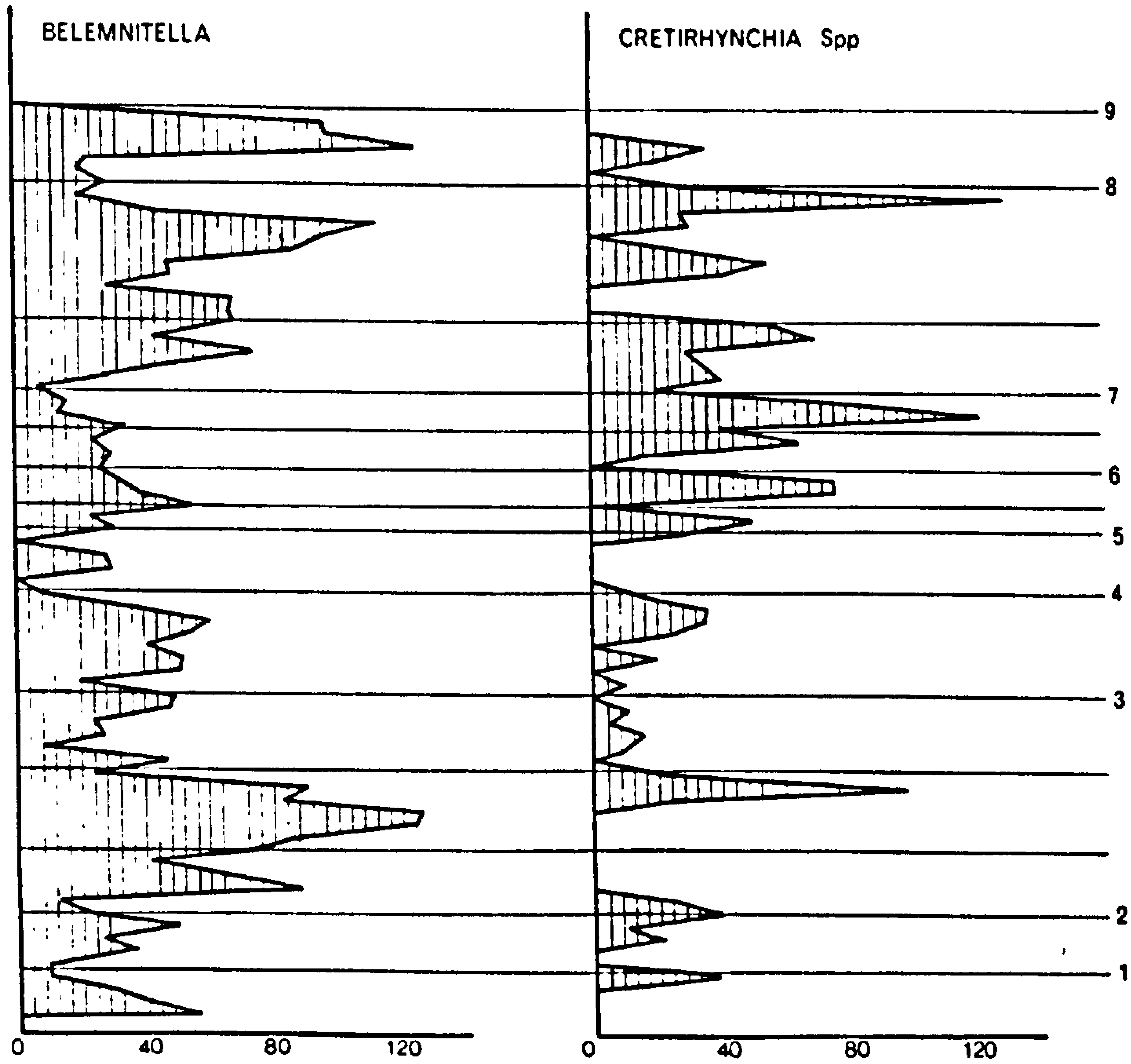


FIGURE 1.16 Volumetric abundances (per. cubic metre of chalk) for *Belemnitella* and *Cretirhynchia* spp. collected from Caistor St. Edmund. Numbers on right-hand side represent flint bands in the section.

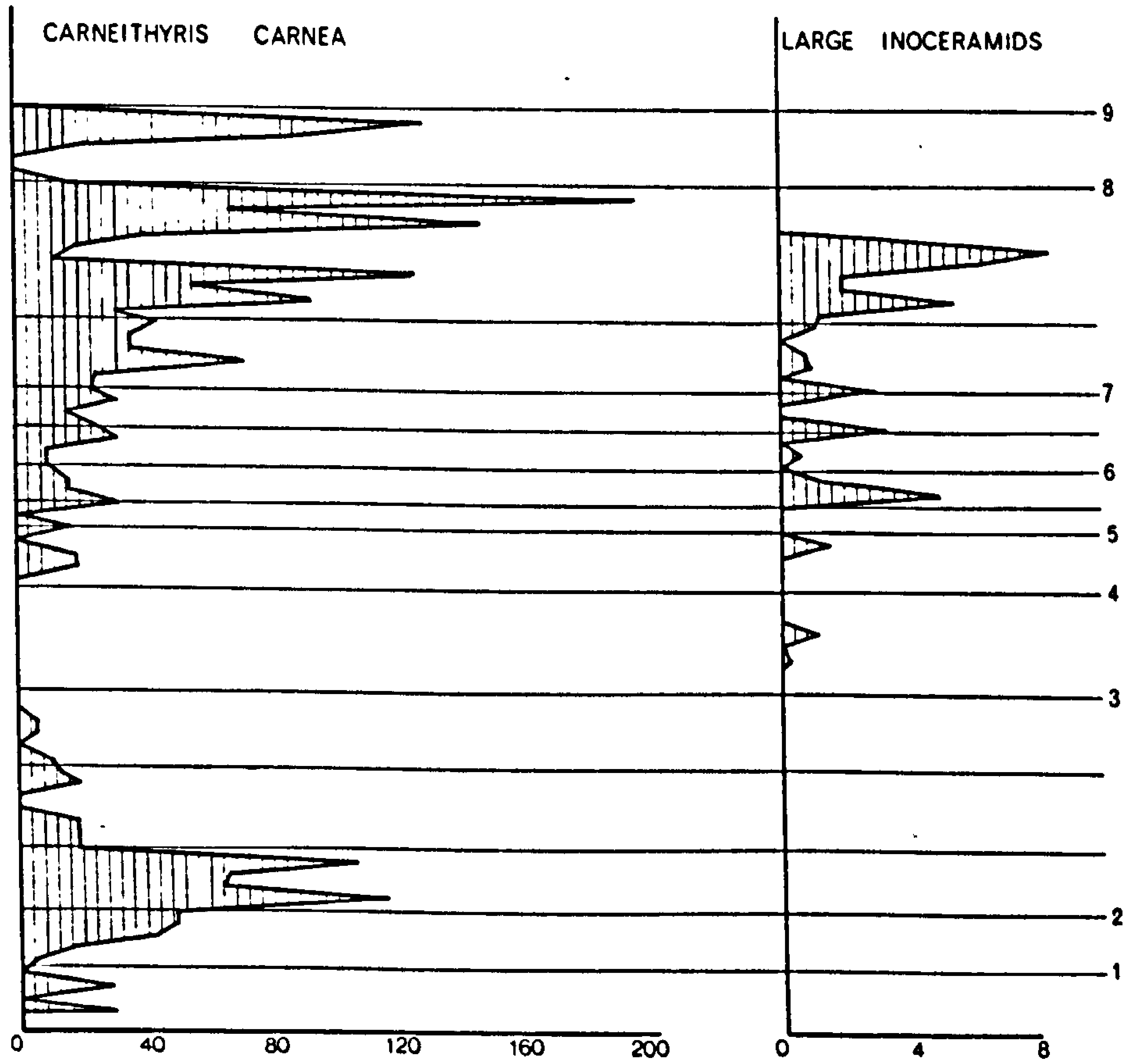
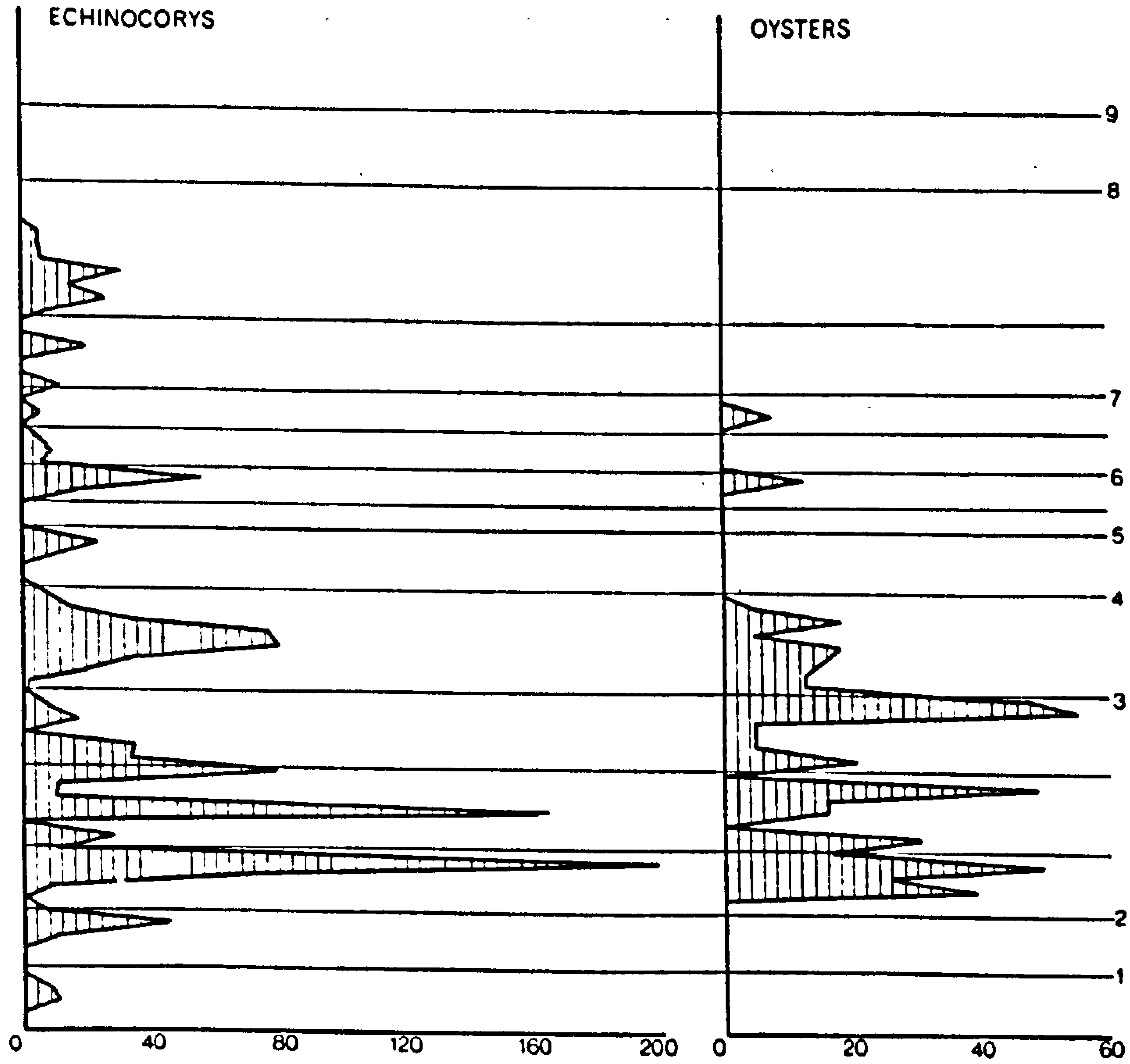


FIGURE 1.17 Volumetric abundances (per. cubic metre of chalk) for *Carneithyris carnea* and large Inoceramids collected from Caistor St. Edmund. Numbers on right-hand side represent flint bands in the section.



<u>FIGURE 1.18</u> Volumetric abundances (per. cubic metre of chalk) for *Echinocorys* spp. and oysters collected from Caistor St. Edmund. Numbers on right-hand side represent flint bands in the section.

(1988, p. 68).) Several glauconite-coated chalk pebbles were found below flint 1.

Between flint bands 1 and 2 *Belemnitella* is very abundant (Figure 1.16), as is *Carneithyris carnea* (Figure 1.17). Several specimens of *Cretirhynchia arcuata* (which first appears just below the Catton Sponge Beds and commonly in the basement beds of the Beeston Chalk), *C. norvicensis* and *C.* sp. were collected, along with two examples of the large and distinctive terebratulid *Neolithyrina obesa* and fragments of the common bivalves *Neithea sexcostata* and *Spondylus dutempleanus*. *Echinocorys* sp. is well represented by fragments including a group of five individuals collected 20 cm below flint 2. Impressions of several sponges were noted at this level.

A bulk sample from this level yielded (in addition to fauna already listed) a complete terebratulid (*Terebratulina* sp.), fragments of the bivalves *Inoceramus* spp., *Lyropecten* sp., and *Mimachlamys cretosa*, and the serpulid *Eoplacostegus pusillus* (Sowerby). Echinoderms included spines of cidarid echinoids, columnals of the crinoid *Bourgueticrinus* sp., ossicles of the starfish ?*Ophryaster* sp. and *Metopaster* sp., and plates of the common ophiuroid *Ophiomusium granulosum*. A plate of the cirripede *Proverruca laurae* Withers was also found, as were the foraminifera *Dentalina* sp., *Gavelinella* spp., and globigerinelloidinae. The anascan bryozoans "Biflustra" argus, Coscinopleura lamourouxi, Lunulites sp., Onychocella inelegans, and Woodipora disparilis, and the tubuloporinans Clinopora lineata, Crisisina carinata (Roemer), and Pustulopora sp. were identified, as were Meliceritites gothica and Porina goldfussi.

Ostreids first appear just above band 2, are then relatively common up to band 3 (especially just below it), and decrease in number above it (Figure 1.18). Recognised forms included Acutostrea cf. incurva Nilsson, Gryphaeostrea canaliculata (J. Sowerby), ?Hyotissa semiplana, Margostrea alaeformis (S. Woodward), and Pycnodonte vesiculare. As the ostreids increase in abundance, Carneithyris becomes less common and was not recorded between flint bands 3 and 4.

Echinocorys (usually crushed and fragmented but possibly referable to the undescribed, flat-based, conical form, E. aff. conoidea Goldfuss: Peake and Hancock, 1961, p. 318) is common throughout this part of the section often occurring in "nests" of up to 15 individuals of varying sizes. The echinoids appear to be most common between flint band 2 and a level 1 m below band 3 and less so between 3 and 4 (the so-called "Echinocorys Band" of Wood, 1988, p. 68).

Belemnitella is common throughout this part of the section (especially mid-way between flint bands 2 and

3) (Figure 1.16) and Cretirhynchia arcuata, C. norvicensis, and C. spp. are locally abundant. The brachiopods Magas chitoniformis (Schlotheim), Kingena pentangulata, Neolithyrina obesa, and Terebratulina spp., and fragments of indeterminate forms were collected . Bivalves represented were Spondylus dutempleanus, S. sp., Plicatula sp., Neithea sexcostata, and Gyropleura inequirostrata, fragments of Inoceramus spp. (first recorded 205 cm below flint 3 but common only from 50 cm above that level), and a well preserved partial specimen of the large pectinid Plagiostoma hoperi Mantell. The serpulid Pentaditrupa subtorquata, spines of cidarid echinoids, an ossicle of Metopaster sp., a solitary coral (Coelosmilia sp.), and the cirripede Scalpellum maximum var. sulcatum (J. de C. Sowerby) were also noted.

Additional fauna recognised from a bulk sample ~1 m below band 3 included fragments of the bivalve Lyropecten sp., ossicles of Astropecten sp. and Nymphaster studlandensis Schultz, plates of Ophiura hagenowi, a cirripede (Brachylepas naissanti (Hébert)), the coral Moltkia sp., and the foraminifera Gavelinella spp. and globigerinelloidinae. The anascan bryozoans "Biflustra" argus, Onychocella inelegans, O. nysti, and Woodipora disparilis were also collected from the sieved residue.

Between flint bands 4 and 7 oysters are extremely rare (Figure 1.18) with only a single specimen of Gryphaeostrea canaliculata and a second indeterminate Ostrea sp. collected. Carneithyris carnea occurs, but is relatively uncommon compared with the bottom part of the section, as are tests of Echinocorys spp. which decrease in frequency upwards (except for a minor concentration just below flint 6) (Figure 1.18). Large inoceramids, up to 50 cm in diameter are visible in the quarry faces and smaller fragments are very numerous in this part of the sequence. Cretirhynchia arcuata, C. norvicensis, and C. sp. become more numerous particularly below band 7. Belemnitella is well represented throughout (Figure 1.16).

Other fossils collected or noted from the face between flint bands 4 and 7 included the brachiopods Terebratulina striata d'Orbigny, Neolithyrina obesa, Magas chitoniformis, Kingena pentangulata, and an Orbirhynchia sp. Fragments of the bivalves Lima sp., Spondylus dutempleanus, Mimachlamys cretosa, and Neithea sexcostata, the serpulid Pentaditrupa subtorquata, and the sponge Porosphaera globularis were also recognised. Two bulk samples (from between bands 5 and 6) additionally gave fragments of the bivalves Acutostrea cf. incurva, Spondylus spinosus, and Pseudolimea granulata, the serpulid Vermiliopsis fluctuata, spines of cidarid echinoids, ossicles of the asteroid Chomataster sp., and the foraminifera Gavelinella spp. and globigerinelloidinae.

The bryozoan fauna included the anascans "Biflustra" argus and Onychocella nysti, and species of the salpinginan Meliceritites, the tubuloporinans Idmidronea and Pustulpora, and the cancellatan Sparsicavea.

Belemnitella is common above flint 7 (Figure 1.16) as are, often small, Carneithyris which are particularly numerous below bands 8 and 9 (Figure 1.17). Cretirhynchia norvicensis and C. arcuata are also very numerous particularly below band 8 (Figure 1.18), whereas Echinocorys spp. is rare, not recorded higher than 90 cm below flint 8. Large inoceramids are abundant in a zone 1.2 m thick (200 cm to 80 cm below 8), above which no further fragments were found. Other collected fossils were brachiopods including an example of Magas chitoniformis, three of Kingena pentangulata, and several indeterminate forms, fragments of Neithea sexcostata, and a single specimen of the serpulid Glomerula gordialis.

A bulk sample taken between flints 7 and 8 furnished fragments of the bivalves Lyropecten campaniensis (d'Orbigny), Mimachlamys cretosa, Ostrea spp., and Plagiostoma cretaceum Woods, spines of cidarid echinoids, and columnals of the crinoids

Bourgueticrinus sp. and Austinocrinus bicoronatus (Hagenow), and Dentalina sp., together with fragments of the common and long ranging anascan bryozoans Onychocella matrona and Woodipora disparilis, and the tubuloporinan Pustulopora sp.

The outlines of sponges, picked out by iron-staining, are common just above flint band 1, below flint 3, between bands 4 and 5, just below 6, and intermittently between bands 7 and 9.

1.3.5.3 BRACONDALE, NORWICH (TG 2390 0740)

This pit is cut in low Beeston Chalk (Figure 1.21) and probably lies at about the same level as Caistor, although correlation between the localities is not apparent. A small degraded section of soft white chalk 2.8 m high in the south-east corner of the pit is all that remains of the original faces (Figure 1.19). Two flint courses were visible, the lower by well spaced, small, black nodular flints, the upper formed by black nodular flints (rarely carious) with very thin white cortices <1 mm thick.

The only fossils collected were fragments of Inoceramus sp. and the ostreid Acutostrea cf. incurva. From bulk samples fragments of Belemnitella, the brachiopods Carneithyris carnea, Cretirhynchia spp., Isocrania costata, Kingena pentangulata, Magas

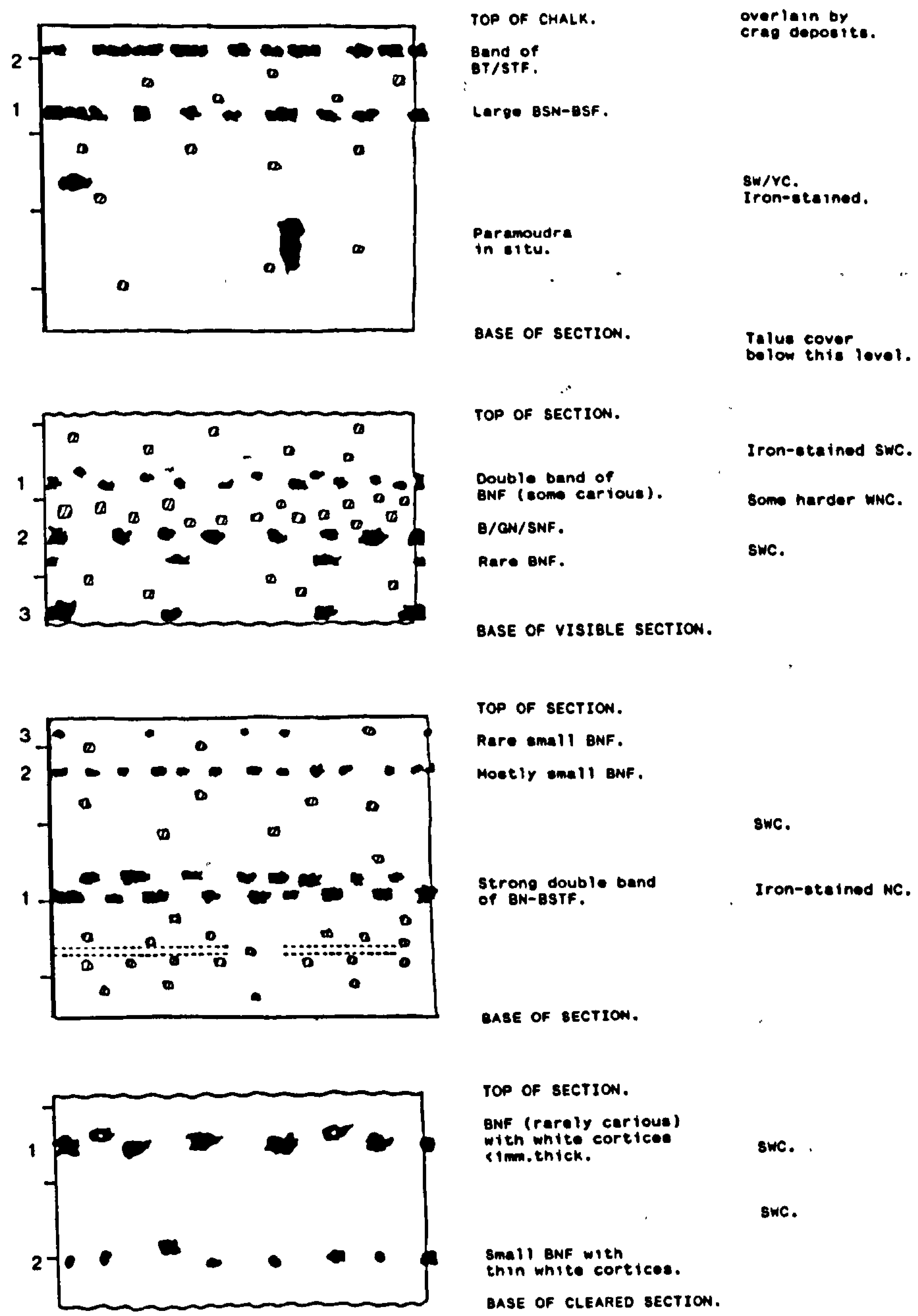


FIGURE 1.19 Diagrammatic five-metre wide sections of the chalk at Bracondale, Norwich (TG 2390 0740) (bottom figure), Frettenham (JSS. Aggregates Ltd.) (TG 2370 1670) (second figure), Frettenham (W.M. Howes Ltd.) (TG 2460 1730) (third figure), and Whitlingham (TG 2681 0770) (top figure). Symbols and abbreviations as in Figure 1.2.

chitoniformis, and *Terebratulina* spp., and the bivalves *Inoceramus* spp., *Mimachlamys cretosa*, *Neithea sexcostata*, the rare *N. striatocostatus* Goldfuss, *Ostrea* sp., and *Spondylus dutempleanus* were identified. The serpulid *Vermiliopsis fluctuata*, the sponges *Porosphaera sessilis* and *P.* sp. (fusiform), echinoderms including fragments of *Echinocorys* sp., columnals of *Bourgueticrinus* sp., spines and test fragments of cidarid echinoids, an ossicle of the starfish ?*Chomataster* sp., and plates of the ophiuroids *Ophiomusium granulosum* and *Ophiura hagenowi* were obtained, as was a plate of the cirripede *Cretiscalpellum paucistriatum* (H. Woodward). The coral *Stephanophyllia clathrata*, ostracod carapaces, and the foraminifera *Dentalina*, *Frondicularia*, *Vaginulina*, *Gavelinella*, and globigerinelloidinae were also collected.

The anascan bryozoans "*Biflustra*" *argus*, *Onychocella inelegans*, *O.* sp., and *Woodipora disparilis*, the ascophoran *Porina goldfussi*, the cancellatan *Crisina* sp., the salpinginans *Meliceritites gothica* and *M.* sp., and the tubuloporinans *Clypeina rosula*, *Crisisina carinata*, *Clinopora* sp., and *Pustulpora* spp. were recognised.

1.3.5.4 FRETTENHAM (JSS. Aggregates Ltd.) (TG 2370 1670)

This pit (now used to store sand and gravel) lies to the west of the Norwich to Frettenham road some 500 m south-west of the village and is cut in the middle of the Beeston Chalk above the level of Caistor St. Edmund (Figure 1.21). Two small chalk faces were found, a 1.6 m section in the south-east corner of the pit and 4.5 m on the north edge of the workings in a recently excavated hole. The smaller section contains a prominent double band of black nodular flints near its top. This correlates with a well developed, double band of black nodular - semi-tabular flints with thin white cortices <1 mm thick in the other section (band 1) (Figure 1.19). A band of mostly small, black nodular flints with thin white cortices is present 1.7 m above the double flint. Apart from a poorly developed zone of somewhat harder, iron-stained chalk below the double band, the white chalk in both sections is soft.

Collected fauna included several specimens of _Belemnitella_, _Carneithyris carnea_, and _Cretirhynchia arcuata_. A single juvenile _Cretirhynchia norvicensis_ was found, as were fragments of the bivalves _Mimachlamys cretosa_, _Inoceramus_ sp., and _Ostrea_ sp. Echinoderms included fragments of _Echinocorys_ sp., ossicles of _Chomataster_ sp. and _Recurvaster_ sp., and an unidentified crinoid columnal. The moulds of several sponges were also noted.

Three bulk samples from this locality yielded a large fauna. This comprised fragments of the brachiopods Kingena pentangulata, Cretirhynchia spp., and valves of Terebratulina spp., fragments of the bivalves Mimachlamys cretosa, Spondylus dutempleanus, Pycnodonte vesiculare, Ostrea sp., and Inoceramus spp., and the serpulids Glomerula gordialis var. ilium, Hamulus sexangularis, Neomicrorbis crenatostriatus, and Pentaditrupa subtorquata. The common sponges Porosphaera globularis and P. sessilis, and echinoderms including columnals of the crinoid Bourgueticrinus brydonei, ossicles of the asteroids Astropecten sp. and Nymphaster sp., and plates of the ophiuroids Ophiomusium granulosum and Ophiura hagenowi were also collected, as were plates of the cirripede Brachylepas fallax, fragments of indeterminate aseptate corals, and one of Stephanophyllia clathrata. Several foraminifera were present including Dentalina sp., Vaginulina spp., Frondicularia sp., Gavelinella spp., and globigerinelloidinae.

A varied bryozoan fauna was identified including the anascans "Biflustra" argus, Coscinopleura lamourouxi, Escharifora sp., Lunulites spp., "Membranipora" flabelliformis, Onychocella inelegans, O. matrona, O. nysti, Quadricellaria grania, and

Woodipora disparilis. The ascophorans Porina socia, P. sp., and Beisselina sp. were found, as was the dactylethratan Clausa globulosa, the tubuloporinans Clypeina rosula, Siphoniotyphlus tenuis, and Spiropora sp., the rectangulatan Disporella irregularis, the salpinginans Meliceritites gothica and M. sp., the cancellatan Sparsicavea sp., and forms referable to "Ceriopora" sp.

1.3.5.5 FRETTENHAM (W.M. HOWES Ltd.) (TG 2460 1730)

This section (Figure 1.19 (a SSSI)) about 500 m north-east of the JSS. Aggregates pit, is all that remains of the old workings and lies at the southern edge of the original pit. Two days of tree felling and removal of debris revealed a low face of chalk some 10 m long and 2.7 m high.

Three flint bands are visible in the section, the bottom band is only sporadically visible at the extreme base of the cleared section and is composed of black nodular flints with thin white rinds. The central, (open double) band contains nodular/semi-nodular dark grey flints with white rinds. The top flint band is characterised by black nodular flints with thin white cortices. A few smaller flints occur just above the main band. The blocky white chalk (with some iron-staining on surfaces) is generally soft, although harder chalk is present above the central flint course.

Belemnitella is common throughout, as are the brachiopods *Carneithyris carnea* and *Cretirhynchia norvicensis*, and fragments of *Inoceramus* spp. A piece of *Pycnodonte vesiculare* was found, as was a partial pectinid bivalve (*Plagiostoma marrotiana* d'Orbigny) and a fragment of *Echinocorys* sp. A bulk sample additionally yielded fragments of *Magas chitoniformis*, *Cretirhynchia* spp., and *Ostrea* sp., the serpulids *Glomerula gordialis*, *G. g.* var. *ilium*, and *Vermiliopsis fluctuata*, the sponge *Porosphaera sessilis* and plates of the ophiuroids *Ophiomusium* sp. and *Ophiura substriata*, together with those of a cirripede (*Cretiscalpellum* sp.), *Dentalina* sp., *Frondicularia* sp., *Gavelinella* spp., globigerinelloidinae, and a single specimen of *Onychocella inelegans*.

1.3.5.6 ST. JAMES HOLLOW (TG 2420 0950)

This was originally a huge pit but only about 1 m of chalk is currently visible at the bottom of a wooded slope on the eastern side of a playground. The soft yellow chalk contains a single large black flint and from its geographical position appears to lie high in the Beeston Chalk (Figure 1.21).

No fossils were found in the small section, but a bulk sample yielded a specimen of *Belemnitella*, numerous inoceramid fragments, cidarid spines and fragments of *Echinocorys* sp. test. The bryozoans *Onychocella matrona* and *Woodipora disparilis* were also obtained.

1.3.5.7 SUMMARY

The Beeston Chalk is characterised by common *Belemnitella*, numerous bands of fragments and larger individuals (up to 50 cm in diameter) of the bivalve *Inoceramus* spp. and, especially, by the rich and diverse brachiopod fauna. The terebratulid *Carneithyris carnea* is numerous throughout as are the rhynchonellids *Cretirhynchia norvicensis* and *C. arcuata*. Other brachiopods including *Magas* spp., *Kingena pentangulata*, and *Terebratulina* spp. are scattered through the chalk. A large suite of oysters is represented, including *Acutostrea* cf. *incurva*, *Gryphaeostrea canaliculata*, *Hyotissa semiplana*, and *Pycnodonte vesiculare*. Fragmentary remains of the bivalves *Neithea sexcostata*, *Mimachlamys cretosa*, and *Spondylus* spp. are also relatively common.

The sponge *Porosphaera sessilis* and columnals of the crinoids *Bourgueticrinus* spp. and *Austinocrinus bicoronatus* are present, along with spines of cidarid echinoids, and ophiuroid plates referable to *Ophiomusium granulosum* and *Ophiura substriata*.

Bryozoans are common throughout the Beeston Chalk. Of the anascans, long ranging forms such as "Biflustra" argus, Onychocella inelegans, O. matrona, O. nysti, and Woodipora disparilis are well represented, as is Lunulites spp. which becomes increasingly common higher in the division. Other common forms are the tubuloporinans Clypeina rosula and Pustulopora spp., and the salpinginan Meliceritites gothica.

The chalk of the Beeston division is mostly soft and white containing many strong flint bands.

1.3.6 PARAMOUDRA CHALK

1.3.6.1 INTRODUCTION

This subdivision, the highest in the Belemnitella mucronata Zone, is characterised by chalk with large columns of huge, vertical, cylindrical flints (paramoudras) up to several metres in height formed round the burrow Bathichnus paramoudrae Bromley, Schulz and Peake (Bromley et al. 1975). The fauna is dominated by small-sized Carneithyris and Cretirhynchia transitional between C. arcuata and C. limbata (Schlotheim). Echinoids including Echinocorys spp. and Micraster spp. are relatively common as are ostreids. The only extant section in the zone visited was at Whitlingham. The intermittent coastal (foreshore) exposures between East Runton and Cromer, on the north

Norfolk coast, were never revealed during the course of research.

1.3.6.2 WHITLINGHAM (Colman's pit) (TG 2681 0770)

About 4 m of chalk is visible in a small exposure beneath a tree on the eastern side of the old quarry (Figure 1.19). The weathered chalk is very soft and stained yellow/orange/brown in colour due to percolation of iron-rich waters from the overlying Pleistocene sands and gravels. Two flint bands occur at the top of the section, the upper is composed of black tabular/semi-tabular flints with iron-stained cortices up to 3 mm thick. The lower is formed by large, black semi-nodular - sheet-like flints with thin, iron-stained cortices. A single paramoudra is visible _in situ_ near the base of the section. Several others lie in the talus at the bottom of the pit.

The only fossils collected were a single valve of _Carneithyris carnea_, a fragment of _Inoceramus_ sp., and a partially complete _Echinocorys_ sp. embedded in a flint. Two bulk samples yielded an undiagnostic fauna of long ranging forms including fragments of _Belemnitella_, _Cretirhynchia_ spp., and _Isocrania costata_, and numerous pieces of _Inoceramus_ spp. The serpulid _Glomerula gordialis_ var. _ilium_, sponges referable to _Porosphaera globularis_ and _P. sessilis_, and columnals of _Bourgueticrinus_ spp. were also recognised, as were the foraminifera *Vaginulina* sp. and globigerinelloidinae. Identified bryozoans included *Coscinopleura lamourouxi*, *Clinopora lineata*, *Crisisina carinata*, *Disporella irregularis*, *Onychocella inelegans*, *Spiropora verticillata*, *Woodipora disparilis*, a form of *Diastopora* sp., and a *Sparsicavea* sp.

1.4 CORRELATION OF SECTIONS

1.4.1 *GONIOTEUTHIS* ZONE (GZ) (Figure 1.20)

The thickness of this zone (85 m) is an estimate based on the 260 feet shown by Peake and Hancock (1961, p. 297, Figure 3) and the sections and boreholes measured during this research. No overlap between any of the chalk exposures was recognised and they have been placed in assumed stratigraphical order based, largely, on their geographical positions. The occurrence of the restricted anascan bryozoan *Vincularia supercilium* in the cliff-section at Stiffkey (STF) and in the upper part of the Wymondham Boreholes (WYM BHS, see chapter two)) indicates chalk of an equivalent horizon.

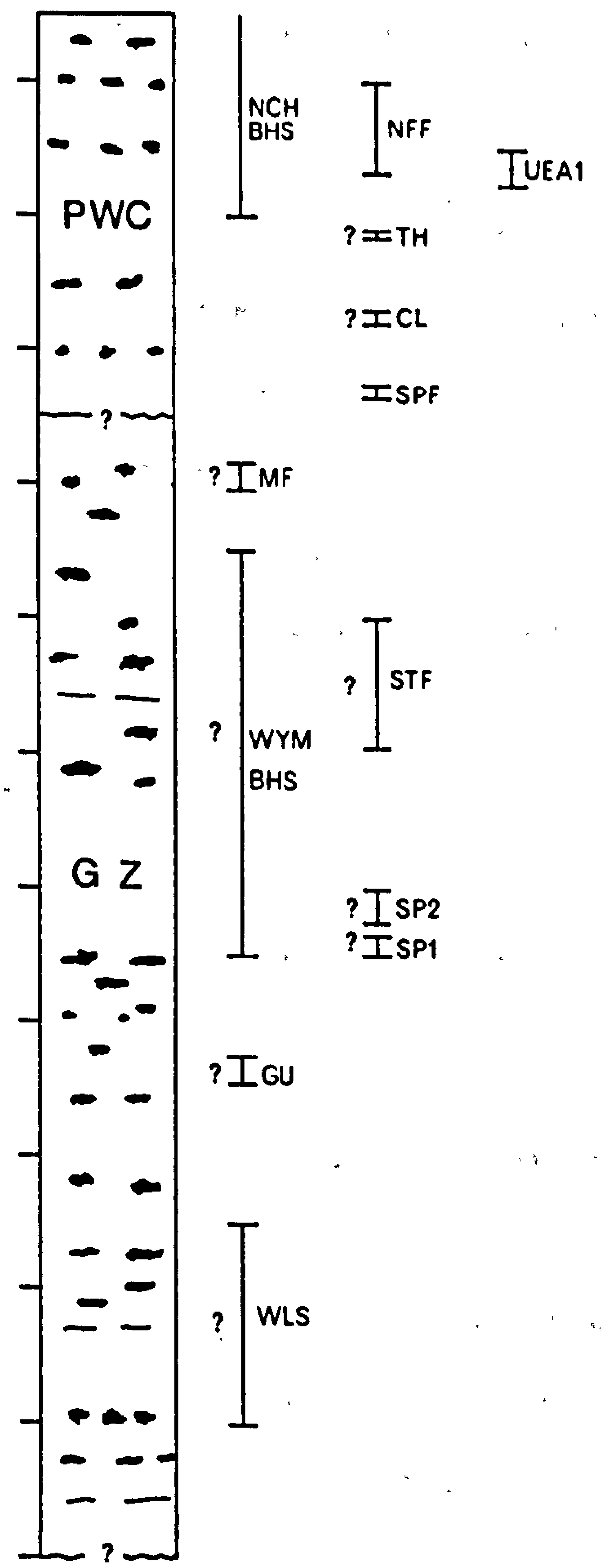


FIGURE 1.20 Relative stratigraphic positions of all sections and boreholes in the *Gonioteuthis* Zone (GZ) and the Pre-Weybourne Chalk (PWC) division of the *Belemnitella mucronata* Zone. Ticks on left side every ten metres. WLS=Wells; GU=Guist; SP2, SP1=Sparham; WYM=Wymondham boreholes; STF=Stiffkey, MF=Marlingford; SPF=Spring Farm, Attlebridge; CL=Cley-next-the-sea; TH=Tharston; NCH BHS=Norwich boreholes; NFF=Newfound Farm, Cringleford; UEA1=University of East Anglia.

1.4.2 BELEMNITELLA MUCRONATA ZONE

1.4.2.1 PRE-WEYBOURNE CHALK (PWC) (Figure 1.20)

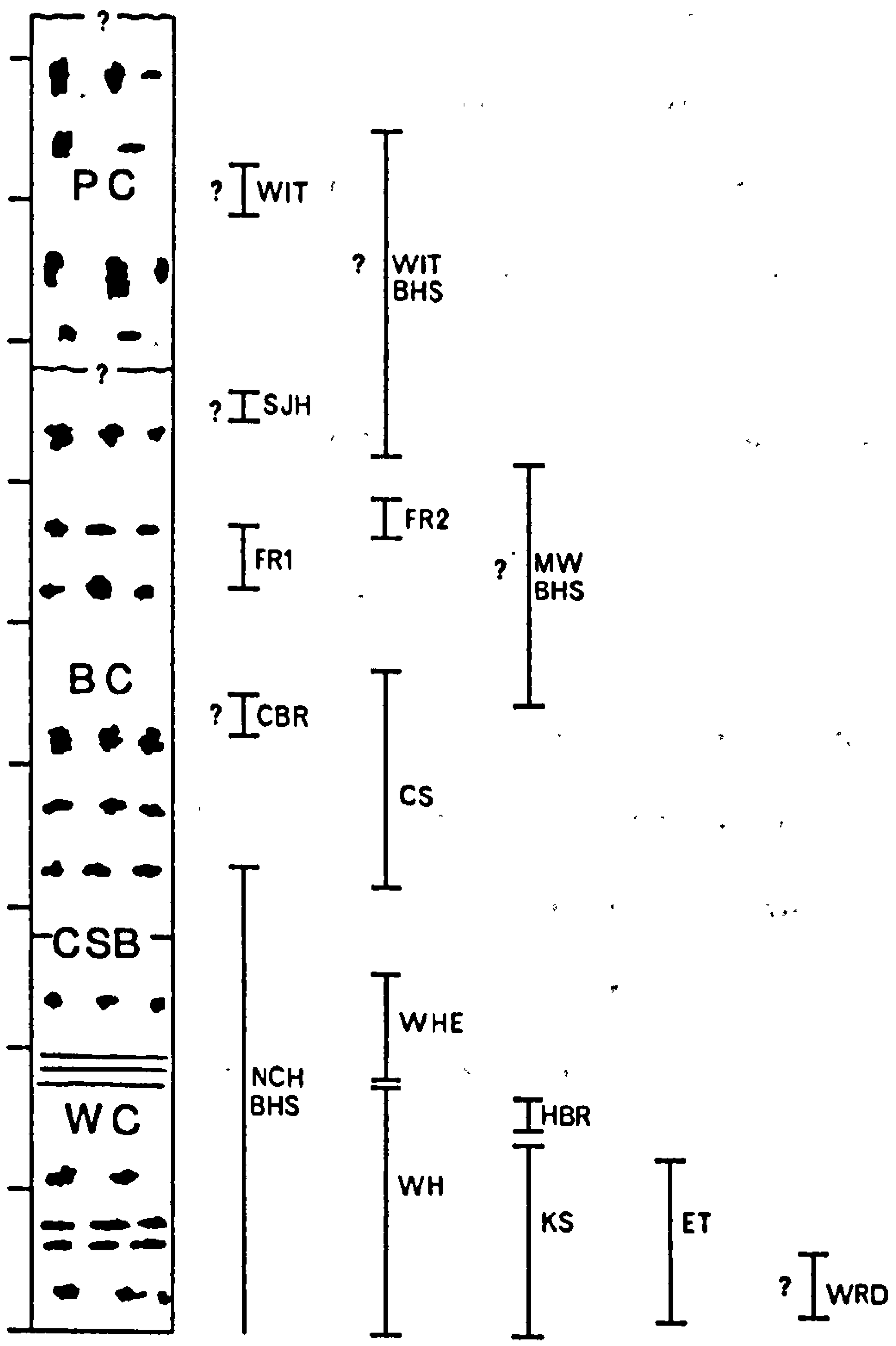
This division of the mucronata zone is about 30 m thick. Of this, the lower half is poorly exposed. The top 15 m was sampled by the Norwich Boreholes (NCH BHS) see chapter two)). Correlation between these and the chalk exposed at the University of East Anglia (UEA1) and Newfound Farm, Cringleford (NFF) is possible due to the presence of the stratigraphically restricted anascan bryozoan Volviflustrellaria taverensis in the boreholes and UEA 1.

1.4.2.2 WEYBOURNE CHALK (WC) (Figure 1.21)

About 28 m thick, this chalk is well exposed on the north Norfolk coast at Weybourne Hope ((WH) the type section) and Weybourne Hope East (WHE), and in the correlative inland localities at Keswick (KS), Eaton (ET), and Harford Bridges (HBR). The Norwich Boreholes ((NCH BHS) see chapter two) passed throughout.

1.4.2.3 CATTON SPONGE BEDS (CSB) (Figure 1.21)

These are presumed to have been sampled in the top few metres of the Norwich Boreholes (NCH BHS).



<u>FIGURE 1.21</u> Relative stratigraphic positions of all sections and boreholes in the Weybourne Chalk (WC), Catton Sponge Beds (CSB), Beeston Chalk (BC), and Paramoudra Chalk (PC) divisions of the *Belemnitella mucronata* Zone. Ticks on left side every ten metres. NCH BHS=Norwich boreholes; WH=Weybourne Hope-Old Butts Gap; KS=Keswick; ET=Eaton; WHR=Whiffler Road, Hellesdon; WHE=Weybourne Hope East; HBR=Harford Bridges; CBR=Colmans, Bracondale; CS=Caistor St. Edmund; FR1=Frettenham (J.S.S. Aggregates); FR2=Frettenham (W. M. Howes); MW=Mayton Wood boreholes; SJH=St. James's Hollow; WIT=Whitlingham; WIT BHS=Whitlingham boreholes.

1.4.2.4 BEESTON CHALK (BC) (Figure 1.21)

This division, totalling about 40 m, is best exposed at Caistor (CS) which lies close to its base. Two localities at Frettenham (FR1 and FR2) reveal higher levels. The boreholes at Mayton Wood ((MW BHS) see chapter two) are assumed to have passed through the upper and midlle parts of the Beeston Chalk.

1.4.2.5 PARAMOUDRA CHALK (PC) (Figure 1.21)

This chalk was represented by a single exposure (Whitlingham (WIT)) which lies somewhere in the middle of the division, and by the Whitlingham Boreholes ((WIT BHS) see chapter two) which sampled the central and lower parts of the Paramoudra Chalk.

CHAPTER TWO

BOREHOLE MATERIAL

2.1 INTRODUCTION

A total of 229 bulk samples of chalk were obtained from the Campanian zones of *Gonioteuthis* and *Belemnitella mucronata* (Table 1.1, p. 5) in Norfolk. Of these, 56 were collected from the chalk sections described in chapter one. The other 173 came from boreholes drilled by the Anglian Water Authority (AWA) at Norwich and Whitlingham, the Department of Transport (DOT) at Wymondham, and the Highways Laboratory of Norfolk County Council at Mayton Wood.

Most of the chalk was soft enough to be washed directly through sieves of 500 and 150 micron apertures, the residues being oven dried, and the larger fraction picked over to remove fauna. However, harder samples, particularly from Wells, needed treatment with a supersaturated solution of Glauber's salt (Surlyk, 1972, p. 6). The samples were repeatedly frozen and thawed until the chalk was sufficiently broken down to enable it to be sieved.

The majority of the samples (about 180) were processed at the Highways Laboratory of Norfolk County County in Norwich, where drying facilities enabled numerous samples to be dealt with simultaneously. The borehole chalk came in various forms. Solid core 100 mm in diameter (U100) was obtained from Whitlingham in 50 cm lengths, the middle 20 cm portion of each was sieved (the tops of the cores had not been marked). A uniform weight of ~1.5 Kg was taken from the bagged sample residues of the Norwich Boreholes. The Wymondham samples came in small plastic tubs and averaged <0.5 Kg in weight. The few remaining samples (from Mayton Wood) were of larger size, and about 2 Kg of each was processed.

The borehole chalk was mostly pervasively weathered for at least 10-15 m below its upper surface with samples containing much soft chalk, surrounding small blocks (1 to 10 cm across) of intact rock. Some samples contained a considerable proportion (up to 30%) of harder, nodular chalk and flints.

All identifiable fossils, in each of the 229 samples, were listed on, computer produced, spreadsheets (Appendices 8-12). This allowed faunal distribution patterns to be studied from boreholes, and miscellaneous samples, collected from extant localities in the Campanian Chalk in Norfolk.

2.2 WYMONDHAM

Fifty seven samples of mostly, very soft, white chalk were obtained from 11 boreholes drilled for the

DOT along the line of the Wymondham bypass (A11) in south Norfolk. The boreholes lay along a 3.5 km long north-east trending line between borehole number 33 (TM 09380 98260), and borehole 85 (TG 12766 00906). The samples had undergone a series of tests prior to being released by the DOT, and the average weight of the residue received was <0.5 kg (compared to ~2 kg from samples collected elsewhere in the field). Hence, the relative paucity of fauna in the Wymondham samples may well be directly related to the small sample size, rather than a scarsity of mesofauna. Many of the faunal elements were worn, but this is probably a result of DOT testing procedures and the sieving process.

Accurate datum levels for the tops of the boreholes (supplied by the DOT) enabled the depth of every sample to be calculated relative to ordnance datum. These were then arranged to give a stratigraphic order assuming an eastwards dip for the chalk of ~5 m per km, a figure obtained both from literature e.g. Peake and Hancock (1961, p. 296) and field observations. All identified fossils from each borehole were plotted up onto a spreadsheet (Appendix 8) to enable faunal distribution patterns to be assessed.

From their geographical positions relative to known exposures, the boreholes are assumed to have been drilled in chalk of the upper *Gonioteuthis* Zone (Figure 1.20). All identifiable fauna was plotted (Figures

2.1-2.3), and for taxa with more than one record, the range is shown with intermediate occurrences marked.

The non-bryozoan fauna (Figures 2.1 and 2.2) was divided into several groups, each of which will be described in turn. Brachiopods (Figure 2.1) were rare, with only four Cretirhynchia spp., two fragmentary Kingena pentangulata, and several valves of the terebratulid Terebratulina sp. found. Bivalves (Figure 2.1) were more common. Remains of long ranging forms, including Inoceramus sp., Mimachlamys cretosa, Neithea sexcostata, Ostrea spp., Spondylus sp., and a partial specimen of S. spinosus were recognised. Serpulids (Figure 2.1) comprised, in addition to common Glomerula gordialis and G. g. var. ilium, single records of Filogranula cincta, Hamulus sexangularis, Neomicrorbis crenatostriatus, and Vermiliopsis fluctuata, together with several of Neomicrorbis subrugosus, and unidentifiable fragments. The sponges Porosphaera globularis, P. sessilis, and P. sp. (fusiform) (Figure 2.1) ranged throughout.

A varied echinoderm fauna was collected (Figure 2.2). Spines, and their test attachment bosses, of cidarid echinoids were numerous, as were columnals, and arm plates, of the crinoid Bourgueticrinus sp. Ossicles of the asteroids Astropecten sp., Nymphaster sp., Ophryaster sp., Recurvaster sp., and Teichaster sp., a single rostrum of the echinoid Hagenowia sp., and many

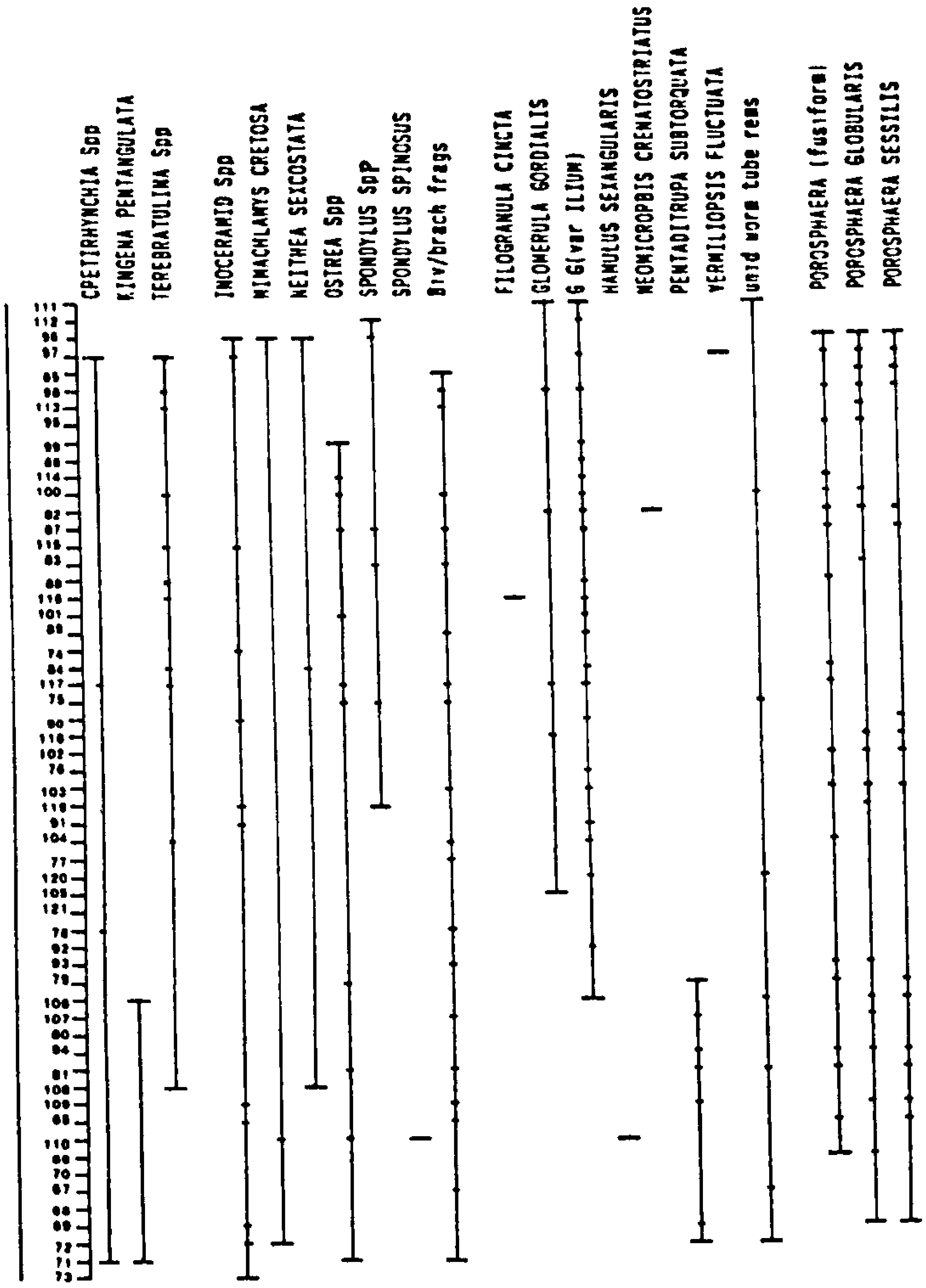


FIGURE 2.1 Occurrence of brachiopod, bivalve, serpulid, and sponge remains in the borehole samples from Wymondham. Sample numbers on left side (Appendix 2) in assumed stratigraphic order.

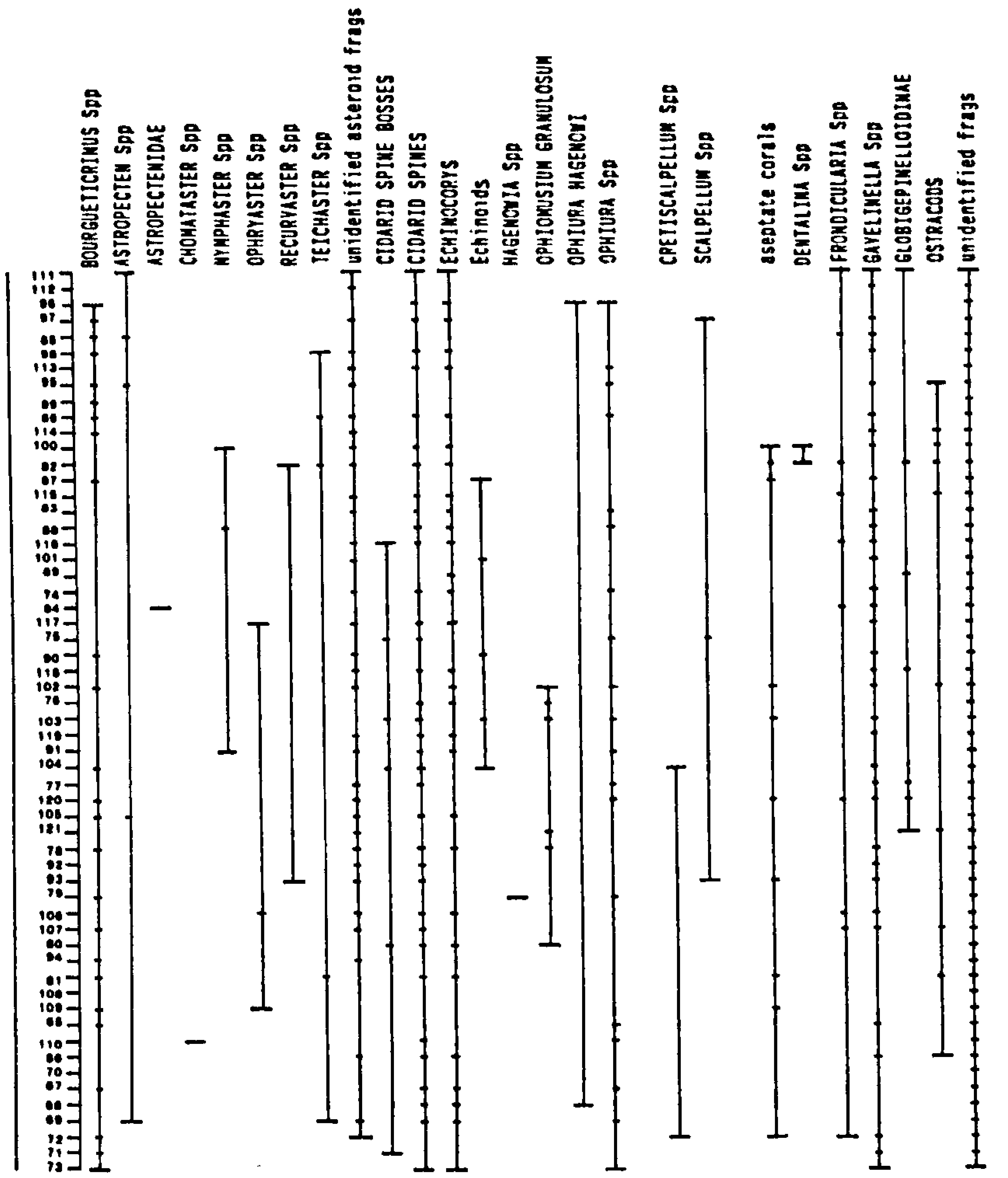


FIGURE 2.2 Occurrence of echinoderm, cirripede, and miscellaneous non-bryozoan taxa (including foraminifera) in the borehole samples from Wymondham. Sample numbers on left side (Appendix 2) in assumed stratigraphic order.

fragments of Echinocorys spp. were discovered in addition to a few plates of the ophiuroids Ophiomusium granulosum, Ophiura hagenowi, and Ophiura sp. The plates of two cirripede genera, Cretiscalpellum and Scalpellum, were found in two and three samples respectively.

Various foraminifera genera (Figure 2.2), including, Dentalina, relatively abundant Frondicularia, and globigerinelloidinae, and numerous Gavelinella were recognised, as were several ostracod carapaces.

Bryozoan remains occurred in many of the sieved residues (Figure 2.3), although in many cases they were too worn to identify. Recognisable forms were dominated by examples of the common, long ranging anascans Onychocella inelegans, O. matrona, and Woodipora disparilis, and by the seemingly stratigraphically restricted Vincularia supercilium, only recorded in the upper two-thirds of the borehole sequence, and in a presumed stratigraphically equivalent exposure at Stiffkey (see section 1.2.6). Other anascans included "Biflustra"argus, Coscinopleura lamourouxi, "Membranipora" spp., two each of Onychocella rowei and O. sp., and three of Quadricellaria grania.

The ascophoran Porina sp. was rarely found, as were the cancellatans Crisina sp., Sulcocava sp., Osculipora

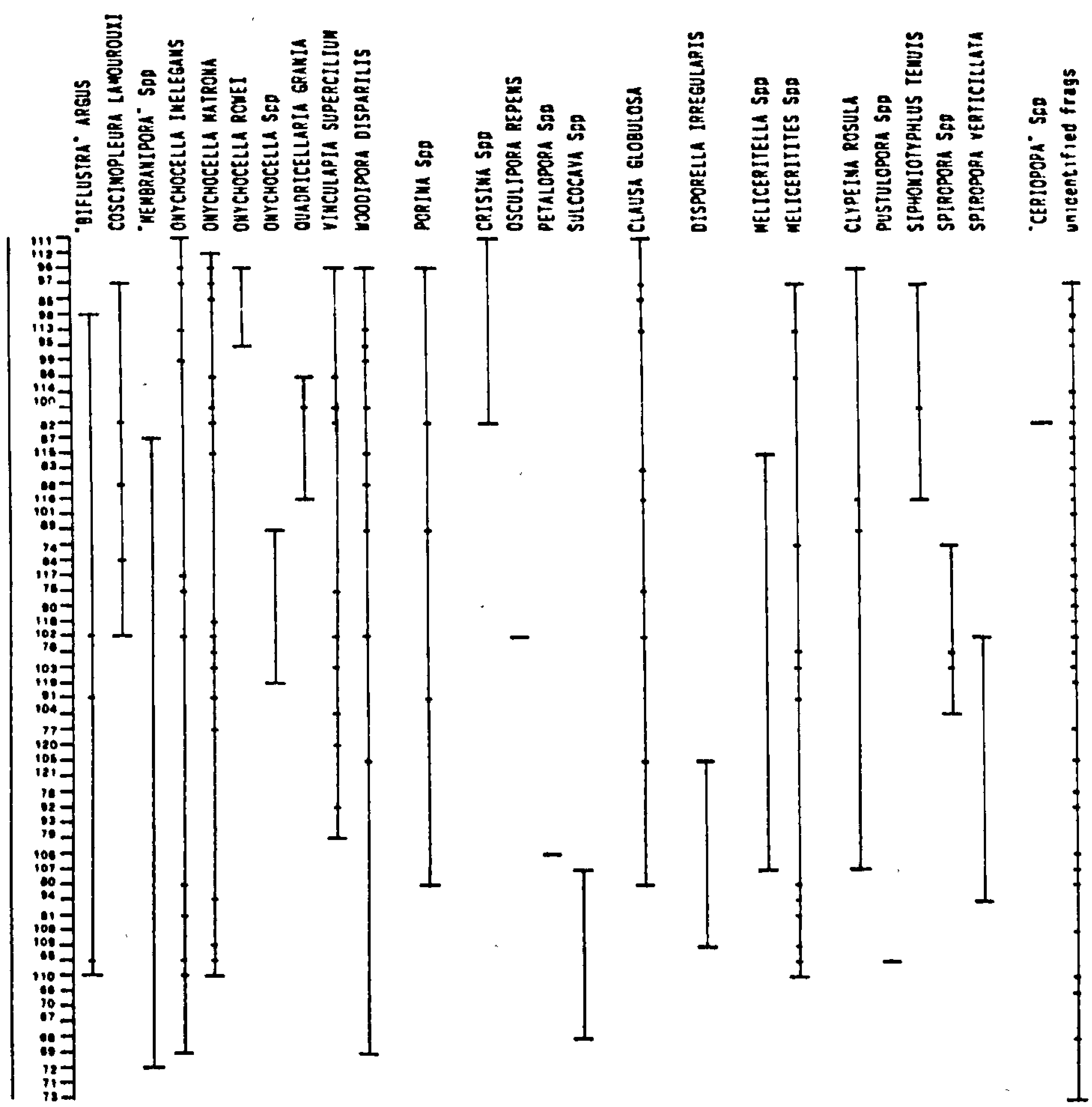


FIGURE 2.3 Occurrence of bryozoan remains in the borehole samples from Wymondham. Sample numbers on left side (Appendix 2) in assumed stratigraphic order.

repens (Von Hagenow), and Petalopora sp. Common fragments of the dactylethratan Clausa globulosa were distinguished, as were two records of the rectangulatan Disporella irregularis. The remainder of the bryozoan fauna included the salpinginans Meliceritella sp. and Melicerities spp., and the tubuloporinans (none commonly) Clypeina rosula, Pustulopora sp., Siphoniotyphlus tenuis, Spiropora verticillata, and S. sp., and a single "Ceriopora" sp.

2.2.1 Summary

The recorded fauna was largely undiagnostic, but importantly, eleven samples contained the stratigraphically restricted Vincularia supercilium, only found in the upper part of the Gonioteuthis Zone.

Long ranging taxa, commonly identified, were the brachiopods Cretirhynchia spp. and Terebratulina spp., the bivalves Inoceramus spp. and Ostrea spp., serpulids, including Glomerula gordialis, and its smaller variant ilium, and the sponges Porosphaera globularis, P. sessilis, and P. sp. (fusiform). Numerous spines of cidarid echinoids, fragments of Echinocorys spp., and plates of the ophiuroid Ophiura sp. were recovered. The foraminifera Gavelinella spp. was also often present.

The bryozoan fauna included many specimens of the long ranging anascans Onychocella inelegans, O. matrona, and Woodipora disparilis.

2.3 NORWICH BOREHOLES

Chalk samples were obtained, in July 1988, from two 50 m deep boreholes (AWA numbers 5 and 6). Borehole 6 [BH6] (TG 2459 0804) lay 350 m east of borehole 5 [BH5] (TG 2425 0792). The samples (Appendix 10), were delivered in bags after testing at the Water Research Council Laboratories. In most cases, the chalk consisted, predominantly, of soft, water impregnated material with some bags containing a considerable proportion (up to 30%) of nodular chalk and flints. The boreholes were correlated, assuming that the chalk in BH6 lay stratigraphically 2 m above that in BH5. This value was calculated from the separation of the boreholes relative to the north-south strike of the chalk.

The correlated samples, together, gave a section of about 50 m depth. This was, however, not continuous, as the chalk represented half-metre portions of the boreholes per metre. In places, larger gaps up to 2-3 m occurred, because the samples from these positions had been subjected to destructive testing. The boreholes yielded samples from the whole of the Weybourne Chalk and part of the Pre-Weybourne Chalk divisions of the Belemnitella mucronata Zone (Figure 1.20 and 1.21).

The Catton Sponge Beds, which cap the Weybourne Chalk, may have been present at the top of BH6, from where several samples containing hard chalk were obtained. The presence of the anascan bryozoan Volviflustrellaria taverensis near the base of both holes indicates a level within the Pre-Weybourne Chalk. This species is only known from stratigraphically restricted bands in that division.

The distribution of the non-bryozoan assemblage from the boreholes is shown in Appendix 10, and in Figures 2.4-2.6. The faunal content of the chalk is described below.

Belemnitella (Figure 2.4) was commonly collected from the sieved residues; along with several brachiopods (Figure 2.4). Of these, fragmentary remains of long ranging forms including the craniaceans Ancistocrania parisiens (Defrance) and Isocrania costata, the rhynchonellid Cretirhynchia spp., Kingena pentangulata, Magas sp., and Terebratulina spp. were often encountered. The terebratulid Carneithyris carnea was discovered in three samples (numbers 143, 146, and 193) at the top of the section. This species characterises the overlying Beeston Chalk and first appears just below the Catton Sponge Beds, in a small

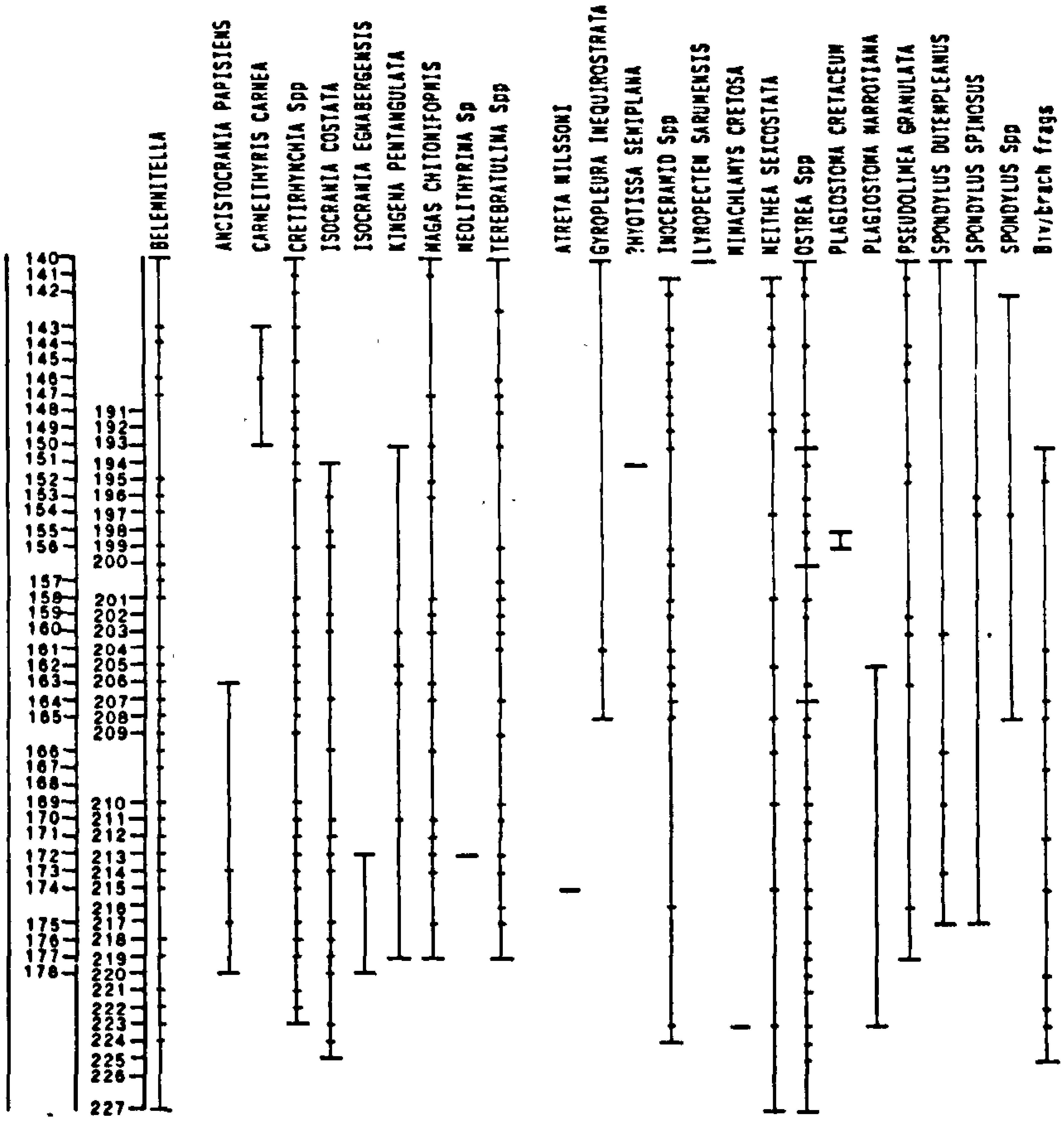


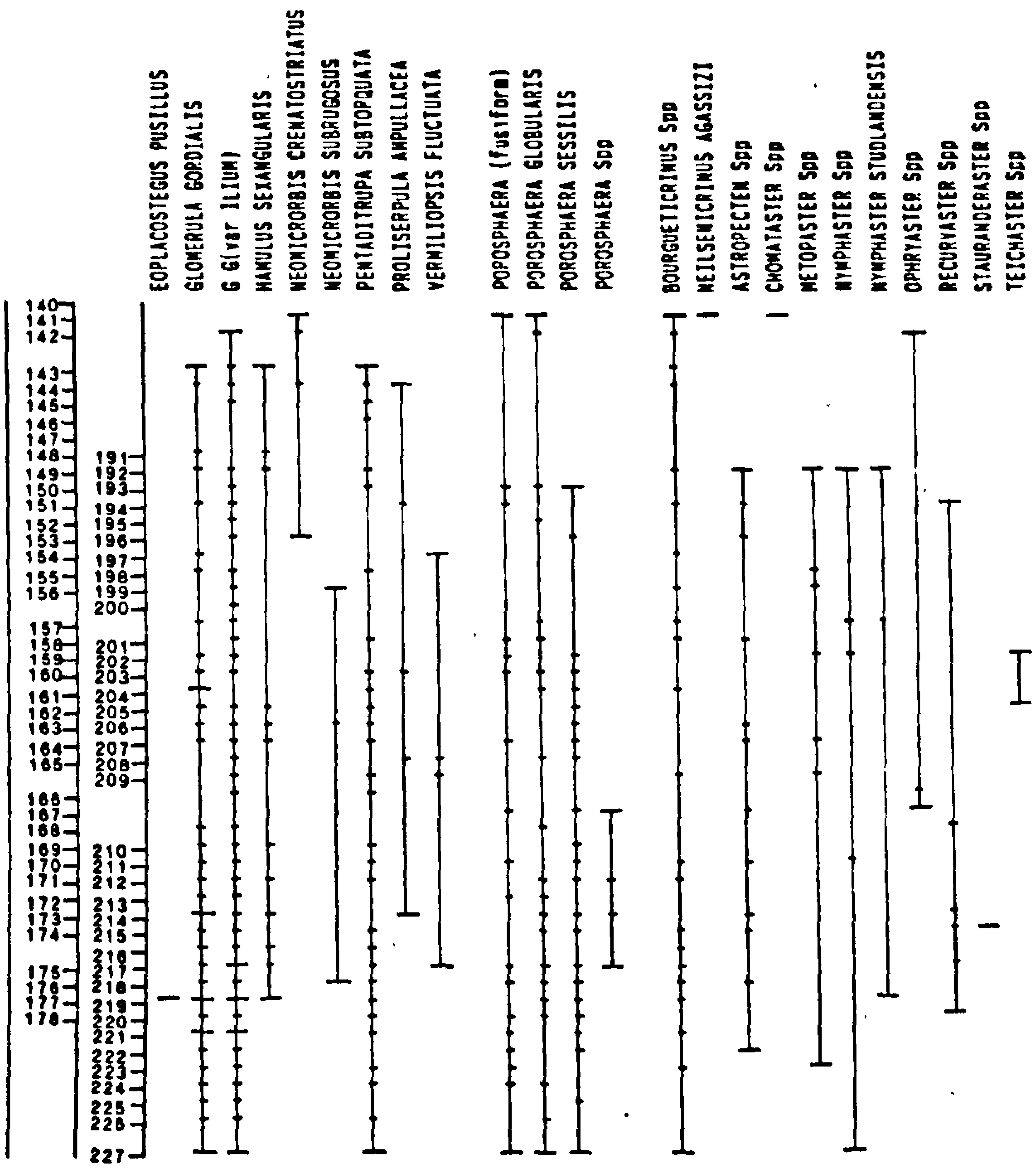
FIGURE 2.4 Occurrence of belemnite, brachiopod, and bivalve remains in the borehole samples from Norwich. Sample numbers on left side (Appendix 2) in assumed stratigraphic order.

section at Harford Bridges (section 1.3.3.7) at a level equivalent to that at which it was present in the boreholes.

A considerable suite of bivalves was recognised (Figure 2.4). Numerous small fragments of Inoceramus spp., Neithea sexcostata, Ostrea spp., and Pseudolimea granulata were collected, along with a partial specimen of Lyropecten sarumensis (Woods). A single instance of the ostreid Hyotissa semiplana, one of Mimachlamys cretosa, and two each of the large pectinids Plagiostoma cretosa and P. marrotiana were noted. The remaining bivalve elements consisted of several portions of the spondylids Spondylus dutempleanus, S. spinosus, and S. sp., together with a single valve of Atreta nilssoni (Hagenow).

The serpulid fauna (Figure 2.5) was dominated by the common species Glomerula gordialis, G. g. var. ilium, Hamulus sexangularis, and Pentaditrupa subtorquata. A few fragments of Neomicrorbis crenatostriatus, N. subrugosus, Proliserpula ampullacea, and Vermiliopsis fluctuata were collected, as was a single piece of Eoplacostegus pusillus. The typical sponges Porosphaera globularis, P. sessilis, and P. sp. (fusiform) were abundantly encountered.

A large fauna of echinoderms was identified (Figures 2.5 and 2.6). This consisted of extremely



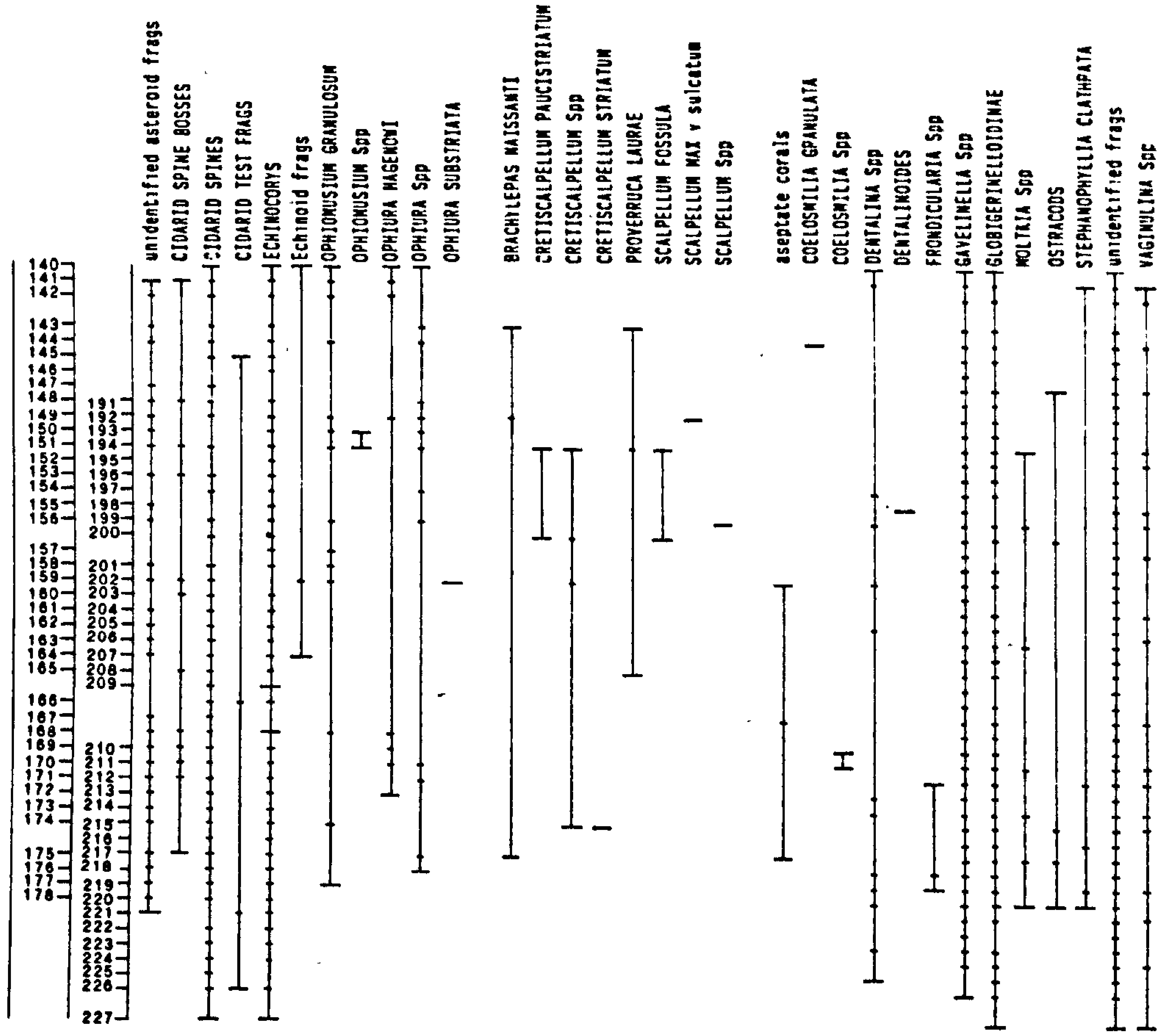
<u>FIGURE 2.5</u> Occurrence of serpulid, sponge, crinoid, and asteroid remains in the borehole samples from Norwich. Sample numbers on left side (Appendix 2) in assumed stratigraphic order.

common spines of cidarid echinoids, columnals of Bourgueticrinus spp., and fragments of Echinocorys spp. A few ossicles of the common asteroids Astropecten sp., Metopaster sp., Nymphaster sp., and Recurvaster sp. were collected throughout the samples, as was one of Chomataster sp., and three of Ophryaster sp. A single columnal of the crinoid Neilsenocrinus agassizi (Hagenow) was noted at the top of BH6, possibly in the basal beds of the Beeston Chalk. Ophiuroid plates of Ophiomusium granulosum, Ophiura hagenowi, and O. sp. also occurred relatively often.

Eight different forms of cirripede plates were found (Figure 2.6). They were referable to Brachylepas naissanti, Cretiscalpellum paucistriatum, C. sp., C. striatum (Darwin), Proverruca laurae, Scalpellum fossula, S. maximum var. sulcatum, and S. sp.

The remainder of the non-bryozoan faunal elements included a few fragments each of aseptate corals, Molkia sp., and Stephanophyllia clathrata, a single example of the coral Coelosmilia granulata, occasional worn C. sp., and several ostracod carapaces. Foraminifera collected included Dentalina sp., Frondicularia sp., and Vaginulina sp., together with numerous Gavelinella spp. and globigerinelloidinae.

The stratigraphically restricted anascan bryozoan Volviflustrellaria taverensis was found in four



<u>FIGURE 2.6</u> Occurrence of echinoid, ophiuroid, cirripede, and miscellaneous non-bryozoan taxon remains (including foraminifera) in the borehole samples from Norwich. Sample numbers on left side (Appendix 2) in assumed stratigraphic order.

samples, close to the bottom of the boreholes (Figure 2.7). This species indicates a level within the Pre-Weybourne Chalk, possibly equivalent to the section exposed at UEA 1 (see section 1.3.2.4). The ubiquitous anascans "Biflustra" argus, Onychocella inelegans, O. matrona, and Woodipora disparilis were all very abundant (Figure 2.7). The other anascans recognised were Coscinopleura lamourouxi, Latereschara galeata, Lunulites sp., "Membranipora" flabelliformis, "M" spp., Onychocella nysti, O. rowei, O. sp., Quadricellaria grania, and rare examples of Tricephalopora sp. and Vincularia allas Brydone.

Ascophorans were not very common (Figure 2.7), only three occurrences of Beisselina spp., seven of Porina golfussi, and three of P. sp. being recorded. Several cancellatans were identified (Figure 2.7), often of the long ranging forms Petalopora spp., Sparsicavea spp., and Sulcocava sp. Examples of Bicavea sp., relatively numerous Crisina spp., Eohornera langethali, rare Homoeosolen sp., Hornera sp., and Osculipora sp., and a single individual of O. truncata (Goldfuss), recovered from the top of BH6, and therefore assumed to come from the basal beds of the Beeston Chalk, were also found.

A few examples of the long ranging dactylethratan Clausa globulosa were discovered (Figure 2.8), along with many of the salpinginans Meliceritites gothica, M. sp., and a solitary ?Meliceritella sp. The only

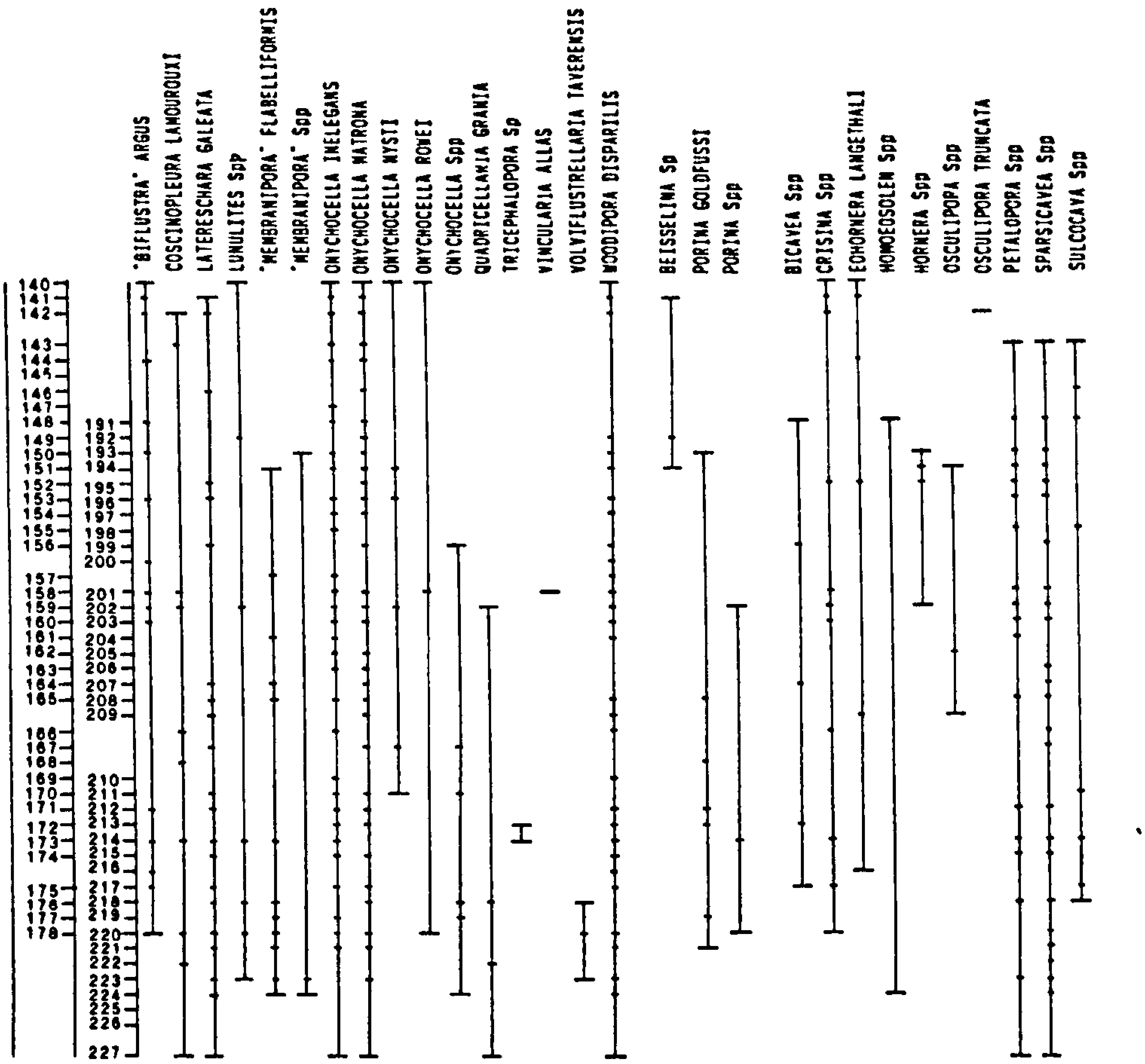


FIGURE 2.7 Occurrence of anascan, ascophoran, and cancellatan bryozoan remains in the borehole samples from Norwich. Sample numbers on left side (Appendix 2) in assumed stratigraphic order.

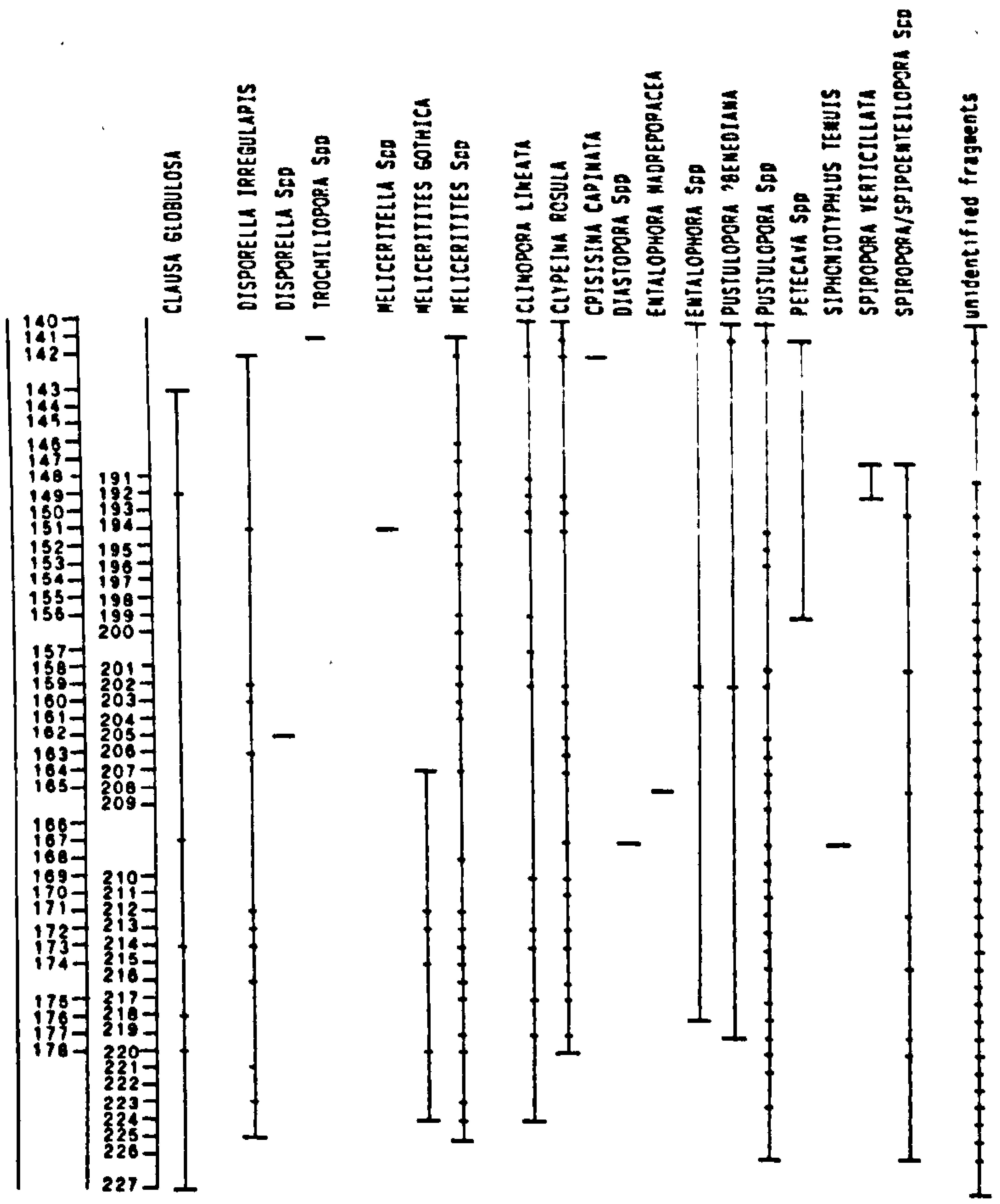


FIGURE 2.8 Occurrence of dactylethratan, rectangulatan, salpinginan, and tubuloporinan bryozoan remains in the borehole samples from Norwich. Sample numbers on left side (Appendix 2) in assumed stratigraphic order.

rectangulatans encountered (Figure 2.8) were Disporella irregularis, D. sp., and a single piece (the sole record) of Trochiliopora sp. from the top of BH6.

The large tubuloporinan group was well represented (Figure 2.8), especially by forms of the long ranging Clinopora lineata, Clypeina rosula, Pustulopora benediana, and P. sp. Other forms recognised were rare Crisisina carinata, Diastopora sp., Entalophora madreporacea (Goldfuss), E. sp., Retecava sp., Siphoniotyphlus tenuis, Spiropora verticillata, and S. sp.

2.3.1 Summary

The two boreholes (BH5 and BH6) yielded a diverse, but largely undiagnostic, fauna. However, the occurrence of Volviflustrellaria taverensis in the bottom of the boreholes is important as it provided correlation with the section at UEA 1(section 1.3.2.4), where this stratigraphically restricted anascan bryozoan was collected.

Many common long ranging forms such as Belemnitella, the rhynchonellid Cretirhynchia spp., the terebratulid Terebratulina spp., fragments of the bivalves Inoceramus spp., Neithea sexcostata, and Ostrea spp., the serpulids Glomerula gordialis, G. g. var. ilium, and Pentaditrupa subtorquata, and various sponges referable to *Porosphaera* spp. were regularly identified. Echinoderms often encountered included columnals of *Bourgueticrinus* spp., spines of cidarid echinoids, *Echinocorys* spp. test fragments, and various asteroid ossicles and ophiuroid plates.

Common bryozoans, such as, "*Biflustra*" *argus*, *Lateroschara galeata*, *Onychocella inelegans*, *O. matrona*, *Woodipora disparilis*, *Petalopora* spp., *Sparsicavea* spp., *Meliceritites* spp., *Clinopora lineata*, *Clypeina rosula*, and *Pustulopora* spp. all have much greater stratigraphic ranges.

2.4 MAYTON WOOD

Nine bagged samples of, mostly, soft white chalk were received from several boreholes drilled by the Highways Laboratory of Norfolk County Council at Mayton Wood (TG 2465 2098) in the north-east of the county in 1987. The holes were put down to monitor water conditions in the bottom of an old pit to test its suitability for usage as a long term rubbish dump. From its geographical position and topographic level (17 m above ordnance datum) the samples were assumed to contain chalk from the middle and upper parts of the Beeston Chalk division of the *mucronata* chalk (Figure 1.21).

The fauna (Figure 2.9 and Appendix 11) was characterised by the common occurrence of Belemnitella and a typical Beeston Chalk brachiopod assemblage comprising abundant Carneithyris carnea, Cretirhynchia spp., and Terebratulina spp., with subordinate Kingena pentangulata, Magas chitoniformis, and Argyrotheca sp. Of the bivalves, fragments of Inoceramus spp. and Ostrea spp. were most abundant, with rarer Lyropecten sp., Mimachlamys cretosa, M. mantelliana, the uncommon Neithea striatocostatus, Pseudolimea granulata, and the spondylids Spondylus dutempleanus, and S. sp. Glomerula gordialis was often, collected along with fewer examples of Eoplacostegus pusillus, Filogranula cincta, Neomicrorbis crenatostriatus, N. subrugosus, Pentaditrupa subtorquata, Proliserpula ampullacea, Vepreculina tuberculifera, and Vermiliopsis fluctuata.

A few specimens of the sponges Porosphaera sessilis and P. sp. (fusiform) were noted. The echinoderm fauna included crinoid columnals of Bourgueticrinus brydonei, B. spp., and Neilsenocrinus agassizi, common spines of cidarid echinoids, fragments of Echinocorys spp. and a rostrum of Hagenowia sp. Ossicles of the asteroids Astropecten spp., Chomataster spp., Metopaster spp. (including M. undulatus), and Recurvaster sp. Remaining elements of the echinoderm fauna included a few plates of the ophiuroids Ophiomusium granulosum, Ophiura hagenowi, O. aff substriata, and O. sp.

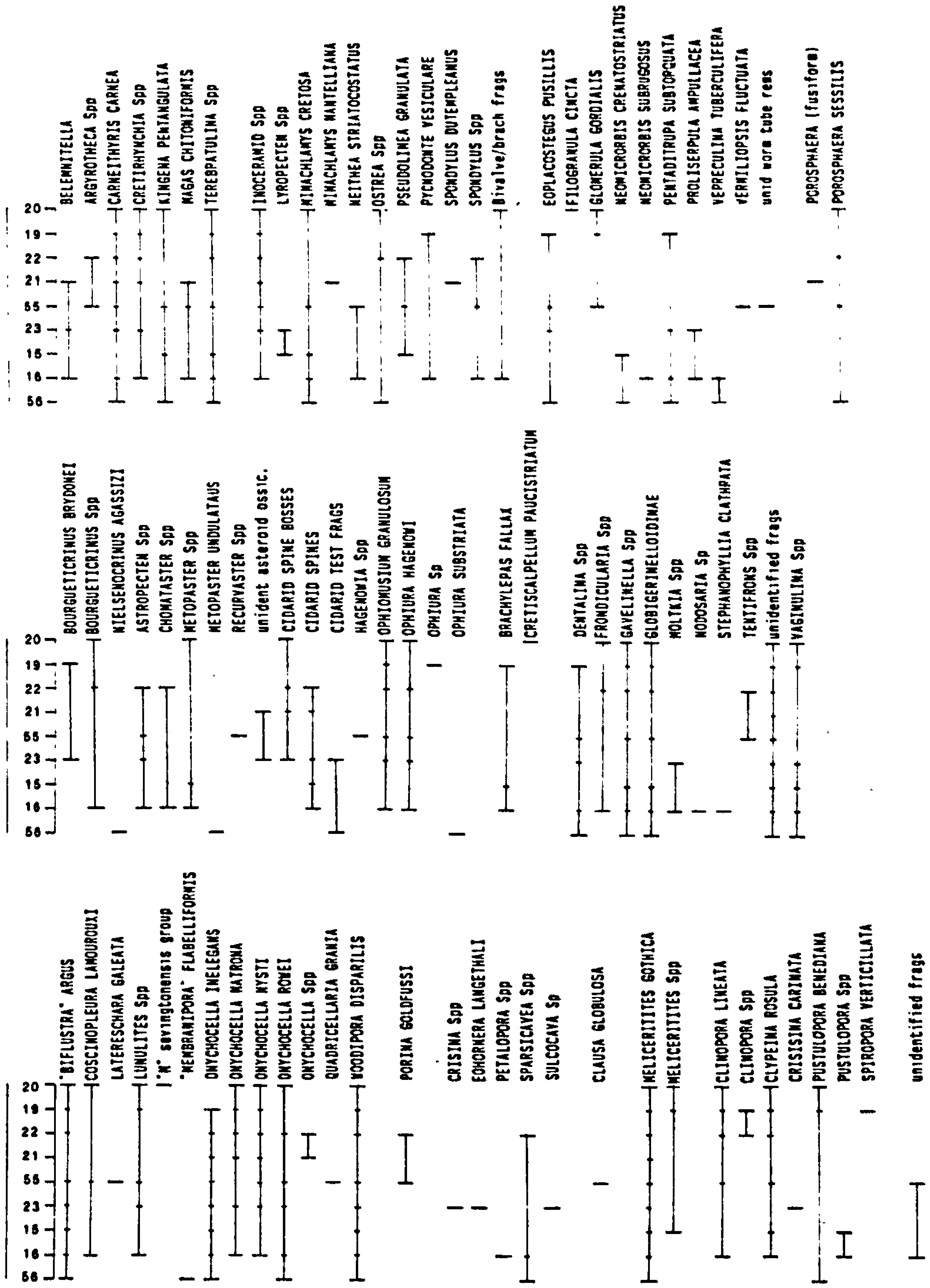


FIGURE 2.9 Occurrence of belemnite, brachiopod, bivalve, serpulid, sponge, echinoderm, cirripede, miscellaneous non-bryozoan taxon remains (including foraminifera) and bryozoan remains in the borehole samples from Mayton Wood. Sample numbers on left side (Appendix 2) in assumed stratigraphic order.

Cirripede plates referable to _Brachylepas fallax_ and _Cretiscalpellum paucistriatum_ were found, as were the corals _Moltkia_ sp. and _Stephanophyllia clathrata_, and foraminifera including common _Dentalina_ sp., _Vaginulina_ spp., _Frondicularia_ sp., _Gavelinella_ spp., _Tentifrons_ sp., and globigerinelloidinae.

Anascan bryozoans were often identified. In particular the common long ranging forms "_Biflustra_" _argus_, _Onychocella inelegans_, _O_. _matrona_, _O_. _nysti_, _O_. _rowei_, _O_. sp., and _Woodipora disparilis_ were present together with less abundant _Coscinopleura lamourouxi_ and _Lunulites_ spp., and one record each of _Latereschara galeata_, "_Membranipora_" _flabelliformis_, a member of the "_M_." sevingtonensis group, and _Quadricellaria grania_. The ascophoran _Porina goldfussi_, was rarely encountered, as were the cancellatans _Crisina_ sp., _Eohornera langethali_, _Petalopora_ spp., _Sparsicavea_ spp., and ?_Sulcocava_ sp., and a single dactylethratan (_Clausa globulosa_).

The salpinginans _Meliceritites gothica_ and _M_. spp. were commonly collected. Identified tubuloporinans included _Clinopora lineata_, _C_. sp., _Clypeina rosula_, _Crisisina carinata_, _Pustulopora benediana_, _P_. sp., and _Spiropora verticillata_.

2.4.1 Summary

The fauna from the Mayton Wood boreholes was undiagnostic except for the occurrence of a typical Beeston Chalk brachiopod assemblage dominated by *Carneithyris carnea*, *Cretirhynchia* spp, and *Terebratulina* spp. Various serpulid and echinoderm remains were commonly collected, as were long ranging anascan genera including "*Biflustra*", *Onychocella*, and *Woodipora*, and the salpinginan *Meliceritites gothica*.

2.5 WHITLINGHAM

Thirty 100 mm diameter (U100) core samples (mostly 50 cm long) were obtained during the early summer of 1988 from two boreholes (Whitlingham 1 (WHIT.1) and 2 (WHIT.2)) drilled by the AWA at Whitlingham, about 5 km east of Norwich. Eighteen of the samples came from WHIT.1 (TG 2770 0707), the remainder from WHIT.2 (TG 2757 0771). As the two sites lay along strike, direct correlation was made between samples at equivalent topographic levels. From their geographical positions both boreholes probably lay within the Paramoudra Chalk, and also through the upper part of the underlying Beeston Chalk (Figure 1.21) division of the *Belemnitella mucronata* Zone.

Where 50 cm core lengths were available (a few samples from WHIT.2 were much smaller), the middle 20 cm portion was processed as it was not apparent which was the top of the core as originally retrieved from the ground. The chalk was very soft, usually iron-stained, and yellow/orange/brown in colour, and sometimes contained sizable flints. All identified fossils were plotted on spreadsheets (Appendix 12).

The non-bryozoan fauna (Figures 2.10-2.12) contained several examples of Belemnitella and a typical Beeston Chalk brachiopod assemblage (Figure 2.10) consisting of abundant Carneithyris carnea, Cretirhynchia spp., and Terebratulina spp., with subordinate Isocrania costata, Kingena pentangulata, and Magas chitoniformis. Bivalves (Figure 2.10) included extremely numerous fragments of Inoceramus spp. (characteristic of the Beeston Chalk), common pieces of Neithea sexcostata, and rarer remains of Hyotissa semiplana, Lyropecten spp., Mimachlamys cretosa, Ostrea spp., Pseudolimea granulata, and the spondylids Spondylus dutempleanus, S. spinosus, and S. sp.

Serpulids were relatively plentiful (Figure 2.10), with the long ranging forms Glomerula gordialis, G. g. var. ilium, Neomicrorbis crenatostriatus, N. subrugosus, Pentaditrupa subtorquata, and Vermiliopsis fluctuata were all recorded several times. Hamulus sexangularis, Proliserpula ampullacea, and Vepreculina tuberculifera (Nielsen) were also present, but less

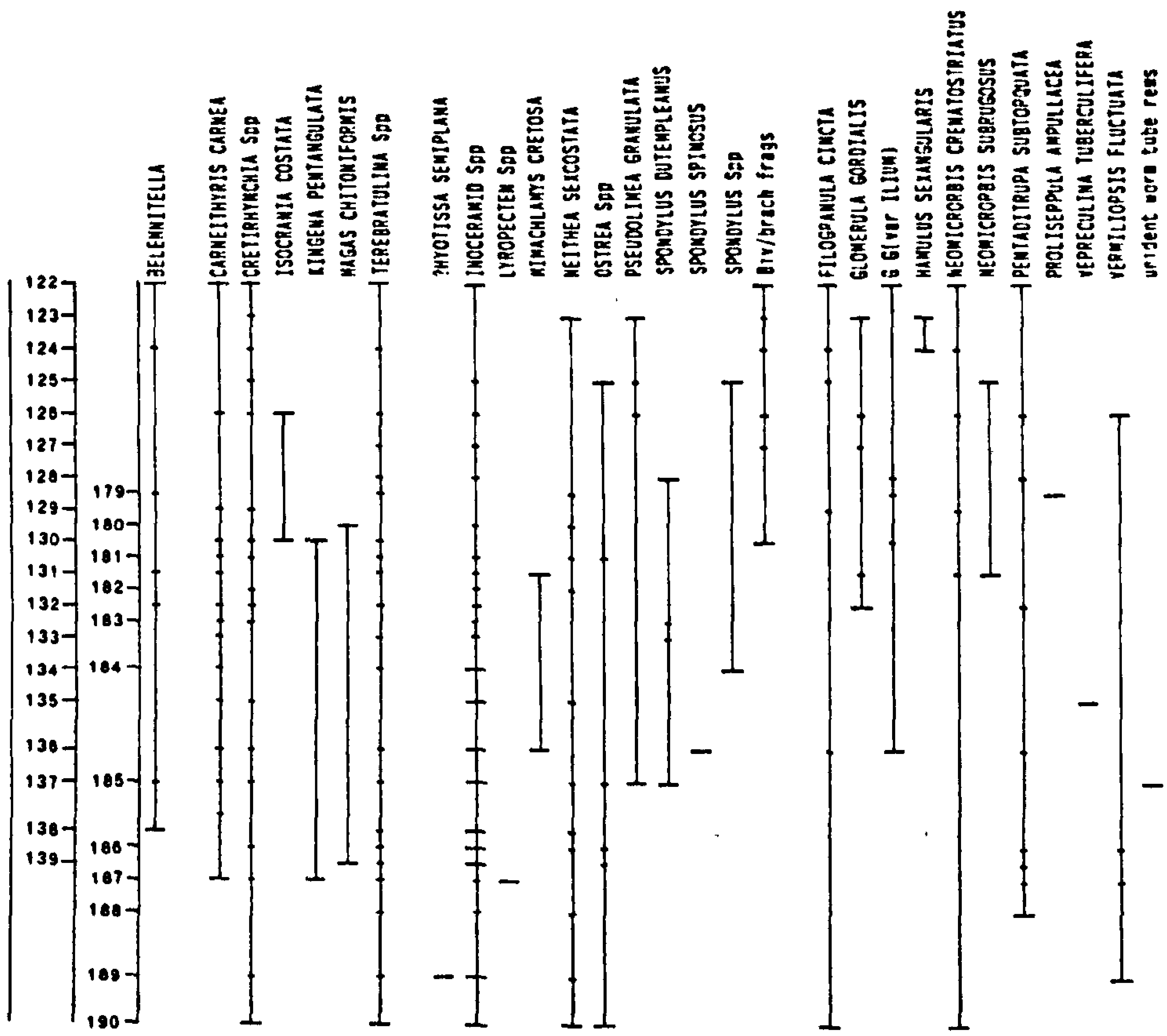


FIGURE 2.10 Occurrence of belemnite, brachiopod, bivalve, and serpulid remains in the borehole samples from Whitlingham. Sample numbers on left side (Appendix 2) in assumed stratigraphic order.

common. The three stratigraphically long lived sponges Porosphaera globularis, P. sessilis, and P. sp. (fusiform) were abundantly encountered.

Echinoderms recovered from the sieved residues (Figure 2.11) included many spines of cidarid echinoids, columnals of Bourgueticrinus spp. (with one of B. brydonei), and fragments of Echinocorys spp. A varied selection of asteroid ossicles were identified, including a few of Astropecten spp. and Nymphaster spp., and isolated examples of Metopaster undulatus Spencer, M. sp., Ophryaster sp., ?Recurvaster sp., and ?Teichaster sp. A single columnal of the crinoid Neilsenocrinus agassizi, a rostrum of Hagenowia sp., and plates of the ophiuroids Ophiomusium granulosum, O. sp., and Ophiura sp. also occurred.

Cirripede plates were never common (Figure 2.11), but forms referable to Brachylepas fallax, B. naissanti, Cretiscalpellum sp., Proverruca laurae, and Scalpellum sp. were collected. The remaining elements of the non-bryozoan fauna (Figure 2.12) comprised, rare fragments of aseptate corals and the coral Moltkia sp., ostracod carapaces, and foraminifera including Dentalina sp., Vaginulina spp., Frondicularia sp., Gavelinella spp., and globigerinelloidinae.

The bryozoan fauna (Figures 2.12 and 2.13) contained many individuals of the long ranging anascans

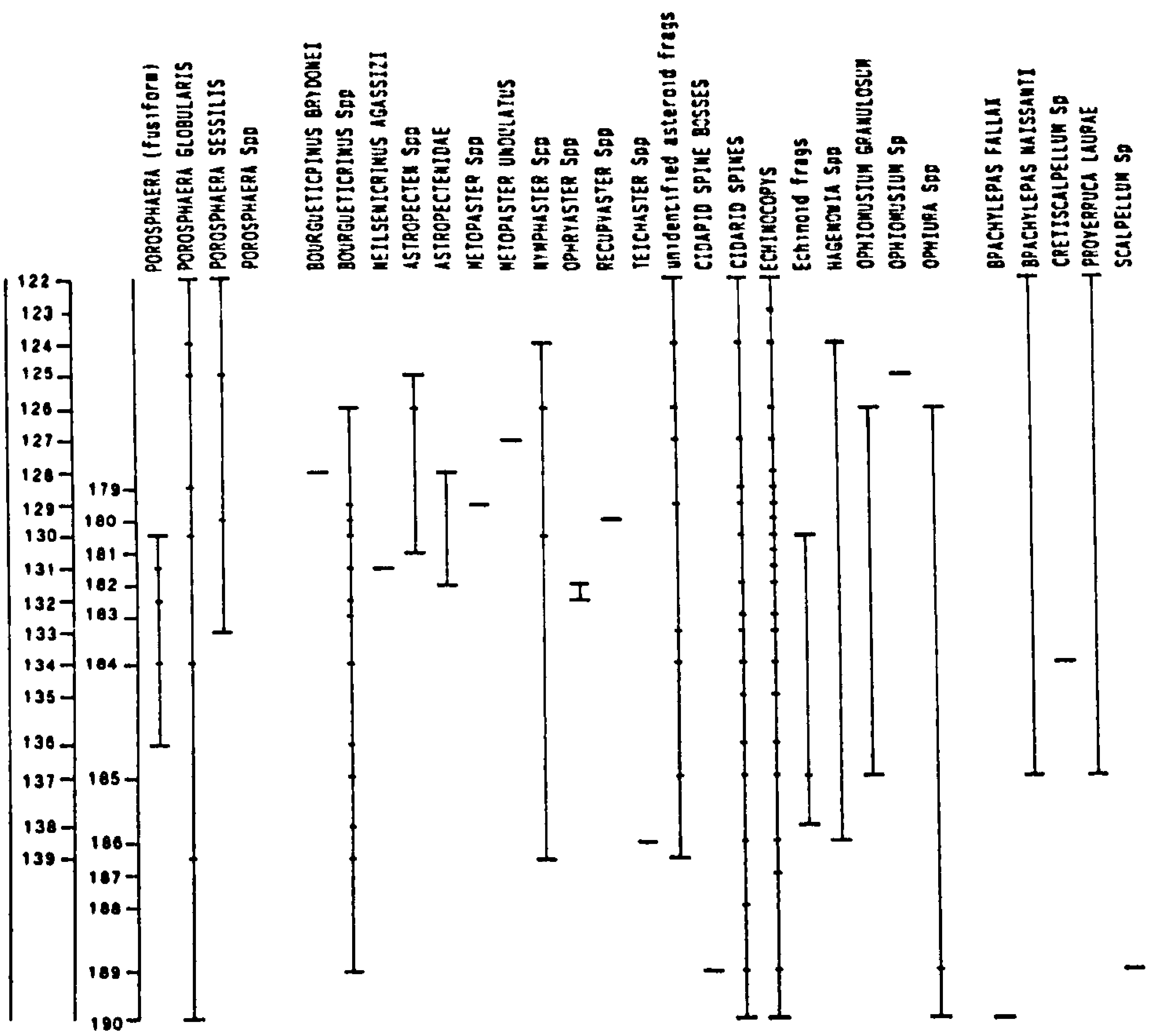


FIGURE 2.11 Occurrence of sponge, echinoderm, and cirripede remains in the borehole samples from Whitlingham. Sample numbers on left side (Appendix 2) in assumed stratigraphic order.

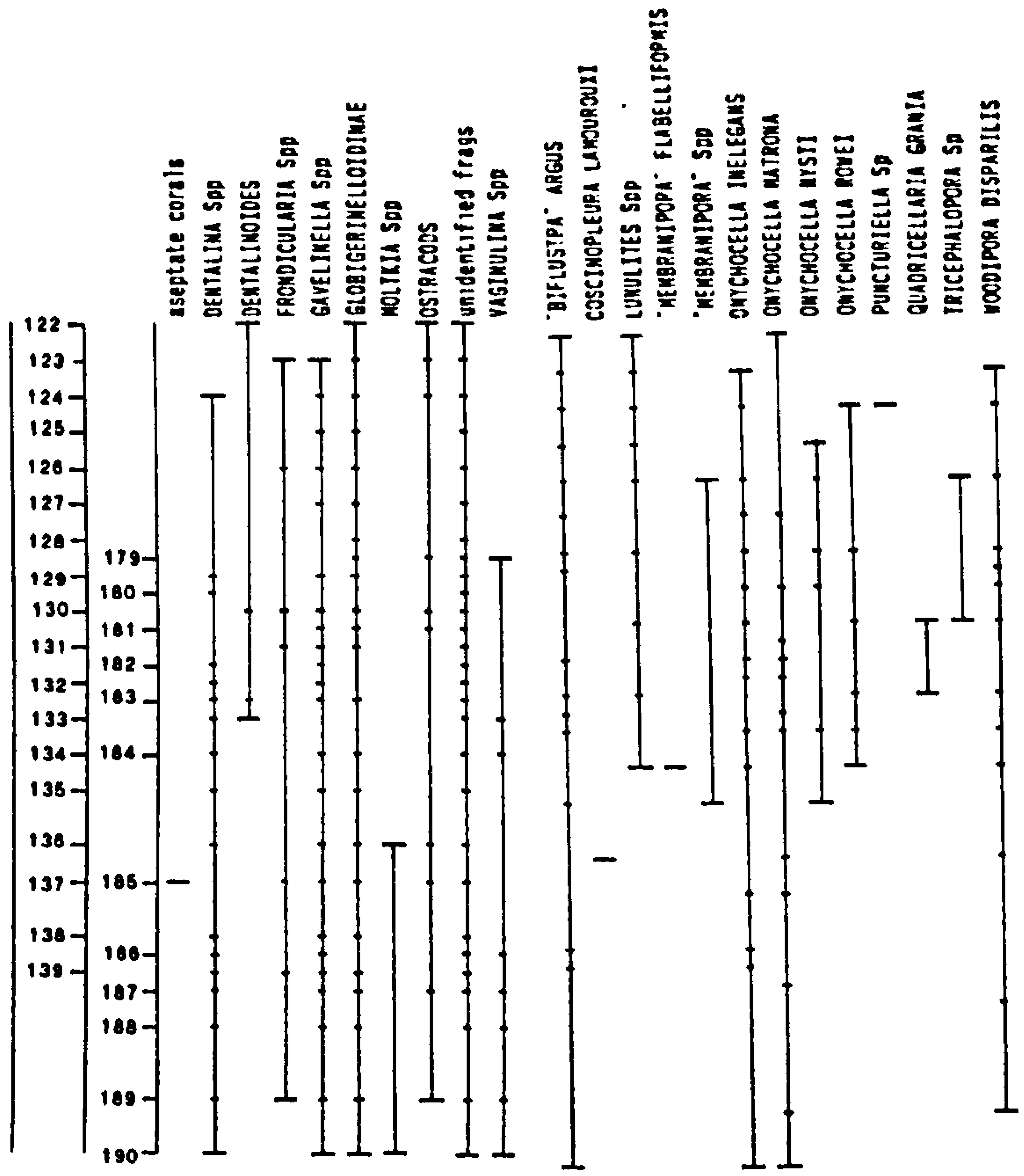


FIGURE 2.12 Occurrence of miscellaneous non-bryozoan taxa (including foraminifera) and anascan bryozoan remains in the borehole samples from Whitlingham. Sample numbers on left side (Appendix 2) in assumed stratigraphic order.

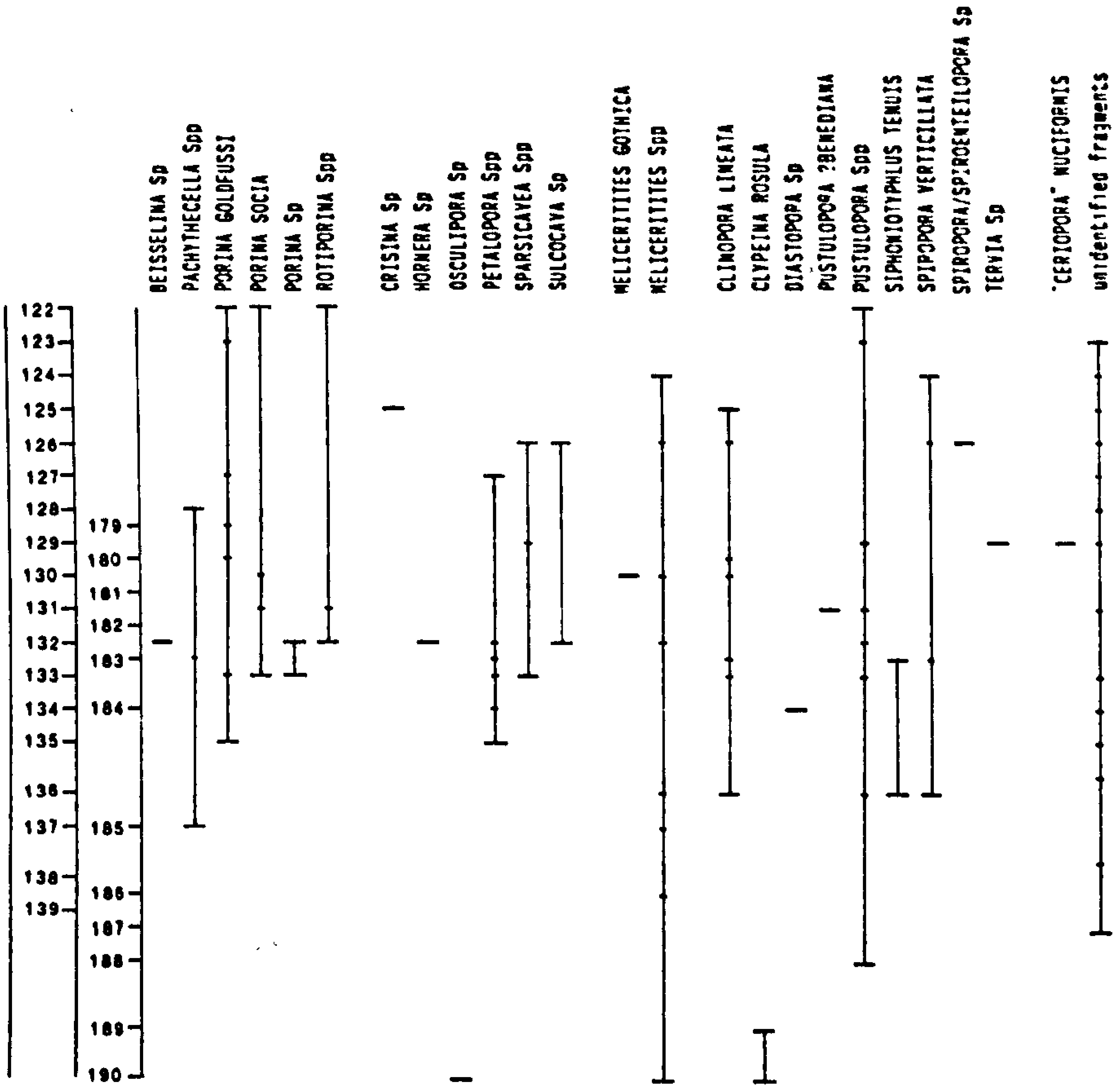


FIGURE 2.13 Occurrence of ascophoran, cancellatan, salpinginan, and tubuloporinan bryozoan remains in the borehole samples from Whitlingham. Sample numbers on left side (Appendix 2) in assumed stratigraphic order.

"*Biflustra*" *argus*, *Lunulites* sp., *Onychocella inelegans*, *O. matrona*, *O. nysti*, *O. rowei*, and *Woodipora disparilis* (Figure 2.12), and occasional specimens of "*Membranipora*" *flabelliformis*, "*M*" spp., *Puncturiella* sp., *Quadricellaria grania*, and *Tricephalopora* sp. Identified ascophorans (Figure 2.13) were *Beisselina* sp., *Pachythecella* sp., several examples, each, of *Porina goldfussi*, *P. socia*, and *P.* sp., and *Rotiporina* sp.

Of the cancellatans (Figure 2.13), only *Petalopora* spp. was regularly noted, although examples of *Crisina* sp., *Hornera* sp., *Osculipora* sp., *Sparsicavea* spp., and *Sulcocava* sp. also occurred.Only one specimen of *Meliceritites gothica* was recorded, although *M.* spp. were numerous. Tubuloporinans formed the remainder of the identifiable fauna (Figure 2.13). Of these, *Clinopora lineata* and *Pustulopora* spp. were most abundant, with specimens of *Clypeina rosula*, *Diastopora* sp., *Pustulopora benediana*, *Siphoniotyphlus tenuis*, *Spiropora verticillata*, *S.* sp., and *Tervia* sp. collected less often. "*Ceriopora*" *nuciformis* Hagenow was represented by a single fragment (the only one found),

2.5.1 Summary

The collected fauna was largely indistinctive, except for the abundant occurrence of a typical Beeston

Chalk brachiopod assemblage dominated by Carneithyris carnea and Cretirhynchia spp., and copious fragments of the bivalve Inoceramus spp. The serpulids Glomerula gordialis, G. g. var. ilium, Pentaditrupa subtorquata, and Vermiliopsis fluctuata, and echinoderms including spines of cidarid echinoids, columnals of Bourgueticrinus spp., Echinocorys spp. test fragments, and various asteroid ossicles were well represented.

The anascan bryozoans "Biflustra" argus, Lunulites spp., Onychocella inelegans, O. matrona, O. nysti, O. rowei, and Woodipora disparilis were very plentiful, as was the cancellatan Petalopora spp., the salpinginan Meliceritites spp., and the tubuloporinans Clinopora lineata and Pustulopora spp. All these bryozoans have long stratigraphic ranges and, therefore, gave little indication as to the horizon represented by the samples.

CHAPTER THREE

FOSSIL BORINGS AND EPIFAUNA

3.1 INTRODUCTION

Many of the fossils collected from the sections described in chapter one were encrusted with epifauna and/or bored. The epifauna was usually external, but occasionally internal, and typically post-mortem. The encrusters appear to have shown no preference towards any particular fossil group as a substrate. Common forms were regularly noted on belemnites, bivalves, brachiopods, and echinoids. The epifauna (listed in Appendices 3-7) was dominated by encrusting bryozoans, with subordinate serpulid worms, brachiopods, bivalves, foraminifera, and sponges. Most of these were forms only recognised as epifauna and not found in the bulk sample residues.

The borings (listed in Appendices 3-7) often had characteristic shapes and were almost exclusively post-mortem, host fossils showing no evidence of repairing the damage caused by the boring agents. All collected macro-fossil groups were attacked but specific forms of borings occurred on certain fossil taxa. Belemnites, in particular, carried a distinctive suite of traces, that were very rare on other taxa. These included the ramified _Calcideletrix_ sp., the stellate _Dendrina_ _belemniticola_ Mägdefrau, the unbranched "tunnel-like" ?*Nygmites* sp., and *Talpina* sp. (branched tunnels, each branch having numerous small circular apertures). Other forms including *Entobia* sp., believed to result from clionid sponge boring activity, and *Rogerella* sp., a slit-like form produced by barnacles, were identified on several fossil groups. Most of the borings are thought to have been made by sponges, although rare brachiopod pedicle attachment scars (*Podichnus* sp.) were recognised.

For ease of description the epifauna will be considered before the borings. The localities are listed in the same stratigraphic order as in chapter one.

3.2 GONIOTEUTHIS ZONE

None of the few macrofossils collected from the rare sections in this zone contained epifauna on their surfaces, or showed any evidence of boring.

3.3 BELEMNITELLA MUCRONATA ZONE

3.3.1 PRE-WEYBOURNE CHALK

3.3.1.1 UEA (1) (section 1.3.2.4)

Two large cidarid spines collected from this locality each bore a single juvenile of the oyster Pycnodonte vesiculare.

3.3.1.2 NEWFOUND FARM, CRINGLEFORD (section 1.3.2.5)

The craniacean brachiopod Ancistocrania parisiens was found on two fossils, the bivalve Atreta nilssoni on three, with Gyropleura inequirostrata and Pycnodonte vesiculare occurring on one fossil each, and the long ranging sponge Porosphaera sessilis (commonly encountered in the bulk samples) on two. Two corals (Coelosmilia sp.) and a single Moltkia sp. were noted, as were four examples of hemi-spherical foraminifera remains (Bullopora sp.). The bryozoan fauna included one record each of the anascans Aechmella anglica (Brydone), Castanopora magnifica (d'Orbigny), and Leptocheilopora magna Lang, three of "Membranipora" spp., and single occurrences of the rectangulatan Disporella irregularis, the tubuloporinans Diastopora sp. and Stomatopora sp., and unidentified bryozoan remains.

The borings recorded on the collected fauna consisted of five records each of Calcideletrix sp. and Dendrina belemniticola, and two of Entobia sp.

3.3.2 WEYBOURNE CHALK

3.3.2.1 WEYBOURNE HOPE (section 1.3.3.3)

A varied suite of epifauna was recorded on the numerous fossils collected from this cliff section on the north Norfolk coast. This included the brachiopod Ancistocrania parisiens and the bivalves Atreta nilssoni (very commonly), Gyropleura inequirostrata, and Pycnodonte vesiculare, the latter usually on fossils collected in the harder chalk between flint bands 10 and 12 of the section (Figure 1.6). The most numerous serpulid identified was "Serpula" accumulata S. Woodward which was recognised on twenty nine different fossils. Other rarer forms were Sclerostyla spp., Vepreculina tuberculifera, and V. sp., each noted on three occasions, and individual records of Cementula spiraserpula (Regenhardt), Neomicrorbis crenatostriatus, and Vepreculina fimbriata.

The sponge Porosphaera sessilis (often present in bulk sample residues) was found on seven specimens, along with single examples of Porosphaera sp., and a mould of a hexactinellid sponge. The corals Coelosmilia spp. and Moltkia spp. were commonly encountered, the former, in particular, being regularly present, as were remains of the hemi-spherical foraminifera Bullopora sp. and indeterminate calcareous foraminifera.

Many different anascan bryozoans were identified as epifauna from Weybourne, although in most cases only rarely. Amongst more numerous forms were Aechmella anglica, Aplousina fulgora (Brydone), Dionella trigonopora, and "Membranipora" spp. Other species collected (from less than six specimens) were "Biflustra" sp., Dionella trifaria (Von Hagenow), Ellisina ringens (Von Hagenow), Herpetopora laxata (d'Orbigny), H. sp., Leptocheilopora magna, several membraniporids including the sole record of a member of the "Membranipora" langei Brydone group, "M". palpebra var. nuntians Brydone, a member of the "M". tenebrosa Brydone group, "M". withersi (Brydone) represented by a single record, and "Membraniporella" monastica Brydone. Two specimens of the ubiquitous, but rarely epifaunal, Onychocella inelegans and O. sp. were noted, as were single individuals of the rare Pliophloea cf. subvitrea (Brydone) and Tricephalopora sp.

The ascophoran Cryptostomella compacta (Brydone) and the cancellatans Crisina sp. and Sulcocava sp. were found on a single occasion. The rectangulatan Disporella sp. was sometimes present, as were tubuloporinans, including Diastopora spp., Stomatopora spp., scarce Idmonea sp., Proboscina sp., and Stomatopora pedicellata (Marsson).

Borings were dominated by forms of the very common Calcideletrix sp., Dendrina belemniticola, and

?Nygmites sp., with subordinate Talpina sp. and Entobia sp. Also identified were two attachment scars left by brachiopod pedicles (Podichnus sp.), two Dictyoporous sp., a member of the Ramosulcichnus bifrons group, and seven records of Rogerella sp., attributed to barnacles.

3.3.2.2 KESWICK (section 1.3.3.4)

This section is laterally equivalent to the lower part of the coastal section at Weybourne (Figure 1.5). The only brachiopod identified was Ancistocrania parisiens, found on nine occasions. Bivalves found were rare Gyropleura inequirostrata and more common Atreta nilssoni and Pycnodonte vesiculare. A varied group of serpulids was recognised. Of these the most numerous were "Serpula" accumulata and unidentified remains. Less common were Neomicrorbis subrugosus, Sclerostyla spp., and Vepreculina sp. Remains referable to Cementula spiraserpula, Glomerula gordialis (unusually found attached to a belemnite), Neomicrorbis sp., Pentaditrupa subtorquata, and Sclerostyla macropus were noted on one or two fossils only.

The sponge Porosphaera sessilis was rarely present, in contrast to the common records of the corals Coelosmilia spp. and Moltkia spp., and foraminiferal remains, mostly of Bullopora sp., or indeterminate calcareous forms.

Twenty different anascan bryozoans were identified. Of these, only "Membranipora" spp., recorded twenty times was common. Aechmella anglica, Aplousina fulgora, Dionella sp., D. trifaria, Herpetopora sp., Leptocheilopora magna, "M". palpebra var. nuntians, and Onychocella sp. occurred on more than one occasion. Andriopora major Larwood, Castanopora castanea Lang, C. dibleyi (Brydone), C. sp., Dionella trigonopora, Ellisina ringens, Herpetopora laxata, Micropora bedensis (Brydone), "Membraniporella" monastica, Onychocella gibbosum (Marsson) (rarely found as an epifaunal coloniser), O. nysti, and Tricephalopora sp. were noted once only.

A single example of the cancellatan Bicavea sp., the rectangulatans Disporella irregularis and D. sp., and the tubuloporinans Diastopora spp., Proboscina sp., Stomatopora pedicellata, and S. sp. were also identified. Borings in fossils collected from Keswick were mostly of Calcideletrix sp., Dendrina belemniticola, ?Nygmites sp., Rogerella sp., and Talpina sp. Rare Entobia sp. and two examples of the barnacle borings Simonizapfes sp. were also identified.

3.3.2.3 EATON TUNNELS (section 1.3.3.5)

This section is largely stratigraphically equivalent to Keswick. Epifauna recognised included occasional specimens of Ancistocrania parisiens, Atreta nilssoni, Gyropleura inequirostrata, Pycnodonte vesiculare, and the serpulids Glomerula gordialis, "Serpula" accumulata, Vepreculina sp., and unidentified remains. The sponge Porosphaera sessilis, the corals Coelosmilia spp. and Moltkia spp., and hemi-spherical (Bullopora sp.) and indeterminate calcareous foraminiferal remains were identified.

The anascan bryozoans Aplousina fulgora, Herpetopora sp., and "Membranipora" sp., the rectangulatan Disporella irregularis, the tubuloporinans Proboscina sp., and Stomatopora sp., and bryozoan attachments were rarely found. Recognised borings were Calcideletrix sp., Dendrina belemniticola, Entobia sp, ?Nygmites sp., Rogerella sp., and Talpina sp.

3.3.2.4 WHIFFLER ROAD (section 1.3.3.6)

The epifauna identified on the few fossils collected from this section consisted of a single example of the common, long ranging, bivalve Atreta nilssoni, two of the foraminifera Bullopora sp., and one of the anascan bryozoan Herpetopora sp. Recognised borings were Calcideletrix sp., Dendrina belemniticola, and ?Nygmites sp.

3.3.2.5 HARFORD BRIDGES (1) (section 1.3.3.7.1)

Rare examples of the craniacean brachiopod Ancistocrania parisiens, the bivalve Pycnodonte vesiculare, the long ranging serpulids Neomicrorbis crenatostriatus and Vepreculina tuberculifera, the sponge Porosphaera sessilis, and the coral Moltkia sp. were recognised on the few fossils collected from this old quarry.

The anascan bryozoans Dionella trifaria, Herpetopora sp., and Onychocella sp., and the tubuloporinans Diastopora sp., Idmonea sp., and Stomatopora sp. each occurred on one or two specimens. The only borings noted were single records of Calcideletrix sp. and Dendrina belemniticola.

3.3.2.6 WEYBOURNE HOPE EAST (section 1.3.3.8)

The only epifauna recorded on the fossils collected from this section, on the north Norfolk coast just west of Sheringham, comprised a single specimen of the common serpulid "Serpula" accumulata and Bullopora sp. Identified borings were Calcideletrix sp. and Dendrina belemniticola.

3.3.2.7 WEYBOURNE CHALK SUMMARY

Epifaunal remains on fossils collected from the extant sections in the Weybourne Chalk were dominated by the brachiopod *Ancistocrania parisiens* and the bivalve *Atreta nilssoni* (the latter noted on more than 130 occasions). Juvenile forms of the oyster *Pycnodonte vesiculare* were often found, as were the serpulids "*Serpula*" *accumulata*, *Sclerostyla* spp., and unidentified worm tubes. The sponge *Porosphaera sessilis* occurred on more than a dozen occasions, but was relatively less common than in the bulk samples. The corals *Coelosmilia* spp. and *Moltkia* spp. were both very plentiful, noted on at least 125 fossils, as were remains of foraminifera, including *Bullopora* sp. and various indeterminate forms.

Several bryozoans were quite common. These were the anascans *Aechmella anglica*, *Aplousina fulgora*, *Dionella trifaria*, and "*Membranipora*" spp., the rectangulatan *Disporella irregularis*, and the tubuloporinans *Diastopora* spp. and *Stomatopora* spp.

Borings (chiefly in belemnite guards) were dominated by forms of *Calcideletrix* sp., *Dendrina belemniticola*, ?*Nygmites* sp., and *Talpina* sp., with less numerous *Rogerella* sp.

3.3.3 BEESTON CHALK

3.3.3.1 CAISTOR ST. EDMUND (section 1.3.5.2)

A large and varied epifauna was identified on some of the 1300 fossils collected from Caistor. Brachiopods included very common Ancistocrania parisiens and occasional ?Diomyodon sp., a form recorded only from this locality. Bivalves were less numerous excepting Atreta nilssoni, although juvenile Gyropleura inequirostrata and Pycnodonte vesiculare occurred intermittently along with two specimens of Spondylus dutempleanus (one of which lived inside a partial Echinocorys sp. test). A large serpulid fauna was recognised, although of these only "Serpula" accumulata and Vermiliopsis fluctuata (confined as epifauna to Caistor) were common. Rarer forms were Cementula spiraserpula, C. sp., a single specimen of Conorca trochiformis (Hagenow), Filogranula cincta, Glomerula gordialis (unusually occurring as epifauna), Neomicrorbis spp., N. subrugosus, Sclerostyla spp., Vepreculina fimbriata, V. spp., and V. tuberculifera.

A few examples of the sponge Porosphaera sessilis, the corals Coelosmilia spp. and Moltkia spp., noted on 40 and 75 occasions respectively, and fairly common Bullopora sp. and indeterminate foraminiferal remains were also noted.

Twenty five different anascan bryozoans were identified as epifauna. Of these only Aechmella anglica, Dionella trifaria, and "Membranipora" spp. occurred with any regularity. Several forms were confined to Caistor. These were Aechmella nitescens (Brydone), A. sp., Homalostega clathrata Beissel, H. sp., Leptocheilopora sp., "Membranipora" furina (Brydone), Onychocella norfolcia Brydone, Ubaghsia crassa (Lang), and U. sp. Other anascans collected were Aplousina fulgora, Dionella sp., Ellisina ringens, Herpetopora laxata, H. sp., Leptocheilopora magna, "M". palpebra var. nuntians, "M". exhaurensis, "Membraniporella" monastica, Onychocella inelegans, O. nysti, and Tricephalopora sp.

The cancellatans Bicavea sp., Crisina sp., and Homoeosolen sp. were rarely present, whereas the rectangulatan Disporella irregularis was relatively plentiful. The tubuloporinans Diastopora spp., Proboscina sp., and Stomatopora spp. were fairly abundant, in contrast to the two records of Actinopora sp. and Idmonea sp., and a single one of Stomatopora gracilis (Edwards). A few miscellaneous bryozoan fragments were also present.

Borings were very numerous on fossils collected from Caistor. In particular, Calcideletrix sp. and Dendrina belemniticola, which were each found on more than 350 of the collected faunal elements. ?Nygmites sp. and Talpina sp. were common (recorded on 146 and 131 occasions, respectively), as were traces of borings made by clionid sponges (Entobia sp.). Also identified were five attachment scars left by brachiopod pedicles (Podichnus sp.) with their characteristic cluster of small circular holes, a single net-like form referable to Dictyoporus nodosus Mägdefrau, five D. sp., twenty seven examples of barnacle borings (Rogerella sp.), and five of unknown affinity.

3.3.3.2 FRETTENHAM (JSS Agg. Ltd) (section 1.3.5.4)

A few epifaunal remains were recognised on the fossils collected from this locality. These included the brachiopod Ancistocrania parisiens and the bivalve Atreta nilssoni, the sponge Porosphaera sessilis, the corals Coelosmilia sp. and Moltkia sp., hemi-spherical foraminiferal remains (Bullopora sp.), and indeterminate worm tube remains. A single specimen of the tubuloporinan Proboscina sp. and an unidentified attachment were the only bryozoans found.

Borings included Calcideletrix sp., Dendrina belemniticola, ?Nygmites sp., and Rogerella sp.

3.3.3.3 FRETTENHAM (WM HOWES Ltd) (section 1.3.5.5)

The epifauna identified from this old pit contained rare examples of the brachiopod Ancistocrania parisiens and the bivalves Atreta nilssoni and Pycnodonte vesiculare, the serpulids "Serpula" accumulata and indeterminate remains of worm tubes. The ubiquitous corals Coelosmilia sp. and Moltkia sp., and examples of Bullopora sp. and indeterminate calcareous foraminifera were occasionally encountered. Bryozoans found were single specimens of the anascans Herpetopora sp. and Onychocella nysti, and three of "Membranipora" spp.

Borings referable to Calcideletrix sp., Dendrina belemniticola, ?Nygmites sp., and Talpina sp. were distinguished.

3.3.3.4 BEESTON CHALK SUMMARY

The brachiopod Ancistocrania parisiens was very commonly recognised and several specimens of ?Diomyodon sp. were also identified (only from Caistor). The bivalves Atreta nilssoni, Pycnodonte vesiculare, and Gyropleura inequirostrata, the serpulids "Serpula" accumulata and Vermiliopsis fluctuata, the sponge Porosphaera sessilis, the corals Coelosmilia spp. and Moltkia spp., and hemi-spherical foraminiferal remains (Bullopora spp.) were also very common. A varied suite of anascan bryozoans was identified, although of these only Aechmella anglica, Dionella trifaria, and "Membranipora" spp. occurred with any regularity, along with the rectangulatan Disporella irregularis, and the tubuloporinans *Diastopora* spp., *Proboscina* sp., and *Stomatopora* spp.

The borings *Calcideletrix* spp., *Dendrina belemniticola*, ?*Nygmites* spp., *Rogerella* sp., and *Talpina* sp. were identified most often on fossils collected in the Beeston Chalk.

3.3.4 PARAMOUDRA CHALK

3.3.4.1 WHITLINGHAM (section 1.3.6.2)

A single specimen of the common serpulid "*Serpula*" *accumulata*, one of the coral *Moltkia* sp., an example of the tubuloporinan bryozoan *Diastopora* sp., and single occurrences of the borings *Calcideletrix* sp., and ?*Nygmites* sp. comprised the total epifaunal and boring records from this section, the only one known in the Paramoudra Chalk.

CHAPTER FOUR

STRATIGRAPHIC RANGES OF COLLECTED FOSSILS

4.1 INTRODUCTION

Stratigraphic data for all the macrofossils collected from sections, mesofauna recovered from borehole sample residues, and the epifauna found on the surfaces of fossils have been combined to produce overall range charts for all taxa. These have been plotted against the section described in chapter one (see section 1.4, Figures 1.20 and 1.21). The non-bryozoan faunal elements will be considered before the bryozoans are described.

(The most commonly encountered macrofaunal and mesofaunal taxa, and stratigraphically important species are illustrated in Plates 1-3)

4.2 BELEMNITES

All belemnites (Figure 4.1) were referred to *Belemnitella mucronata*, the index fossil of the *mucronata* zone. It was commonly present in all sections from low in the Pre-Weybourne Chalk (PWC) to the upper part of the Paramoudra Chalk (PC).

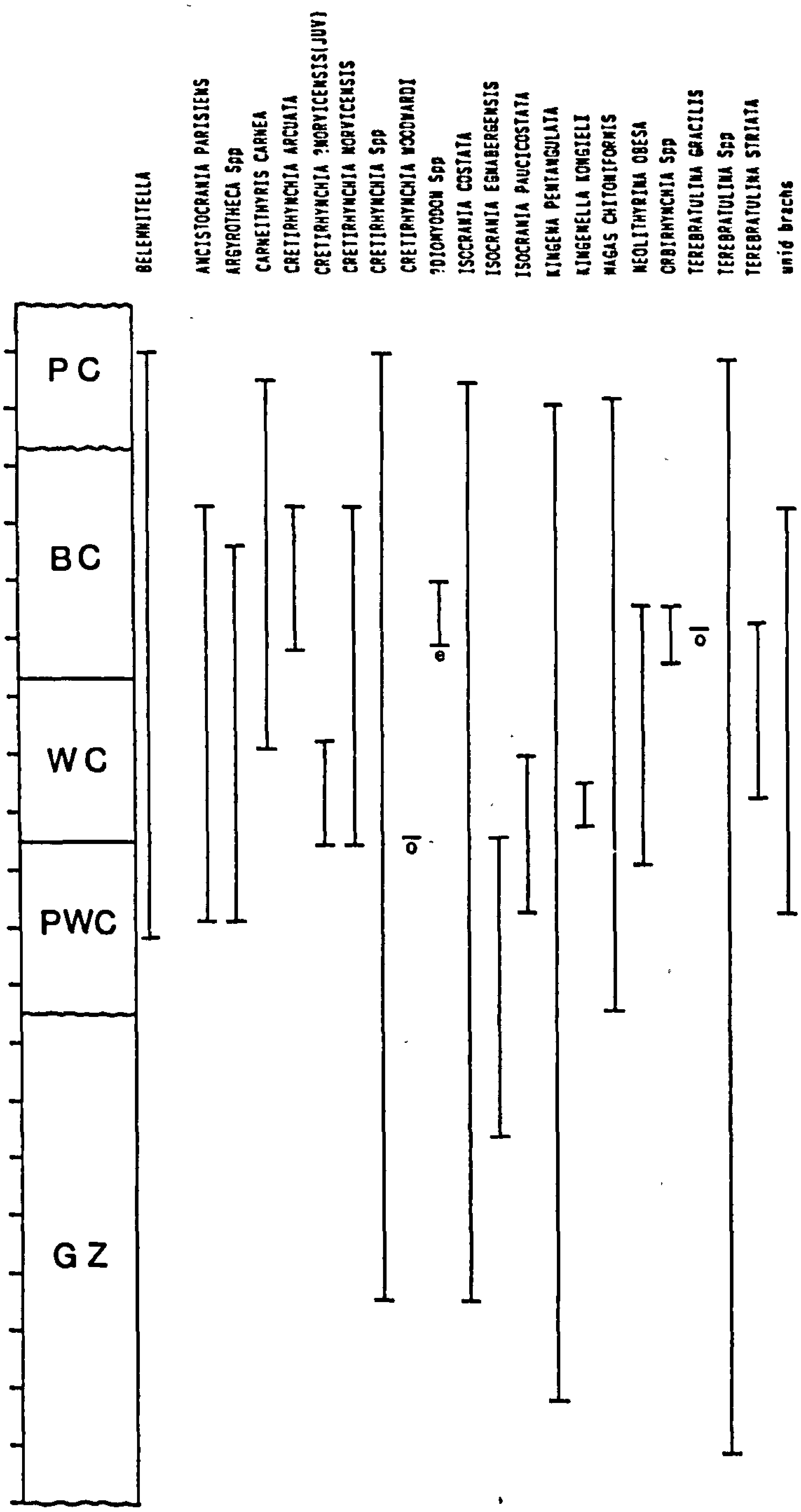


FIGURE 4.1 Stratigraphic ranges of *Belemnitella* and brachiopods collected from the *Gonioteuthis* and *Belemnitella mucronata* Zones. GZ=*Gonioteuthis* Zone; PWC=Pre-Weybourne Chalk; WC=Weybourne Chalk; CSB=Catton Sponge Beds; BC=Beeston Chalk; PC=Paramoudra Chalk; o=only recorded once; e=only found as epifauna.

4.3 BRACHIOPODS

A varied brachiopod fauna was collected (Figure 4.1). This included relatively common *Ancistocrania parisiens*, found almost always as epifauna, which ranged from the middle of the Pre-Weybourne Chalk to the upper Beeston Chalk (BC). The carneithyrid terebratulid *Carneithyris carnea* was characteristically, and abundantly, collected from all sections and many of the bulk samples (in fragmentary form) from the Beeston Chalk and the Paramoudra Chalk, first appearing below the Catton Sponge Beds (CSB) in the middle of the Weybourne Chalk (WC).

Several species of the rhynchonellid *Cretirhynchia* were identified. Of these, *C. arcuata* was found only in the Beeston Chalk, in considerable numbers, whilst *C. norvicensis* occurred in both the Weybourne and Beeston Chalks. *C. ?norvicensis* (juv), a small form with many characteristics of adult *C. norvicensis*, was found throughout the Weybourne Chalk, wherein it was very common. A single specimen of *C. woodwardi* was collected from the lower part of the Weybourne Chalk, whilst indeterminate fragments of *C.* spp. were often found at all levels above the middle of the *Gonioteuthis* Zone (GZ).

Three species of the craniacean *Isocrania* were found. The most common form was *I. costata*, collected between the middle of the _Gonioteuthis_ Zone and the middle of the Paramoudra Chalk. _I. egnabergensis_ (upper _Gonioteuthis_ Zone (UGZ)-basal Weybourne Chalk (BWC)) and _I. paucicostata_ (middle Pre-Weybourne Chalk (MPWC)-middle Weybourne Chalk (MWC)) were rarely identified. Small terebratulids included a few examples of _Argyrotheca_ spp., which were collected between the middle of the Pre-Weybourne Chalk and the middle Beeston Chalk. Most small terebratulids were referable to _Terebratulina_ spp., common at all horizons, although a few individuals of _T. striata_ were collected in the Weybourne and Beeston Chalks, and a single, complete, _T. gracilis_ from the middle of the Beeston Chalk.

Kingena pentangulata was relatively numerous throughout, and a few specimens of _Kingenella kongieli_ were recorded in the basal part of the Weybourne Chalk. _Magas chitoniformis_ was often noted above the lower part of the Pre-Weybourne Chalk, although it is likely that forms from below the Beeston Chalk are related to _Magas_ sp. nov. (Wood, 1988, p. 23).

The remainder of the identifiable brachiopod fauna comprised a few examples of the epifaunal ?_Diomyodon_ sp. from Caistor (basal Beeston Chalk), several examples of the distinctive, large, terebratulid _Neolithyrina obesa_, with its large pedicle foramen, found between the topmost beds of the Pre-Weybourne Chalk and the middle of the Beeston Chalk, and rare

?undescribed Orbirhynchia sp. from the lower Beeston Chalk.

4.4 BIVALVES

The most commonly encountered bivalves (Figure 4.2) were, the almost exclusively epifaunal, Atreta nilssoni which ranged from the middle of the Pre-Weybourne Chalk to the upper Beeston Chalk and ostreids. Of these, fragments of Ostrea spp. ranged throughout, whilst Pycnodonte vesiculare was locally very abundant in the middle of the Weybourne Chalk and present from the middle of the Pre-Weybourne Chalk to the upper part of the Beeston Chalk. Other forms were Acutostrea cf. incurva (MWC)-middle Beeston Chalk (MBC)), Hyotissa semiplana (lower Weybourne Chalk (LWC)-upper Beeston Chalk (UBC)), rare Gryphaeostrea canaliculata, and a single specimen of Margostrea alaeformis (both lower Beeston Chalk (LBC)).

Several Gyropleura inequirostrata were collected, mostly as epifauna, on fossils collected between the middle of the Pre-Weybourne Chalk and a similar level in the Beeston Chalk. Also found were isolated specimens of Lima sp. (LBC), Lyropecten campaniensis (MBC), L. sarumensis (basal Beeston Chalk (BBC)), and several L. spp. (middle Gonioteuthis Zone (MGZ)-UBC). Inoceramus spp., mostly represented by small pieces, were found at all levels (but were very abundant in,

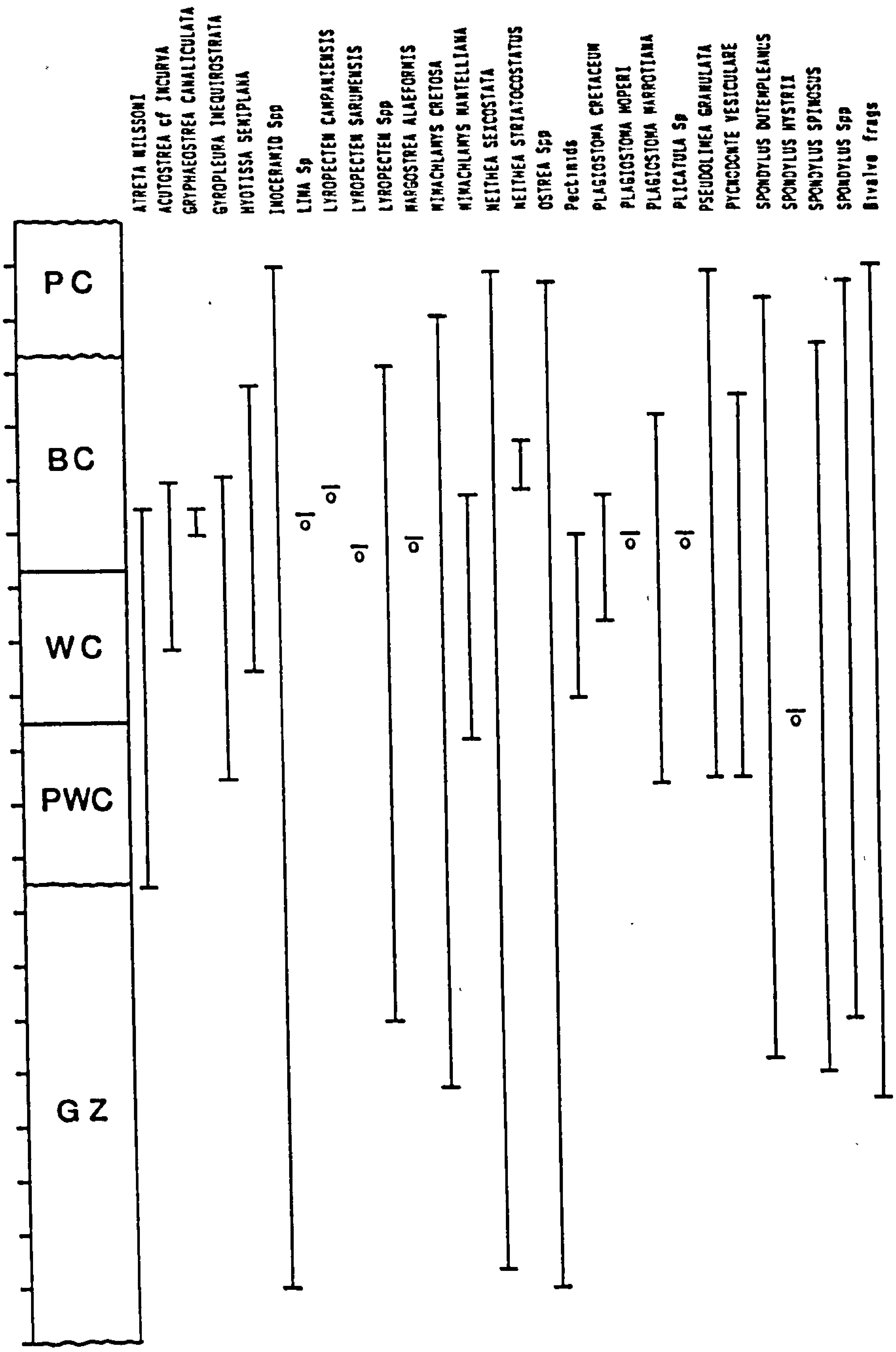


FIGURE 4.2 Stratigraphic ranges of bivalves collected from the *Gonioteuthis* and *Belemnitella mucronata* Zones. (Abbreviations as in Figure 4.1.)

and characteristic of, the Beeston Chalk) as was *Neithea sexcostata*. In contrast, *N. striatocostatus* was very rare, recorded only in the middle of the Beeston Chalk.

Mimachlamys cretosa was found fairly frequently above the middle of the *Gonioteuthis* Zone, with rarer *M. mantelliana* (upper Pre-Weybourne Chalk (UPWC)-LBC). Three different species of *Plagiostoma* were collected, although none was common. They were *P. cretaceum* (MWC-MBC), *P. marrotiana* (MWC-UBC), and a single specimen of *P. hoperi* from the lower Beeston Chalk. A few fragments of indeterminate pectinids were recovered from the Weybourne Chalk and the basal part of the Beeston Chalk. One *Plicatula* sp. (LBC) and scattered, fragmentary, *Pseudolimea granulata* (MPWC)-middle Paramoudra Chalk (MPC)) were also recognised.

The remainder of the bivalve fauna was made up by fairly common *Spondylus dutempleanus*, *S.* spp. (both MGZ-MPC), *S. spinosus* (MGZ-basal Paramoudra Chalk (BPC)), a single *S. hystrix* from Keswick (LWC), and unidentified bivalve fragments (MGZ-upper Paramoudra Chalk (UPC)).

4.5 SERPULIDS

A varied serpulid fauna was collected (Figure 4.3). This included epifaunal remains of *Cementula*

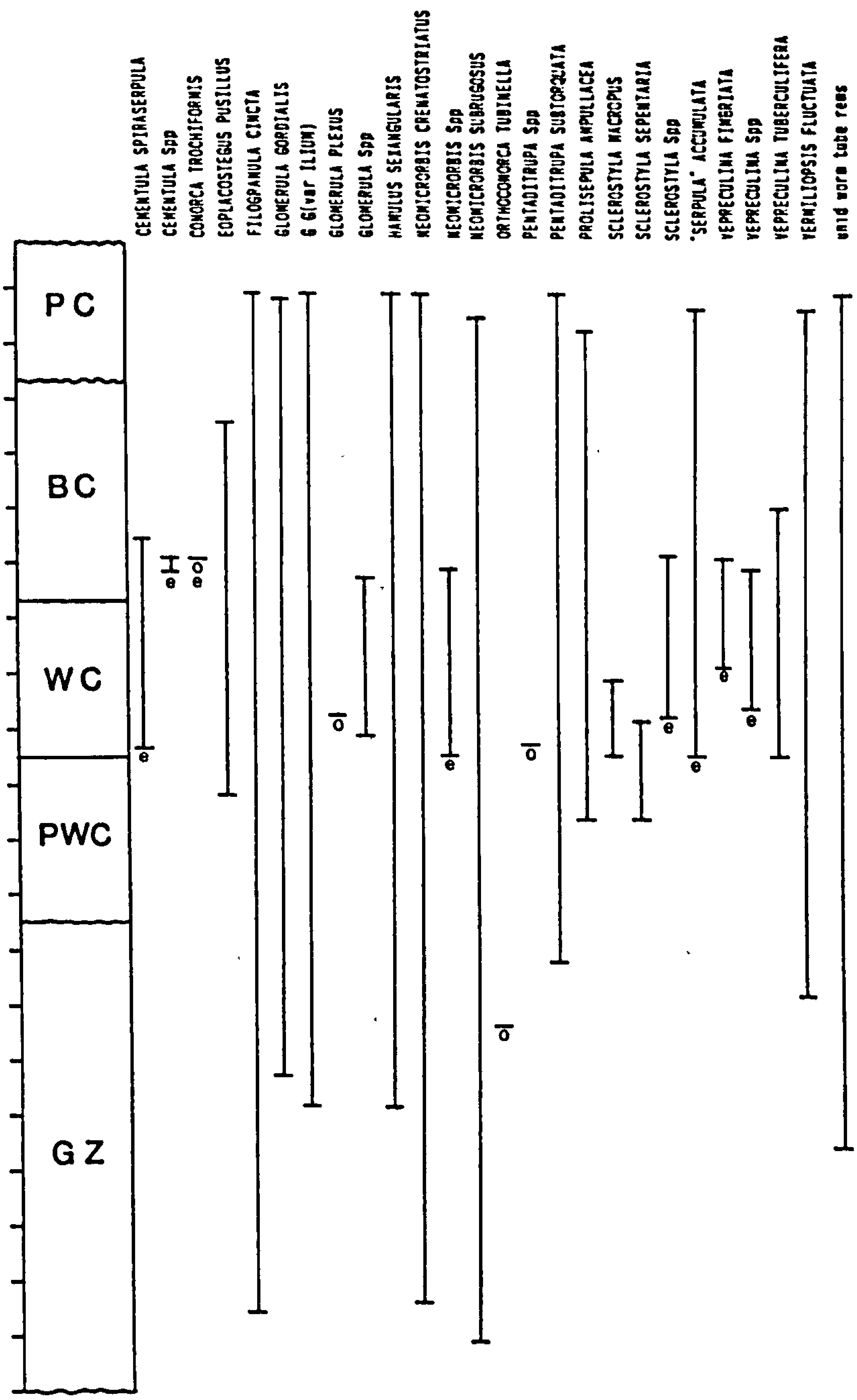


FIGURE 4.3 Stratigraphic ranges of serpulids collected from the *Gonioteuthis* and *Belemnitella mucronata* Zones. (Abbreviations as in Figure 4.1.)

spiraserpula (BWC)-LBC), C. spp. (LBC), and a single specimen of Conorca trochiformis (LBC). A few fragments of Eoplacostegus pusillus (UPWC-UBC) and rare Filogranula cincta (lower Gonioteuthis Zone (LGZ)-UPC) were recognised. Both Glomerula gordialis and G. g. var. ilium were very numerous above the middle of the Gonioteuthis Zone, along with a single example of G. plexus (LWC) and rare G. spp. (LWC-LBC). Common fragments of Hamulus sexangularis (MGZ-UPC) were collected, and Neomicrorbis crenatostriatus and N. subrugosus were found at all levels, predominantly as epifauna, with N. spp. noted throughout the Weybourne Chalk and the lower part of the Beeston Chalk.

A single fragment referable to Orthoconorca tubinella was obtained from the middle of the Gonioteuthis Zone. Pentaditrupa subtorquata was commonly present above the top of the Gonioteuthis Zone, as was Proliserpula ampullacea from the middle of the Pre-Weybourne Chalk. Other serpulids included Sclerostyla sepentaria (UPWC-LWC), S. spp. (LWC-LBC), and relatively plentiful "Serpula" accumulata, (BWC-UPC), exclusively as epifauna.

The remainder of the serpulid fauna comprised a few examples of Vepreculina fimbriata (MWC-LBC), V. tuberculifera (BWC-LBC), an epifaunal form (V. sp.) (LWC-BBC), Vermiliopsis fluctuata (upper Gonioteuthis

Zone (UGZ)-UPC), and unidentified worm tube remains (UGZ-UPC).

4.6 SPONGES

The sponges *Porosphaera globularis* and *P. sessilis* were both very common throughout the studied chalk (Figure 4.4), as was *P.* sp. (fusiform) up to the basal beds of the Paramoudra Chalk. A few indeterminate *P.* sp. were noted (UPWC-LWC), together with numerous iron-stained outlines of various sponges seen in chalk sections in the Weybourne and Beeston Chalks. A single hexactinellid sponge mould from the middle of the Weybourne Chalk and a fragment of a lithistid sponge from the middle of the Beeston Chalk comprised the remainder of the sponge fauna.

4.7 ECHINODERMS

Four different types of crinoid columnals were identified (Figure 4.4). Most common were *Bourgueticrinus* spp., collected in large numbers at all levels, with less numerous *B. brydonei* (MWC-MPC), a single *Austinocrinus bicoronatus* (MBC), *Nielsenocrinus agassizi* (BBC-lower Paramoudra Chalk (LPC)), and a single indeterminate columnal from the middle of the Beeston Chalk.

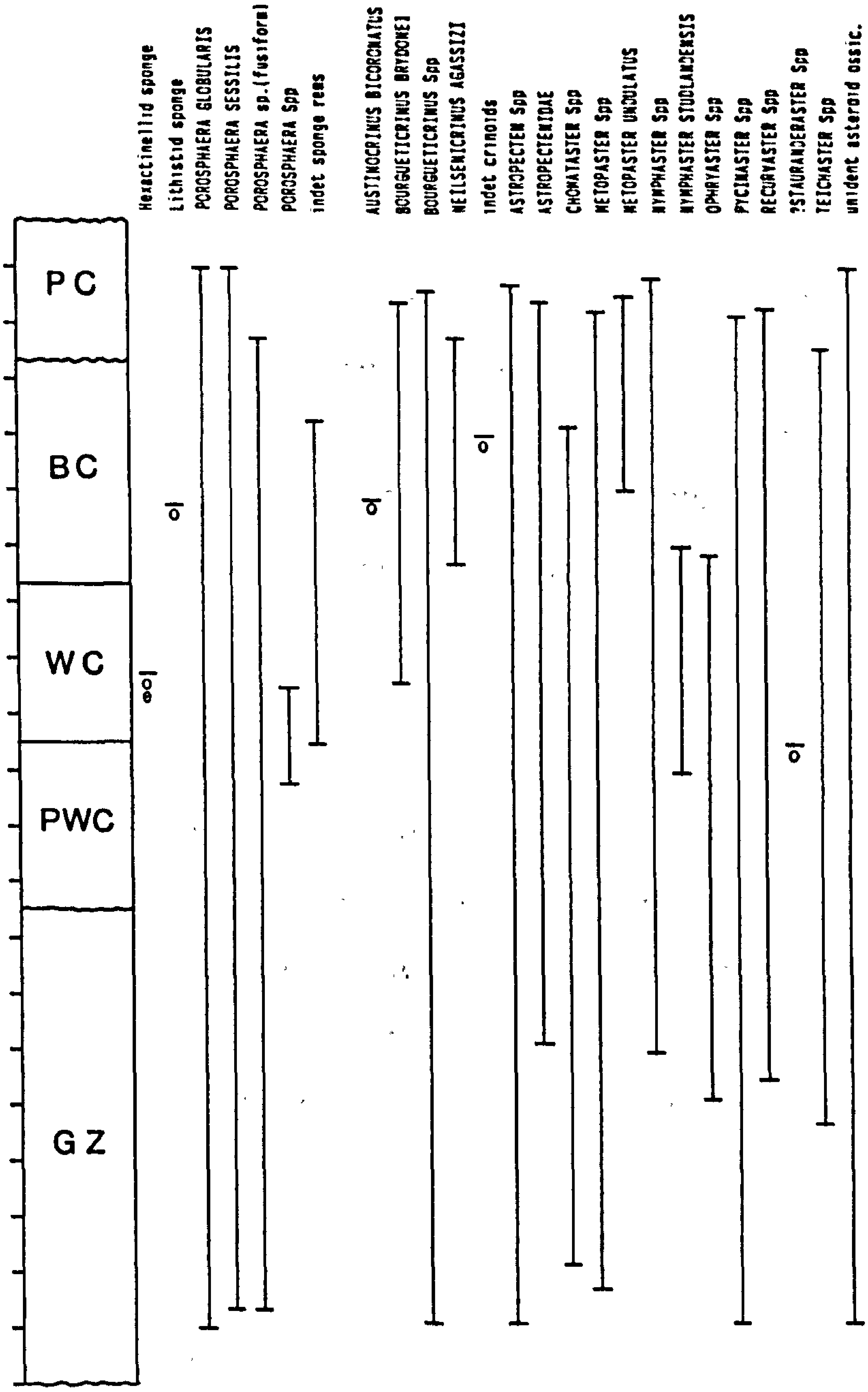


FIGURE 4.4 Stratigraphic ranges of sponges, crinoid remains, and asteroid ossicles collected from the *Gonioteuthis* and *Belemnitella mucronata* Zones. (Abbreviations as in Figure 4.1.)

Asteroid ossicles were an important constituent of the collected echinoderm fauna (Figure 4.4). Several genera ranged from the lower *Gonioteuthis* Zone to the Paramoudra Chalk (as did unidentifiable, worn, ossicles) including *Astropecten*, *Chomataster*, *Metopaster*, and *Pycinaster*. Other forms with smaller ranges were miscellaneous astropectenids (UGZ-MPC), *Metopaster undulatus* (MBC-MPC), *Nymphaster studlandensis* (UPWC-LBC), *N*. spp. (UGZ-UPC), *Ophryaster* spp. (MGZ-LBC), a single ?*Stauranderaster* sp. (BWC), and *Teichaster* spp. (MGZ-BPC).

Echinoids (Figure 4.5) were often collected from sections and identified from fragments in sieved residues. Dominant forms were *Echinocorys* spp. and copious spines of cidarid echinoids (both LGZ-UPC), with subordinate cidarid spine bosses (MGZ-UBC), cidarid test fragments (MPWC-MBC), and pieces of indeterminate echinoids (UGZ-MPC). Other forms noted were rare rostra of *Hagenowia* spp. (MGZ-UPC), and forms of *Micraster* including *M. gibba* (M-UWC), *M*. ?*glyphus* (B-MWC), and *M*. spp. (BWC-upper Weybourne Chalk (UWC)).

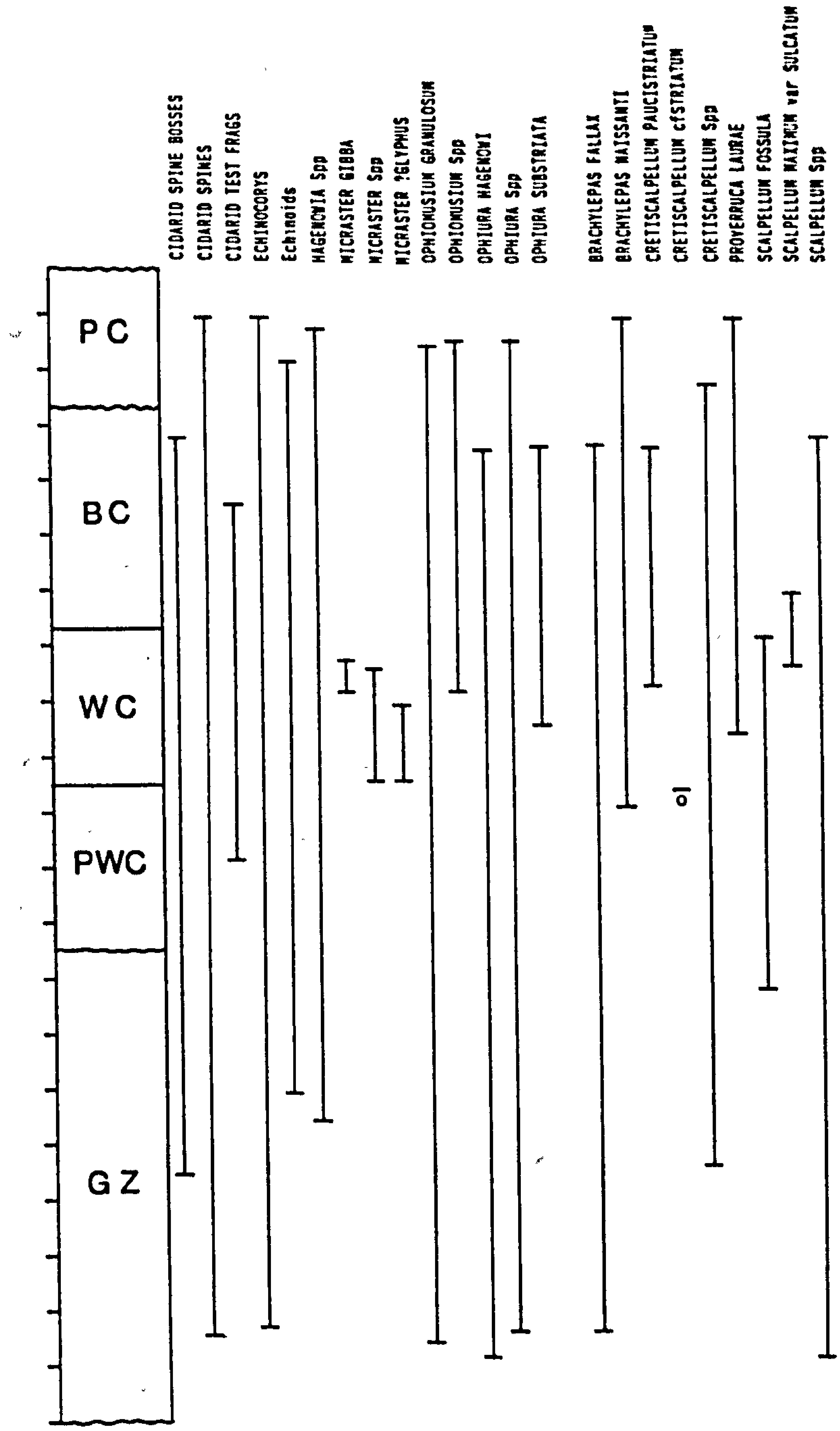


FIGURE 4.5 Stratigraphic ranges of echinoids, ophiuroids, and cirripedes collected from the *Gonioteuthis* and *Belemnitella mucronata* Zones. (Abbreviations as in Figure 4.1.)

Ossicles of several ophiuroids were identified (Figure 4.5), of which Ophiomusium granulosum and Ophiura spp. (both LGZ-MPC) were most common, with less numerous forms referable to Ophiomusium spp. (MWC-MPC), Ophiura hagenowi (LGZ-UBC), and O. substriata (MWC-UBC) recognised.

4.8 CIRRIPEDES

Nine different cirripedes were found (Figure 4.5), although none was very common, the longest ranging of which was Brachylepas fallax (LGZ-UBC). Other forms included B. naissanti (UPWC-UPC), Cretiscalpellum paucistriatum (MWC-UBC), a solitary C. cf. paucistriatum (UPWC), C. spp. (MGZ-LPC), Proverruca laurae (LWC-UPC), Scalpellum fossula (UGZ-UWC), S. maximum var. sulcatum (UWC-LBC), and S. spp. (LGZ-UBC).

4.9 MISCELLANEOUS NON-BRYOZOANS

Several forms of coral were found (Figure 4.6). The most common of these were the basal attachment remains of Coelosmilia spp. (MPWC-UBC) and Moltkia spp. (UGZ-BPC), both usually found as epifauna, with less common aseptate corals (LGZ-BPC) and Stephanophyllia clathrata (basal Pre-Weybourne Chalk (BPWC)-MBC), and a single example of Coelosmilia granulata (LGZ).

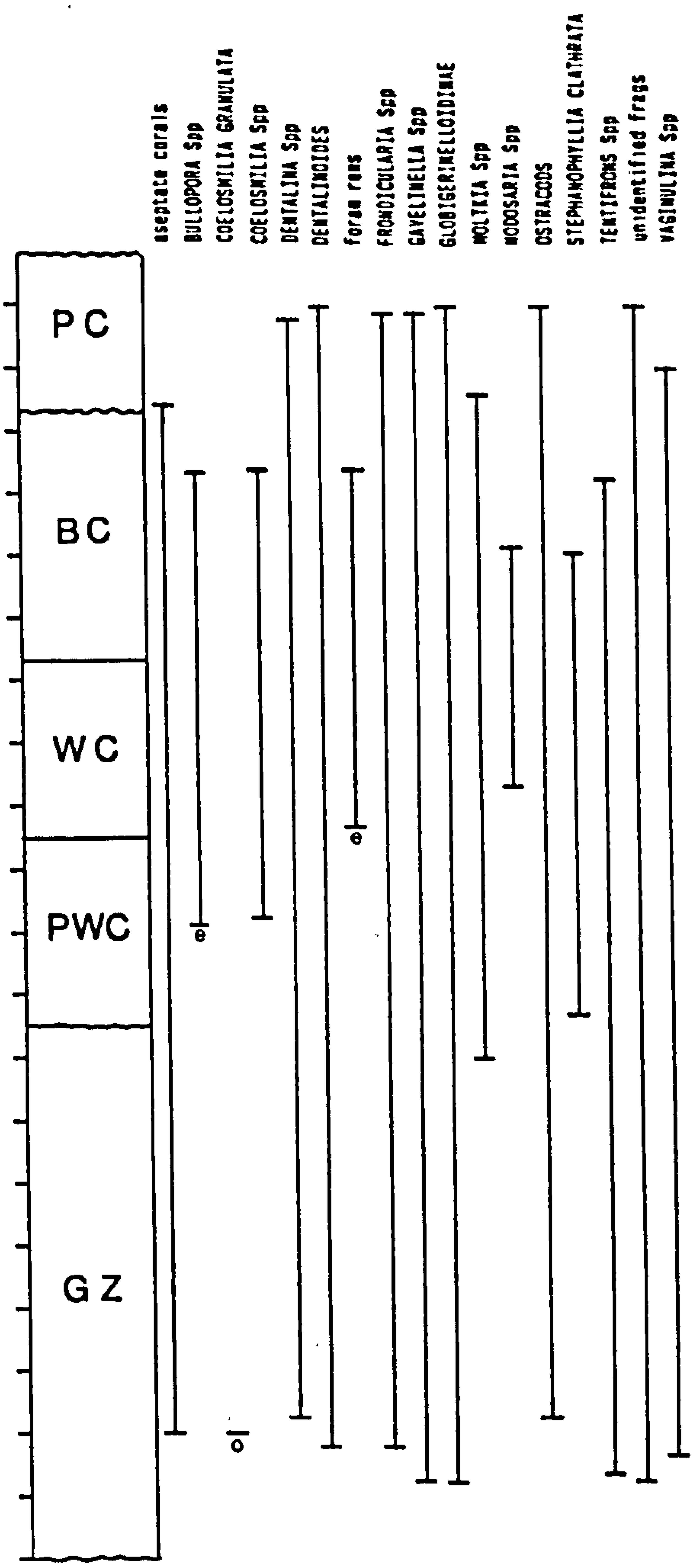


FIGURE 4.6 Stratigraphic ranges of corals and miscellaneous non-bryozoan taxa (including foraminifera) collected from the *Gonioteuthis* and *Belemnitella mucronata* Zones. (Abbreviations as in Figure 4.1.)

The remaining elements of the non-bryozoan fauna comprised various foraminifera (Figure 4.6) including numerous remains of the exclusively epifaunal *Bullopora* sp. (MPWC-UBC), intermittent records of *Dentalina* spp., *Frondicularia* spp., and indeterminate dentalinoides (all LGZ-UPC). Forms referable to *Gavelinella* spp. and the globigerinelloidinae were abundantly encountered at all levels. Other foraminifera identified were *Nodosaria* spp.(LWC-MBC), *Tentifrons* spp.(LGZ-UBC),and *Vaginulina* spp. (LGZ-MPC). Indeterminate epifaunal foraminiferal remains were fairly common between the base of the Weybourne Chalk and the upper Beeston Chalk, as were ostracod carapaces at all horizons.

4.10 BRYOZOANS

A large and varied fauna of epifaunal anascan bryozoans was identified (Figures 4.7 and 4.8), although many were found on only a single "host" fossil. Several specimens of *Aechmella anglica* were recognised on macrofossils collected between the upper Pre-Weybourne Chalk and the lower Beeston Chalk, whereas *A. nitescens* was recorded only once, from the lower Beeston Chalk. *Aplousina fulgora* was noted on a few occasions throughout the Weybourne Chalk and lowest levels of the Beeston Chalk, with a solitary occurrence of *A.* sp. in the lower Beeston Chalk.

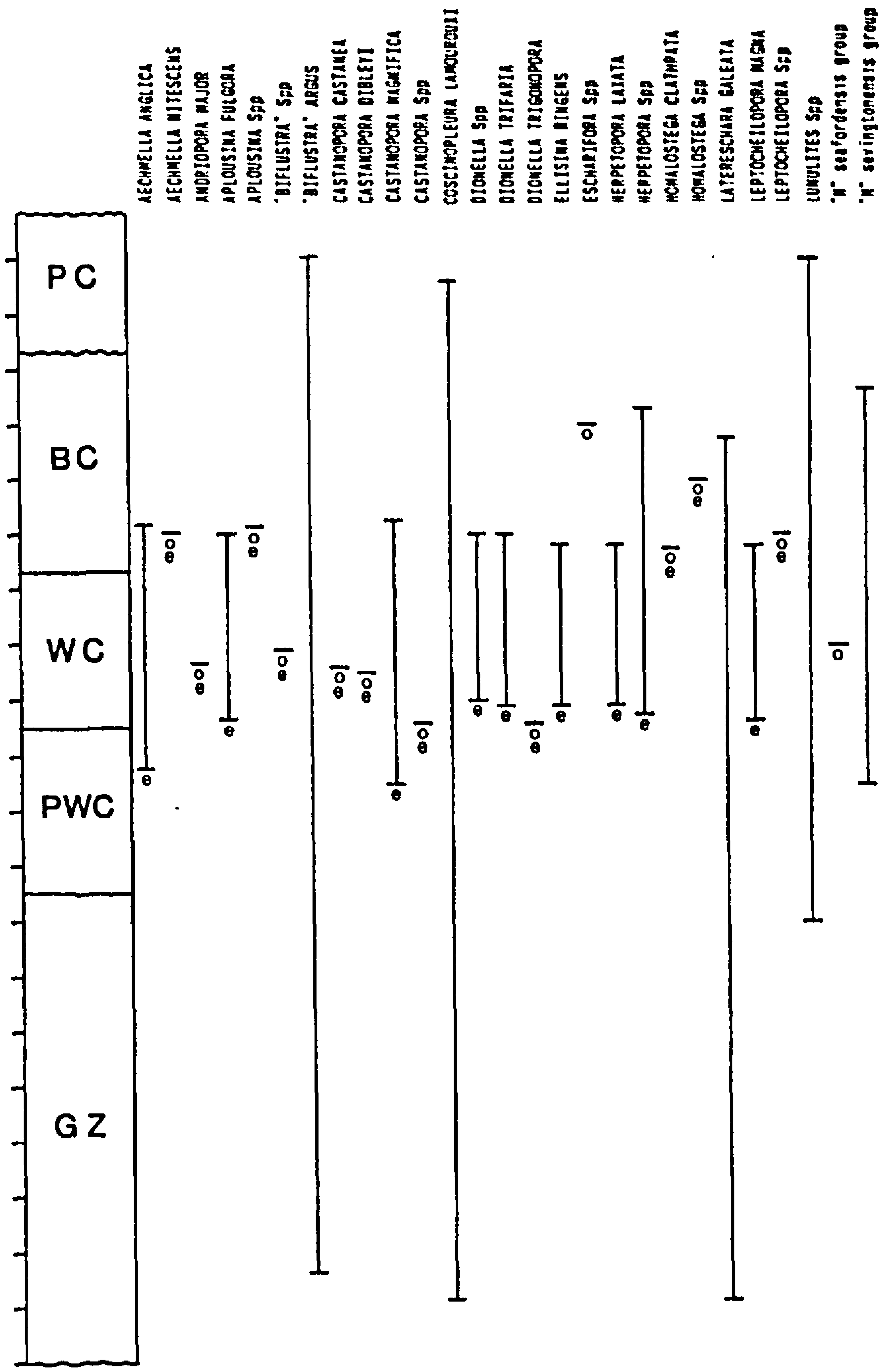
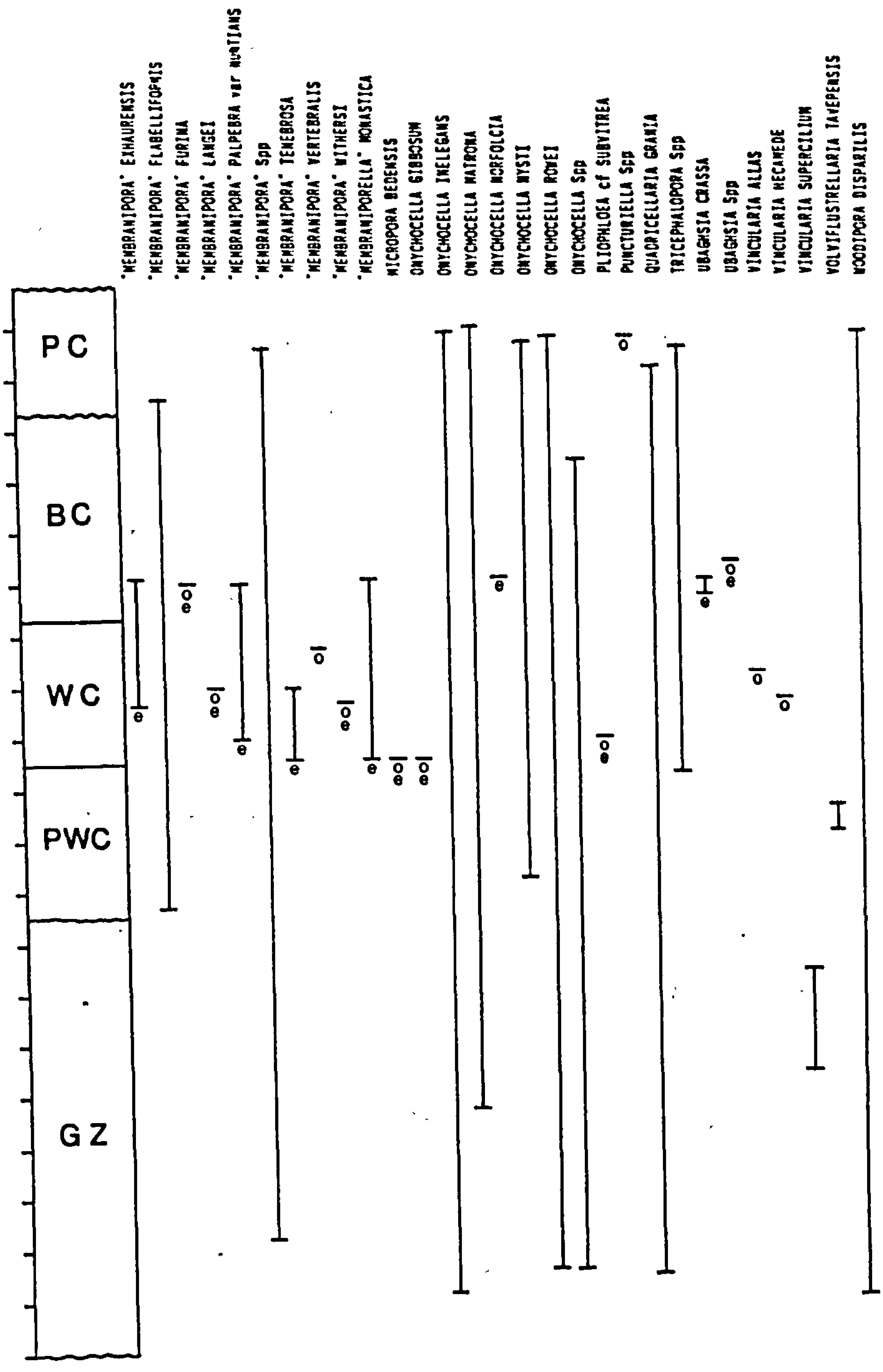


FIGURE 4.7 Stratigraphic ranges of anascan bryozoans collected from the *Gonioteuthis* and *Belemnitella mucronata* Zones. (Abbreviations as in Figure 4.1.)



<u>FIGURE 4.8</u> Stratigraphic ranges of anascan bryozoans collected from the <u>Gonioteuthis</u> and <u>Belemnitella mucronata</u> Zones. (Abbreviations as in Figure 4.1.)

Castanopora was represented by single specimens of *C*. *castanea*, *C*. *dibleyi* (both LWC), *C*. sp. (BWC), and a few well preserved examples of *C*. *magnifica* on fossils collected between the upper Pre-Weybourne Chalk and the lower Beeston Chalk. Two forms of *Dionella* (*D*. *trifaria* and *D*. sp.) were rarely found (both BWC-LBC), along with a solitary example of *D*. *trigonopora* (BWC). *Ellisina* *ringens*, *Herpetopora* *laxata* (both BWC-LBC), and common *H*. spp. (BWC-UBC) were noted, especially on tests of *Echinocorys* spp. Five specimens of *Leptocheilopora* *magna* (BWC-BBC) and one of *L*. sp. (LBC) were also noted.

Membraniporids were common elements of the epifaunal anascan fauna. Of them, "*Membranipora*" *exhaurensis* (MWC-LBC), "*M*". *palpebra* var. *nuntians* (BWC-LBC), members of the "*M*". *tenebrosa* group (B-MWC), and "*Membraniporella*" *monastica* (BWC-LBC) were noted on more than one occasion. Single specimens of "*Membranipora*" *furina* (LBC), "*M*". *langei*, and "*M*". *withersi* (both LWC) were also found.

Isolated instances of *Micropora* *bedensis* and *Onychocella* *gibbosum* (both BWC) were noted, along with single examples of *Pliophloea* cf. *subvitrea* (LWC), *Ubaghsia* sp. (LBC), and a few *U*. *crassa* and *Onychocella* *norfolcia* (both LBC). Other epifaunal anascans, found on one occasion only were *Andriopora* *major*, "*Biflustra*" sp. (both LWC), *Homalostega clathrata* (BBC), and *H*. sp. (MBC).

Anascans not found as epifauna, or rarely so, included several very common species that ranged throughout the studied chalk. Of these, "*Biflustra*" *argus*, the ubiquitous *Onychocella inelegans*, *O*. *rowei*, and *Woodipora disparilis* were found most often, with rarer *Coscinopleura lamourouxi* and *Quadricellaria grania*. Other forms with shorter ranges included fairly common *Latereschara galeata* (LGZ-MBC), *Lunulites* spp. (UGZ-UPC), rare members of the "*Membranipora*" *sevingtonensis* group (UPWC-UBC), "*M*". *flabelliformis* (BPWC-LPC), "*M*". spp. (LGZ-MPC), numerous examples of *Onychocella matrona* (MGZ-UPC), *O*. *nysti* (lower Pre-Weybourne Chalk (LPWC-UPC), *O*. spp. (LGZ-UBC), and occasional *Tricephalopora* spp. (UPWC-MPC).

Two species with stratigraphic significance were identified. These were *Vincularia supercilium* from the upper *Gonioteuthis* Zone and *Volviflustrellaria taverensis*, collected from the central beds of the Pre-Weybourne Chalk. The remainder of the anascan fauna comprised single records of a member of the "*Membranipora*" *seafordensis* group, *Vincularia allas*, *V*. *hecamede* (all MWC), "*Membranipora*" *vertebralis* (UWC), *Escharifora* sp. (UBC), and *Puncturiella* sp. (UPC).

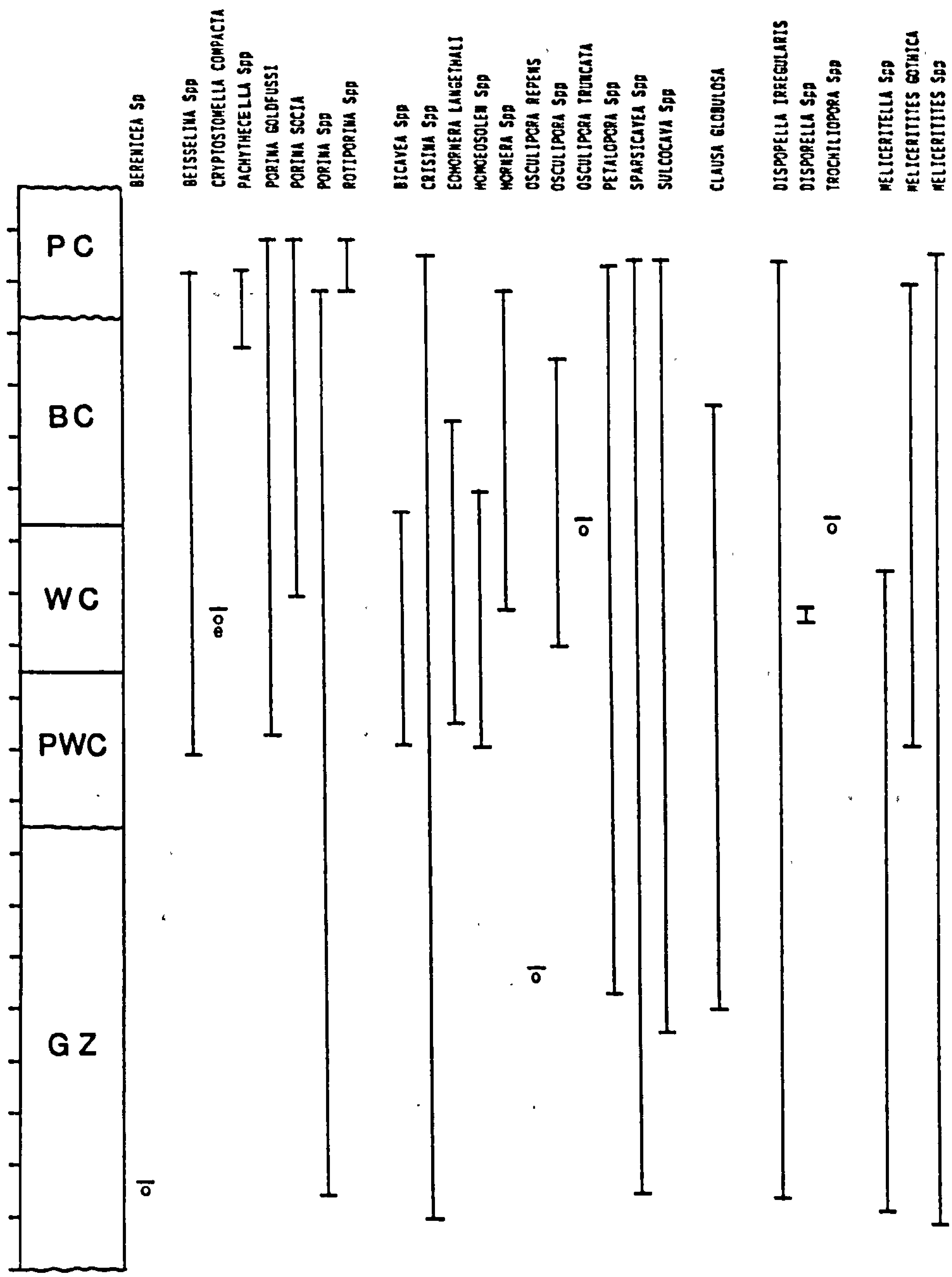


FIGURE 4.9 Stratigraphic ranges of articulatan, ascophoran, cancellatan, dactylethratan, rectangulatan, and salpinginan bryozoans collected from the *Gonioteuthis* and *Belemnitella mucronata* Zones. (Abbreviations as in Figure 4.1.)

The only articulatan identified was a single fragment of *Berenicea* sp. (Figure 4.9) from the lower *Gonioteuthis* Zone. The most common ascophorans (Figure 4.9) noted were *Porina goldfussi* (MPWC-UPC), *P. socia* (MPWC-UPC), and *P.* spp. (LGZ-MPC). Other forms collected were rare examples of *Beisselina* spp. (MPWC-MPC), *Pachythecella* spp. (UBC-MPC), *Rotiporina* spp. (M-UPC), and a single occurrence of the epifaunal *Cryptostomella compacta* (MWC).

Cancellatans were fairly numerous (Figure 4.9), in particular, forms referable to *Eohornera langethali* (UPWC-MBC), *Petalopora* spp. (MGZ-MPC), *Sparsicavea* spp. (LGZ-MPC), and *Sulcocava* spp. (MGZ-MPC). Less common were records of *Bicavea* spp. (MPWC-BBC), *Crisina* spp. (LGZ-UPC), *Homoeosolen* spp. (MPWC-BBC), and *Hornera* spp. (MWC-MPC). A single example of *Osculipora truncata* (BBC), several *O.* spp. (LWC-UBC), and a solitary specimen of *O. repens* (UGZ) comprised the remainder of the identified cancellatan fauna.

The dactylethratan *Clausa globulosa* (Figure 4.9) was found intermittently between the middle of the *Gonioteuthis* Zone and the middle of the Beeston Chalk. Of the rectangulatans identified (Figure 4.9), *Disporella irregularis* (LGZ-UPC) was most numerous, with rare *D.* sp. (MWC), and a single *Trochiliopora* sp. (LBC) also collected. The salpinginan *Meliceritites*

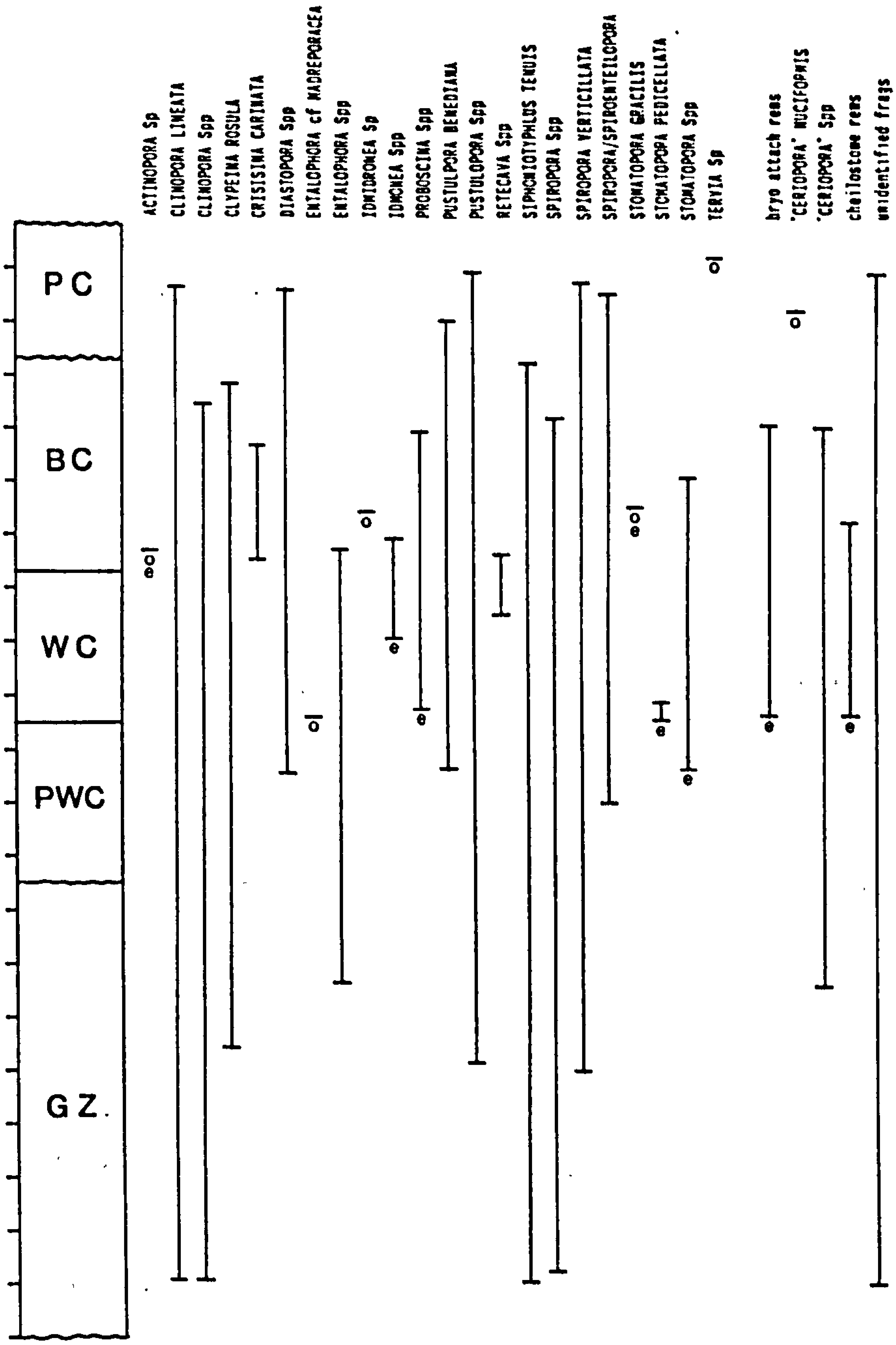


FIGURE 4.10 Stratigraphic ranges of tubuloporinan and miscellaneous bryozoans collected from the Gonioteuthis and Belemnitella mucronata Zones. (Abbreviations as in Figure 4.1.)

gothica was very common at levels above the middle of the Pre-Weybourne Chalk (Figure 4.9), with M. spp. well represented throughout, and Meliceritella spp. found below the upper Weybourne Chalk.

Tubuloporinans (Figure 4.10) were well represented, both by epifaunal forms, and specimens obtained from bulk sample residues. Epifaunal forms included a single Actinopora sp. from the basal Beeston Chalk, rare Idmonea spp. (MWC-BBC), Proboscina spp. (LWC-UBC), one specimen of Stomatopora gracilis (MBC), S. pedicellata (BWC), and S. spp. (UPWC-MBC). Non-epifaunal forms included relatively common Clinopora lineata (LGZ-UPC), C. spp. (LGZ-UBC), Clypeina rosula (MGZ-UBC), Diastopora spp. (UPWC-UPC), Pustulopora benediana (UPWC-MPC), P. spp. (MGZ-UPC), Siphoniotyphlus tenuis (LGZ-UBC), Spiropora spp. (LGZ-MBC), and S. verticillata (MGZ-UPC).

Rarer forms were Crisisina carinata (B-UBC), Entalophora spp. (UGZ-BBC), Retecava spp. (UBC-LBC), and Spiroenteilopora spp. (MPWC-MPC). Single examples of Entalophora cf. madreporacea (BWC), Idmidronea sp. (LBC), and Tervia sp. (UPC) were also recognised.

Miscellaneous bryozoans (Figure 4.10) included a single "Ceriopora" nuciformis from the middle of the Paramoudra Chalk, rare "C". spp.(MGZ-UBC), unidentified fragments (LGZ-UPC), indeterminate epifaunal bryozoan attachment remains (BWC-UBC), and cheilostome bryozoan remains (BWC-LBC).

4.11 BORINGS

Borings, almost exclusively in belemnite guards and echinoid test remains, (Figure 4.11) were dominated by forms of *Dendrina belemniticola* (UPWC-MBC), *Calcideletrix* sp. (UPWC-MPC), *Entobia* sp. (UPWC-LBC), ?*Nygmites* sp. (BWC-MPC), and *Talpina* sp. (BWC-MBC). Subordinate to these were *Rogerella* sp. (BWC-MBC) and rare *Dictyoporus nodosus* (MBC), *D*. sp.(BWC-LBC), *Podichnus* sp. (BWC-MBC), a member of the *Ramosulchichnus bifrons* group (MWC), *Simonizapfes* sp. (LWC), and unidentified borings (B-MBC).

4.12 SUMMARY

Common non-bryozoan faunal elements collected throughout the Campanian Chalk included forms of the brachiopod *Terebratulina* spp., the bivalves *Inoceramus* spp., *Neithea sexcostata*, and *Ostrea* spp., the serpulids *Neomicrorbis crenatostriatus* and *N*. *subrugosus*, and the ubiquitous sponges *Porosphaera globularis* and *P*. *sessilis*. Columnals of *Bourgueticrinus* spp., ossicles of the asteroids *Astropecten* spp. and *Metopaster* spp., spines of cidarid echinoids, test fragments of *Echinocorys* spp., and

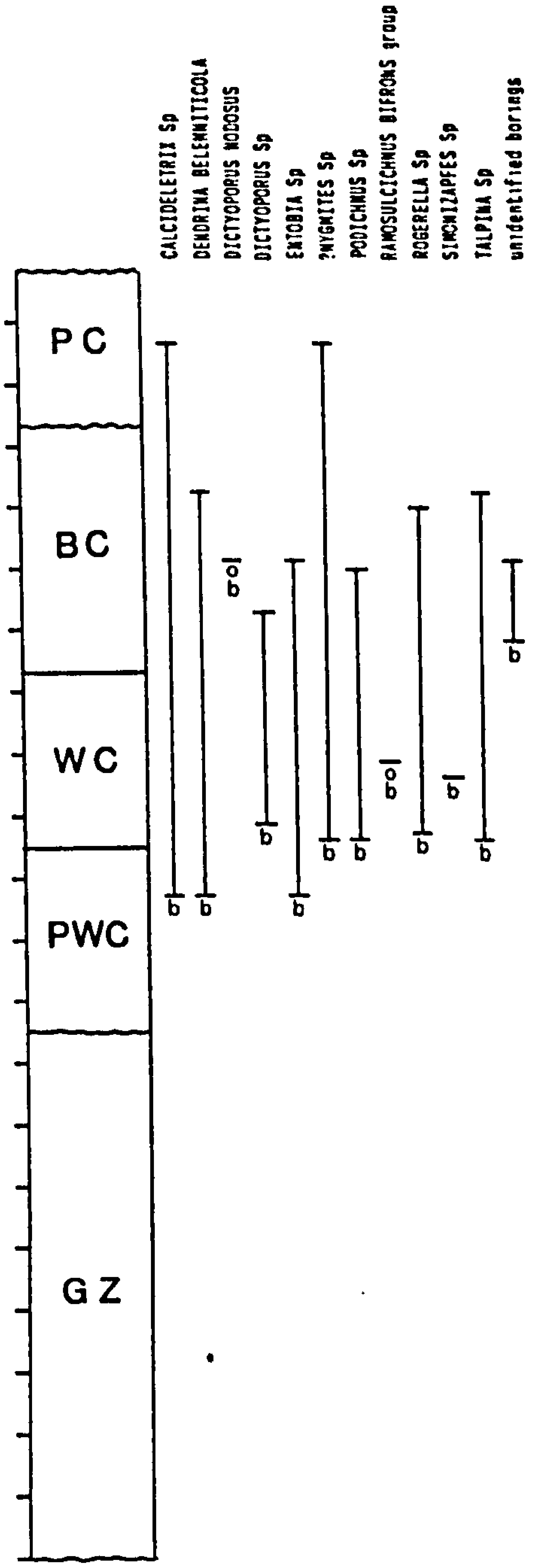


FIGURE 4.11 Stratigraphic ranges of borings noted in fossils collected from the <u>Gonioteuthis</u> and <u>Belemnitella mucronata</u> Zones. (Abbreviations as in Figure 4.1.)

plates of the ophiuroids *Ophiomusium granulosum* and *Ophiura* spp. also occurred regularly at all levels.

Several foraminiferal genera including *Dentalina*, *Frondicularia*, and *Gavelinella*, miscellaneous globigerinelloidinae, and indeterminate ostracod carapaces were found in bulk samples at every horizon.

Abundant fossils with lesser stratigraphic ranges included *Belemnitella* (LPWC-UPC), the brachiopods *Ancistocrania parisiens*, *Atreta nilssoni*, (both MPWC-UBC), *Carneithyris carnea* (UWC-MPC), *Cretirhynchia arcuata* (L-UBC), and *C.* ?*norvicensis* (juv) (B-UWC). The bivalves *Pycnodonte vesiculare* (UPWC-UBC) and *Spondylus dutempleanus* (MGZ-MPC), and the serpulids *Glomerula gordialis*, *G. g.* var. *ilium* (both MGZ-UPC), and "*Serpula*" *accumulata*, (BWC-UPC) were often found, along with the coral *Moltkia* spp. (UGZ-BPC).

Bryozoans well represented, throughout, were the anascans "*Biflustra*" *argus*, *Coscinopleura lamourouxi*, various "*Membranipora*" spp., *Onychocella inelegans*, *O. rowei*, *Quadricellaria grania*, and *Woodipora disparilis*, the cancellatan *Sparsicavea* spp., the salpinginan *Meliceritites* spp., and the tubuloporinan *Clinopora lineata*.

Common, less diverse forms included the anascans *Latereschara galeata* (LGZ-MBC), *Lunulites* spp., *Onychocella matrona* (MGZ-UPC), *O. nysti* (LPWC-UPC), and

O. spp. (LGZ-UBC), and the ascophorans *Porina goldfussi* (MPWC-UPC) and *P*. spp. (LGZ-MPC).

The cancellatans *Eohornera langethali* (UPWC-MBC), *Petalopora* spp. (MGZ-MPC), and *Sulcocava* spp. (MGZ-MPC), and the tubuloporinans *Clypeina rosula* (MGZ-UBC) and *Pustulopora* spp. (MGZ-UPC) were also found on many occasions. Two stratigraphically significant anascans were collected, *Vincularia supercilium* from the upper *Gonioteuthis* Zone and *Volviflustrellaria taverensis* from the central beds of the Pre-Weybourne Chalk.

The most common borings (almost always in belemnite guards or echinoid tests) identified were *Dendrina belemniticola* (UPWC-MBC), *Calcideletrix* sp. (UPWC-MPC), *Entobia* sp. (UPWC-LBC), ?*Nygmites* sp. (BWC-MPC), and *Talpina* sp. (BWC-MBC).

CHAPTER FIVE

CAMPANIAN CHALK AND FOSSIL GROUP ECOLOGY

5.1 INTRODUCTION

In this chapter the factors (e.g. temperature, salinity, sedimentation rate) that controlled sea-floor environmental conditions during the Campanian in Norfolk will be discussed. Ecological information from common fossil groups (belemnites, echinoids, brachiopods, bivalves etc.), including that furnished by the relative abundance, form, and nature of borings and epifauna in/on them, will be described, along with palaeocurrent information obtained from belemnites. Finally, an attempt will be made to distinguish between any different palaeocommunities that occurred and to assess the conditions that led to their formation.

5.2 DEPOSITIONAL ENVIRONMENT

5.2.1 SALINITY

The abundance and diversity of stenohaline organisms such as echinoderms, brachiopods, bryozoans, and planktonic foraminifera in the chalk indicate that deposition occurred under normal marine salinities.

5.2.2 WATER DEPTH

The Norfolk Chalk accumulated on a shelf in a tectonically stable region. Water depths are unlikely to have exceeded 300 m. Actual estimates of the depth of the Chalk sea have been based on lithological, faunal, and floral criteria (see Håkansson et al., 1974 and Kennedy and Garrison, 1975 for reviews).

The maximum water depth is difficult to assess. Perhaps the best estimate is that of 200-300 m obtained from hexactinellid sponge assemblages (Reid in Kennedy and Garrison). A figure of similar magnitude was also produced by Hayes and Pitman (1973) as the estimated maximum Upper Cretaceous rise in sea level. Håkansson et al.(1974) concluded that the Maastrichtian Chalk of northwestern Europe was deposited at depths probably below the photic zone, but no deeper than 250 m.

The minimum water depth for chalk deposition was probably less than 50 m for some of the obvious shallow water horizons e.g. Glauconitic Marl, Chalk Marl, and Chalk Rock (Kennedy and Garrison, 1975, p. 321). An even lesser depth (30-50 m) has been suggested for Campanian Chalks in the Hampshire Basin. However it is known that algal bored grains are rare in most chalks which suggests deposition below the euphotic zone, possibly at depths of 180 m or so (Kennedy and Garrison, 1975, p. 322).

Hence, it appears that the depth of the Chalk sea during the Campanian in Norfolk was in the range 150-250 m, but was somewhat less at certain times, for example, when the hardground complex in the middle of the Weybourne Chalk was forming.

5.2.3 WATER TEMPERATURE

On palaeomagnetic evidence southern Britain lay at a latitude of approximately 32-35 degrees North during the Upper Cretaceous. During this non-glacial epoch, with globally high sea levels, annual and diurnal temperature ranges were relatively low. A generally sub-tropical regime is indicated (Kennedy and Garrison, 1975, p. 322).

Oxygen isotope-based palaeotemperatures have been obtained from a variety of chalk fossils including belemnites, oysters, and inoceramids. Lowenstam and Epstein (1954) collected fossils from five quarries, in the *Belemnitella mucronata* Zone, in the Norwich area. They were, in ascending stratigraphic order, the sections at Eaton, Harford Bridges (two localities), Catton Grove (Attoes Pit), and Caistor St. Edmund, although Lowenstam and Epstein seem to have been uncertain as to their relative stratigraphic levels.

Different fossils gave the following palaeotemperature ranges (in ^{o}C):

Belemnitella mucronata	16.5-20.8	(from 40 specimens),
Inoceramus sp.	18.3-21.7	(from 9 specimens),
Ostrea sp.	20.5-24.5	(from 7 specimens).

Belemnitella appears to show a somewhat lower mean temperature, possibly related to its shell synthesis having occurred at lower temperatures than other fossils (Lowenstam and Epstein, 1954, Figure 19, p. 237).

The calculated values must be treated with caution for several reasons. These include the possibility of isotopic fractionation by the organisms themselves, doubts about the original mineralogy, many belemnites show evidence of recrystallisation under cathodoluminescence, and the small sample sizes. Allowing for such uncertainties a figure between 16 and 25^{o}C may be a reasonable estimate of the average sea water temperature.

5.2.4 SEDIMENTATION RATES

The actual sedimentation rate is very difficult to assess. A net sedimentation rate of about 2 cm/1000 years for the complete chalk succession was quoted by Kennedy and Garrison (1975, p. 324). This is similar to the 1.9 cm/1000 years obtained by dividing the estimated thickness of the Norfolk Campanian (210 m) section 1.4) by the stage length of eleven million years (Rawson <u>et al</u>., 1978, p. 7, Table 1). A higher figure (15 cm/1000 years) was given by Håkansson (1974, p. 215) as the average <u>original</u> sedimentation rate for the 700 m thick Maastrichtian Chalk of the central part of the Danish trough, with the assumptions of 5 Ma duration and 10% post-depositional compaction.

It is difficult to assess the appropriate corrections that must be applied to obtain original deposition rates. Håkansson's assumption of 10% compaction (based on the amount of compaction shown by skeletal and body fossils) is too small. The minimum compaction needed to reduce an original ooze with ?70% porosity to the 60-45% porosity of the Maastrichtian was 25-45% (B.M. Funnell personal communication, April 1989).

White chalks often have a porosity of around 40%, equal to that attributed to limestones by Schlanger and Douglas (1974, p. 130). The porosity of oozes immediately below the bioturbated zone (i.e. equivalent to those on which Quaternary rates of deposition are commonly measured) are probably close to the 70% which characterises the top 100 m of calcareous ooze sequences (Schlanger and Douglas 1974, pp. 119, 132). Hence, a porosity reduction of about 30% for the chalk appears to be a reasonable estimate.

Some idea of the gross sedimentation rate can be obtained from study of fossil remains (mostly echinoid tests and belemnite guards) that lay on the sea-floor and were post-mortally colonised by epifauna and/or attacked by boring organisms. If they had lain exposed for prolonged periods (10s to 100s of years), as would be suggested by the very low sedimentation rates, forming very rare "islands of hard substrate" in a soft matrix the following might be expected to have occurred:

a) large, mature epifaunal individuals and colonies on host fossils,

b) high diversity of epifaunal species,

c) very high percentage coverage of exposed remains and widespread evidence of multiple generations of colonisers etc., and

d) partial or complete destruction of test/guard by boring organisms.

Of these, a and b occurred on only a few of the 2700 macrofossils studied, and then only on large belemnites and echinoids, whilst no supporting evidence for c was found. If d had occurred, small, disassociated, bored and worn pieces of fossils should have been found in the bulk sample residues. They were not, even in the smallest (63 micron) fractions. These results imply that fossil remains that lay on the sea-floor were buried fairly quickly.

Of all the factors that make sedimentation rates difficult to gauge, the most problematical is the amount of time represented by omission and hardground surfaces. The former occur ubiquitously throughout the Campanian at spacings ranging from 5-50 cm (averaging 15-30 cm), the latter more sporadically, although commonly in the complex in the middle of the Weybourne Chalk. It is likely that breaks in sedimentation accounted for a high proportion of the time during chalk deposition.

All the different factors, together, suggest that the average chalk sedimentation rate in Norfolk during the Campanian may have been much higher than previously suggested. Allowing for the periods of non-deposition represented by the omission and hardground surfaces, post-depositional compaction, and the relatively rapid post-mortem burial of macrofauna that lay exposed on, or partially buried in, the sediment suggests that the sedimentation rate (at times of deposition) may have been as high as 1 mm per year.

5.3 BELEMNITE DATA

5.3.1 INTRODUCTION

Specimens of *Belemnitella mucronata* were common at all localities in the *mucronata* chalk. The upper surface of every collected individual was marked with permanent ink prior to its removal from the face so that the occurrence, identity, nature, and position of boring traces and epifaunal remains could be recorded in one of four quadrants (north-east (NE), south-east (SE), south-west (SW), north-west (NW)) taken about the longitudinal axis of the guard in order to assess differences and any palaeoecological implications indicated by them.

Two different approaches were attempted in order to study the boring/epifaunal distribution:

a) counting the number of records per quadrant for each specimen,

b) grouping belemnites with the same overall distribution patterns.

The method utilised for each is outlined, briefly, below.

5.3.1.1 Records per Quadrant

The number of borings and epifaunal remains counted per quadrant was assigned to one of four categories:

numerous (N) = ten or more,
few (F) = between two and nine,
one (1) = single occurrence,
zero (0) = none found.

The percentage of records falling into each category per quadrant was plotted for all belemnites collected between particular flint bands.

5.3.1.2 Overall Distribution Patterns

The epifauna and boring distributions of all collected belemnites were split into ten groups, each characterised by a specific combination of remains in each quadrant. They were (NE, SE, SW, NW quadrants respectively):

1. XXXX
2. XXXO/OXXX
3. XXOX/XOXX
4. XXOO/OOXX
5. XOOX
6. OXXO
7. XOXO/OXOX
8. XOOO/OOOX
9. OXOO/OOXO
10. OOOO

(X indicates the presence of records (i.e. "N, F or 1") in that quadrant.

Three general categories (A, B, C) were created by combining the data from groups 1-10, above, for forms that showed particular boring/epifaunal distributions. Group A comprised all belemnites with records in the SE/SW quadrants, group B included all forms with records in the NE/NW quadrants only, and group C those with no borings/epifauna.

The plunge angles and orientation of each belemnite were also measured. The results were incorporated into histograms and rose diagrams for all localities from which sufficient data were obtained. Average plunge angles were calculated using the mid-point values from the five degree wide columns of the histograms.

Information was obtained from all belemnites collected from the sections at Weybourne Hope, Keswick, and Eaton (except for epifaunal and boring distribution data from the latter due to the few fossils collected) in the Weybourne Chalk, and Caistor St. Edmund in the lower Beeston Chalk. (The data from the few belemnites collected from other localities have been included in the overall population summary at the end of the belemnite data section.) Because of variation in the flint band occurrences and consequent differences in flint band notation in the weybourne Chalk sections, the results from each will be presented separately. The notation used for each locality and the correlation between them are shown in Figure 5.1.

The ecological significance of all the results will be discussed in section 5.5.

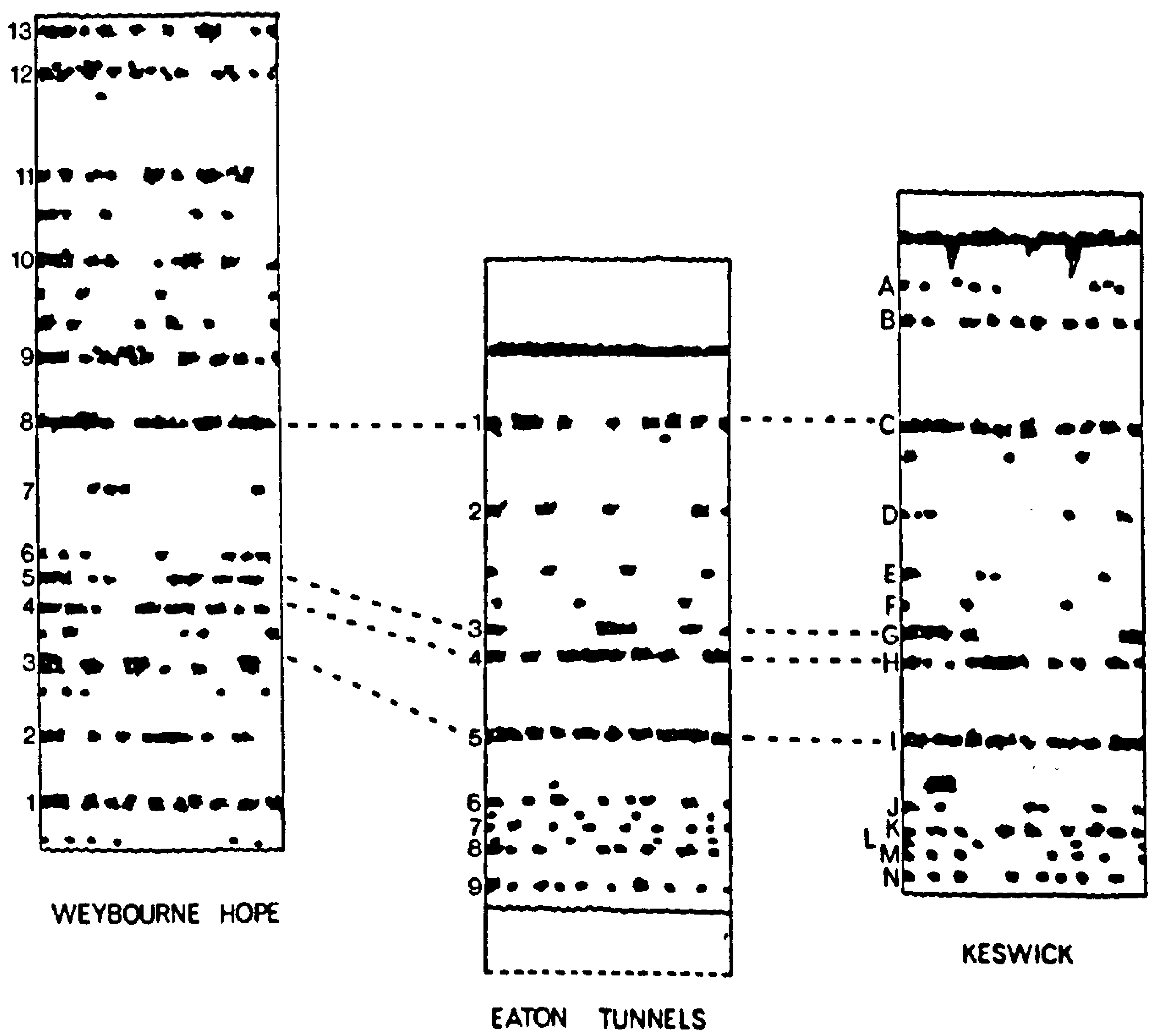


FIGURE 5.1 Correlation between the chalk sections visible at Eaton Tunnels, Keswick, and Weybourne Hope-Old Butts Gap. Numbers on left side of each section indicate the flint band notation used in this chapter.

5.3.2 WEYBOURNE HOPE

5.3.2.1 Borings

5.3.2.1.1 Records per Quadrant (Figures 5.2 and 5.3)

With the exception of the results derived from the few belemnites collected between flint bands 4 and 6 (Figure 5.3) and 8 and 9 (Figure 5.2) which had most borings in their NE and SE (4-6) and SE (8-9) quadrants respectively, a consistent distribution pattern was found at all levels of the section. A higher proportion of specimens had numerous borings in their NE and NW quadrants (20-50%) than the SE and SW (10-25%). The percentage of belemnites without borings in the NE and NW quadrants was, correspondingly, lower (10-30%) than in the SE and SW (40-70%).

The complete plot of all 215 belemnites (Figure 5.3) gave the following percentages of specimens with at least a single boring per quadrant: NE 74, SE 47, SW 43, NW 68, average 58.

The overall percentage distributions were:

NE (N. 32.5, F. 35.0, 1. 6.5, 0. 26.0)
SE (N. 20.0, F. 19.0, 1. 8.0, 0. 53.0)
SW (N. 18.0, F. 17.0, 1. 8.0, 0. 57.0)
NW (N. 32.0, F. 32.0, 1. 4.0, 0. 32.0).

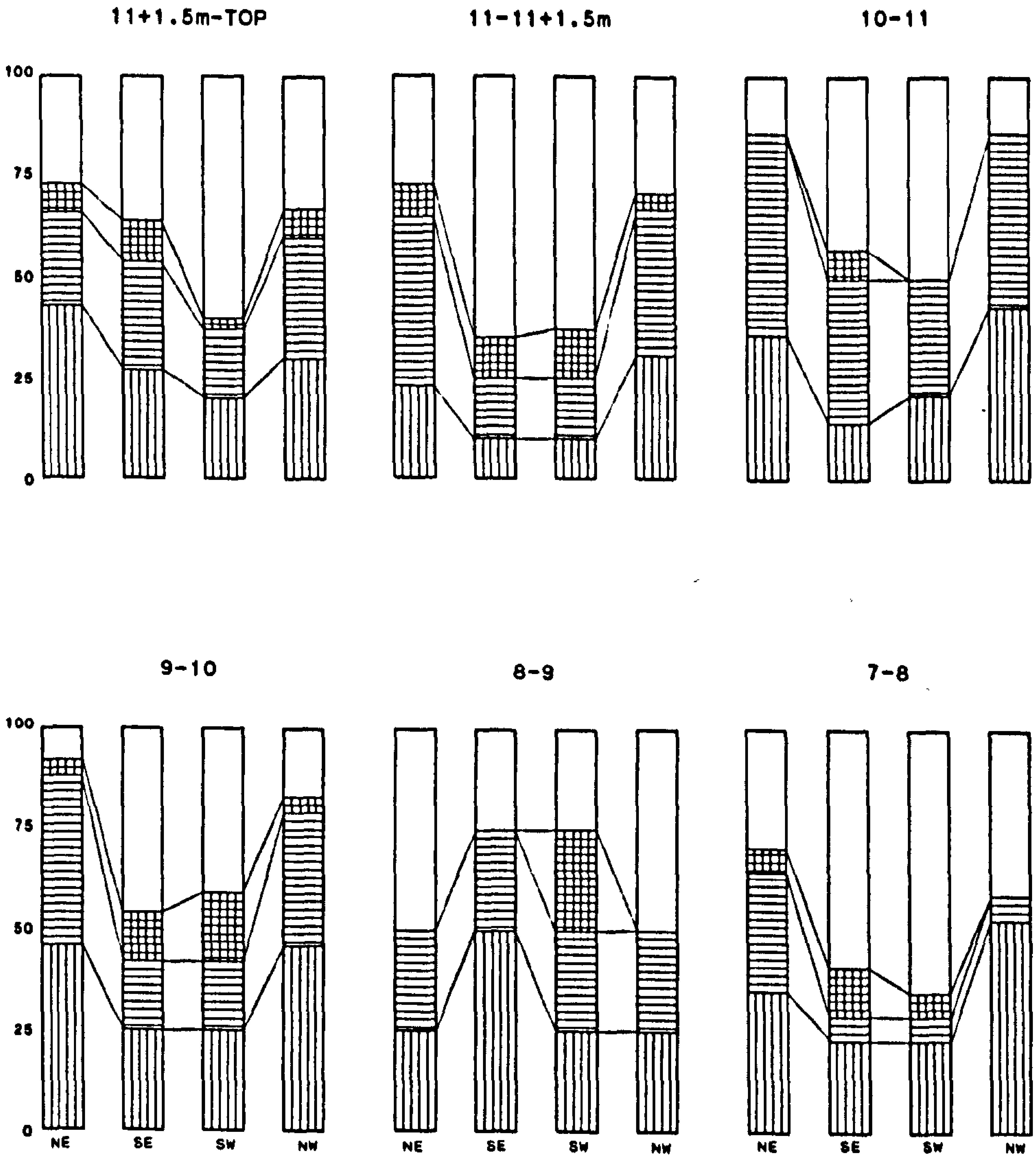


FIGURE 5.2 Percentages of belemnites collected between flint band 7 and the top of the section at Weybourne Hope with numerous (>10) (vertical striping), few (2-9) (horizontal striping), one (cross-hatching), and zero (blank) borings in their NE, SE, SW, and NW quadrants, respectively. Numbers on left side are percentages, letters at base of figures indicate specific quadrants.

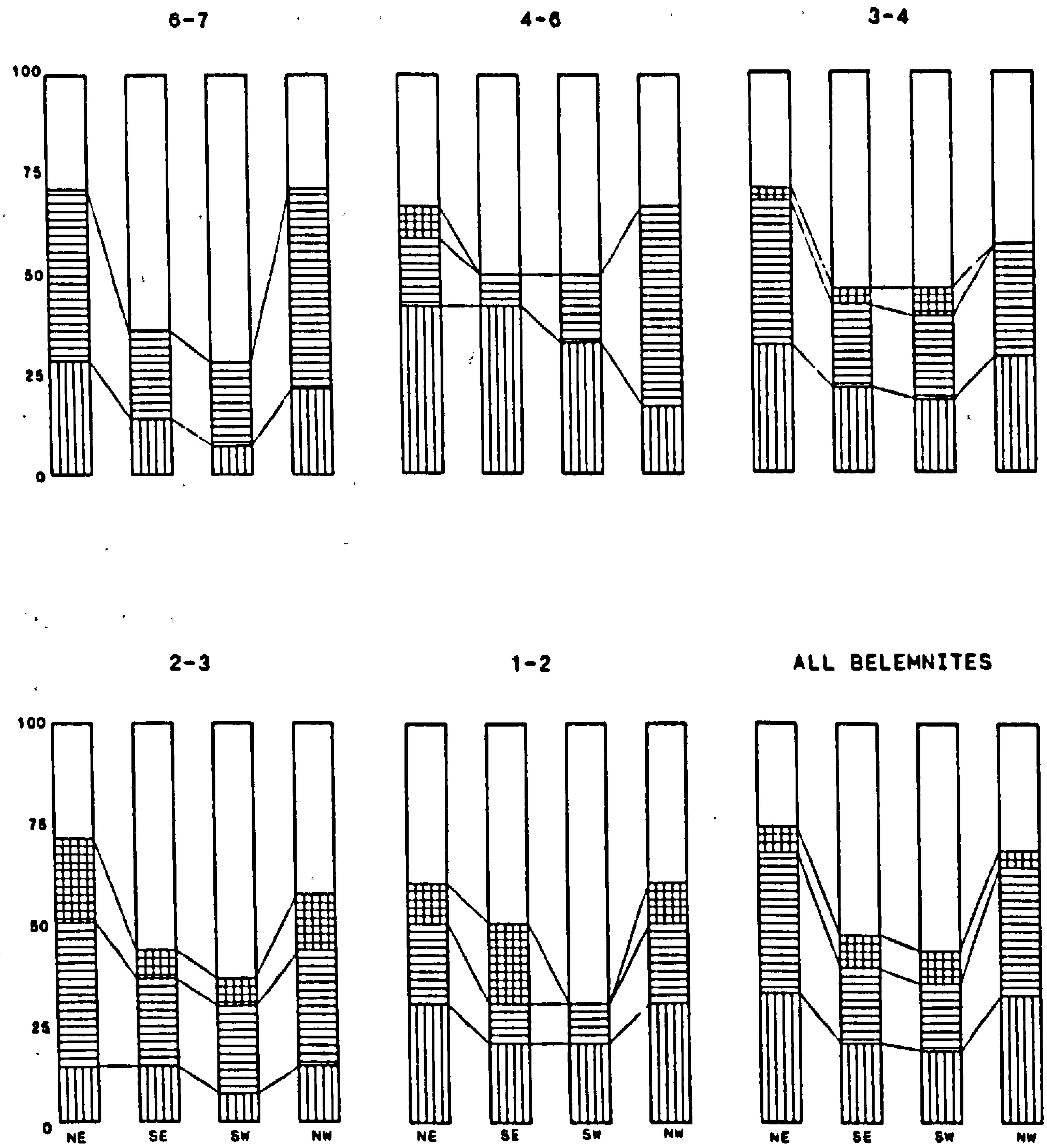


FIGURE 5.3 Percentages of belemnites collected between flint bands 1 and 7 and of the complete population of 215 belemnites from Weybourne Hope with numerous (>10) (vertical striping), few (2-9) (horizontal striping), one (cross-hatching), and zero (blank) borings in their NE, SE, SW, and NW quadrants, respectively. Numbers on left side are percentages, letters at base of figures indicate specific quadrants.

5.3.2.1.2 Overall Distribution Patterns

Considerable variation was found in the percentage of belemnites with boring distributions in each of the ten groups (Table 5.1). Most common were forms bored in all quadrants (group 1) (16.7-50.0%), those with traces in the NE and NW sectors only (group 5) (0.0-35.7%), and forms without borings (group 10) (0.0-29.4%). Of the total population of 215 belemnites, 60 (28.0%) had borings in all four quadrants, 46 (21.4%) in NE and NW quadrants only, 33 (15.4%) were devoid of borings, and the remaining 76 (35.2%) were assigned to the other seven groups.

	PERCENTAGE OF BELEMNITES IN EACH GROUP										
FB	1	2	3	4	5	6	7	8	9	10	N
11+1.5m-TOP	30.0	3.3	13.3	10.0	13.3	3.3	3.3	10.0	3.3	10.0	30
11-11+1.5m	16.7	0	20.8	4.2	29.2	4.2	0	6.2	6.2	12.5	48
10-11	50.0	0	7.1	0	28.6	0	0	0	0	14.3	14
9-10	45.8	0	12.5	0	25.0	0	4.2	4.2	0	8.3	24
8-9	50.0	0	0	0	0	0	0	0	50.0	0	4
7-8	35.3	0	5.9	0	17.6	0	0	11.8	0	29.4	17
6-7	14.3	0	21.4	14.3	21.4	0	0	14.3	0	14.3	14
4-6	33.3	8.3	8.3	8.3	8.3	0	0	16.7	0	16.7	12
3-4	17.9	10.7	17.9	3.6	14.3	3.6	7.1	7.1	0	17.9	28
2-3	21.4	14.3	0	0	35.7	0	0	0	7.1	21.4	14
1-2	30.0	0	10.0	0	20.0	0	0	0	10.0	30.0	10
AVERAGE	28.0	3.2	13.5	4.2	21.4	1.8	1.8	7.0	3.7	15.4	215

<u>TABLE 5.1</u> Percentages of belemnites collected between specific flint bands at Weybourne Hope with boring traces falling into groups 1-10. AVERAGE is for all 215 belemnites, N = number of specimens collected between flint bands. Flint bands as in Figure 5.1.

Recalculating the data for the general distribution categories (Table 5.2) gave population averages of 56.2, 28.4, and 15.4% respectively. Most belemnites (41.2-66.7%) collected at specific levels lay within category A (the 100% value from 8-9 was calculated from just four specimens), with less in B (0.0-35.7%), and C (0.0-30.0%).

PERCENTAGE OF BELEMNITES IN EACH CATEGORY

FB	A	B	C	N
11+1.5m-TOP	66.7	23.3	10.0	30
11-11+1.5m	52.1	35.4	12.5	48
10-11	57.1	28.6	14.3	14
9-10	62.5	29.2	8.3	24
8-9	100.0	0	0	4
7-8	41.2	29.4	29.4	17
6-7	50.0	35.7	14.3	14
4-6	58.3	25.0	16.7	12
3-4	60.7	21.4	17.9	28
2-3	42.9	35.7	21.4	14
1-2	50.0	20.0	30.0	10
AVERAGE	56.2	28.4	15.4	215

TABLE 5.2 Percentages of belemnites collected between individual flint bands at Weybourne Hope with borings in categories A, B, or C (section 5.3.1.2). (Abbreviations as in Table 5.1.)

5.3.2.2 Epifauna

5.3.2.2.1 Records per Quadrant (Figures 5.4 and 5.5)

The epifaunal distribution was generally similar to that shown by the borings. The main difference was the much lower density of remains. No collected specimens had numerous remains (N) on any quadrant, and only a

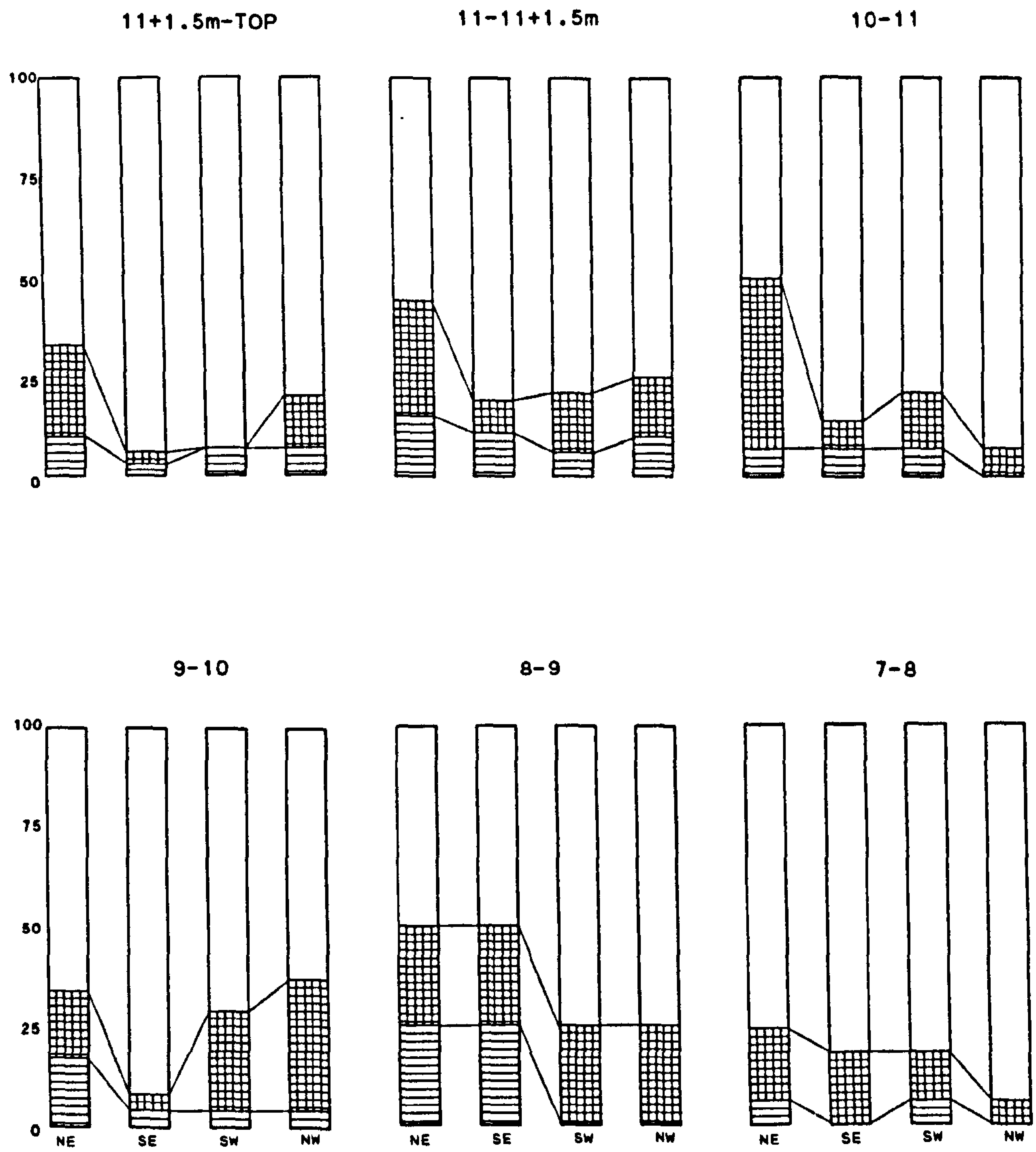


FIGURE 5.4 Percentages of belemnites collected between flint band 7 and the top of the section at Weybourne Hope with numerous (>10) (vertical striping), few (2-9) (horizontal striping), one (cross-hatching), and zero (blank) epifaunal remains in their NE, SE, SW, and NW quadrants, respectively. Numbers on left side are percentages, letters at base of figures indicate specific quadrants.

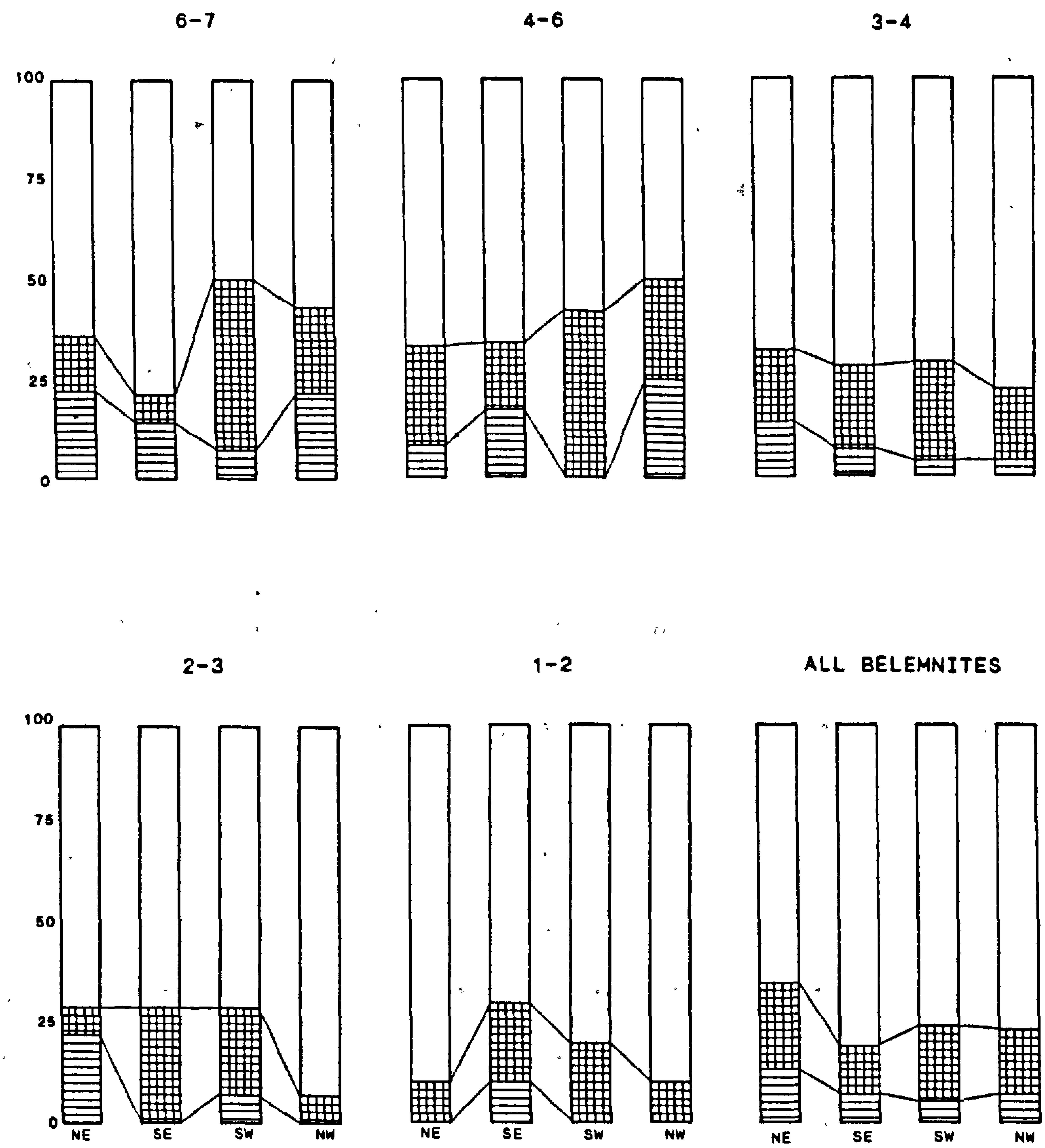


FIGURE 5.5 Percentages of belemnites collected between flint bands 1 and 7 and of the complete population of 215 belemnites from Weybourne Hope with numerous (>10) (vertical striping), few (2-9) (horizontal striping), one (cross-hatching), and zero (blank) epifaunal remains in their NE, SE, SW, and NW quadrants, respectively. Numbers on left side are percentages, letters at base of figures indicate specific quadrants.

small proportion, usually <10%, had more than a single example per quadrant. In every plot (except that of the very small group collected between flint bands 8 and 9) the majority of specimens had no remains at all, about 70% of quadrants per plot being devoid of epifauna.

The complete plot (Figure 5.5) gave the following percentage distributions:

NE (F. 13.0, 1. 22.0, 0. 65.0)
SE (F. 7.0, 1. 12.0, 0. 81.0)
SW (F. 5.0, 1. 19.0, 0. 76.0)
NW (F. 7.0, 1. 16.0, 0. 77.0).

5.3.2.2.2 Overall Distribution Patterns

A low density of epifaunal colonisation was noted (Table 5.3), both for subgroups and the complete population. Of the latter, 83 (38.6%) guards had no epifauna, 47 (21.9%) epifauna solely on NE/NW quadrants, and 26 (12.1%) on the SE/SW quadrants alone. The other 59 (27.4%) lay in the other seven groups.

PERCENTAGE OF BELEMNITES IN EACH GROUP

FB	1	2	3	4	5	6	7	8	9	10	N
11+1.5m-TOP	0	0	0	3.3	6.7	0	3.3	33.3	6.7	46.7	30
11-11+1.5m	2.1	4.2	6.2	4.2	6.2	2.1	4.2	27.1	10.4	33.3	48
10-11	0	0	0	7.1	7.1	7.1	7.1	28.6	7.1	35.7	14
9-10	4.2	0	8.3	4.2	12.5	0	0	16.7	16.7	37.5	24
8-9	0	25.0	0	25.0	0	0	0	25.0	0	25.0	4
7-8	0	5.9	0	5.9	0	5.9	0	17.6	5.9	58.8	17
6-7	14.3	0	7.1	0	14.3	0	0	7.1	35.7	21.4	14
4-6	0	16.7	8.3	25.0	0	0	0	25.0	8.3	16.7	12
3-4	7.1	0	3.6	14.3	0	7.1	0	17.9	10.7	39.3	28
2-3	7.1	7.1	0	0	0	0	7.1	7.1	21.4	50.0	14
1-2	0	0	0	0	0	20.0	0	20.0	10.0	50.0	10
AVERAGE	3.3	3.3	3.7	6.5	5.1	3.3	2.2	21.9	12.1	38.6	215

TABLE 5.3 Percentages of belemnites collected between specific flint bands at Weybourne Hope with epifaunal remains falling into groups 1-10. (Abbreviations as in Table 5.1.)

The population averages for the general distribution categories were 34.4, 27.0, and 38.6% respectively (Table 5.4). In subgroups belemnites occurred most commonly in A (13.3-58.3%) and C (16.7-58.8%) with fewer in B (7.1-40.0%).

PERCENTAGE OF BELEMNITES IN EACH CATEGORY

FB	A	B	C	N
11+1.5m-TOP	13.3	40.0	46.7	30
11-11+1.5m	33.3	33.3	33.3	48
10-11	28.6	35.7	35.7	14
9-10	33.3	29.2	37.5	24
8-9	50.0	25.0	25.0	4
7-8	23.5	17.7	58.8	17
6-7	57.2	21.4	21.4	14
4-6	58.3	25.0	16.7	12
3-4	42.9	17.9	39.3	28
2-3	42.9	7.1	50.0	14
1-2	30.0	20.0	50.0	10
AVERAGE	34.4	27.0	38.6	215

TABLE 5.4 Percentages of belemnites collected between individual flint bands at Weybourne Hope with epifauna in categories A, B, or C (section 5.3.1.2). (Abbreviations as in Table 5.1.)

5.3.2.3 Belemnite Orientations (Figures 5.6-5.8)

The 230 guards measured from the east-west cliff section showed no evidence of preferential orientations. The intermediate plots between particular flint bands often gave polymodal distributions. The overall plot (Figure 5.8) shows slight bias in favour of specimens with north/south orientations. This reflecting the enhanced probability of finding specimens at large angles to the cliff compared to those aligned nearly parallel to it.

5.3.2.4 Plunge Angles (Figures 5.9-5.11)

The histograms produced for subsets of belemnites collected between flint bands and the total population (Figure 5.11) showed the same pattern. Most guards had low plunge angles, only eleven out of 230 (4.8%) had

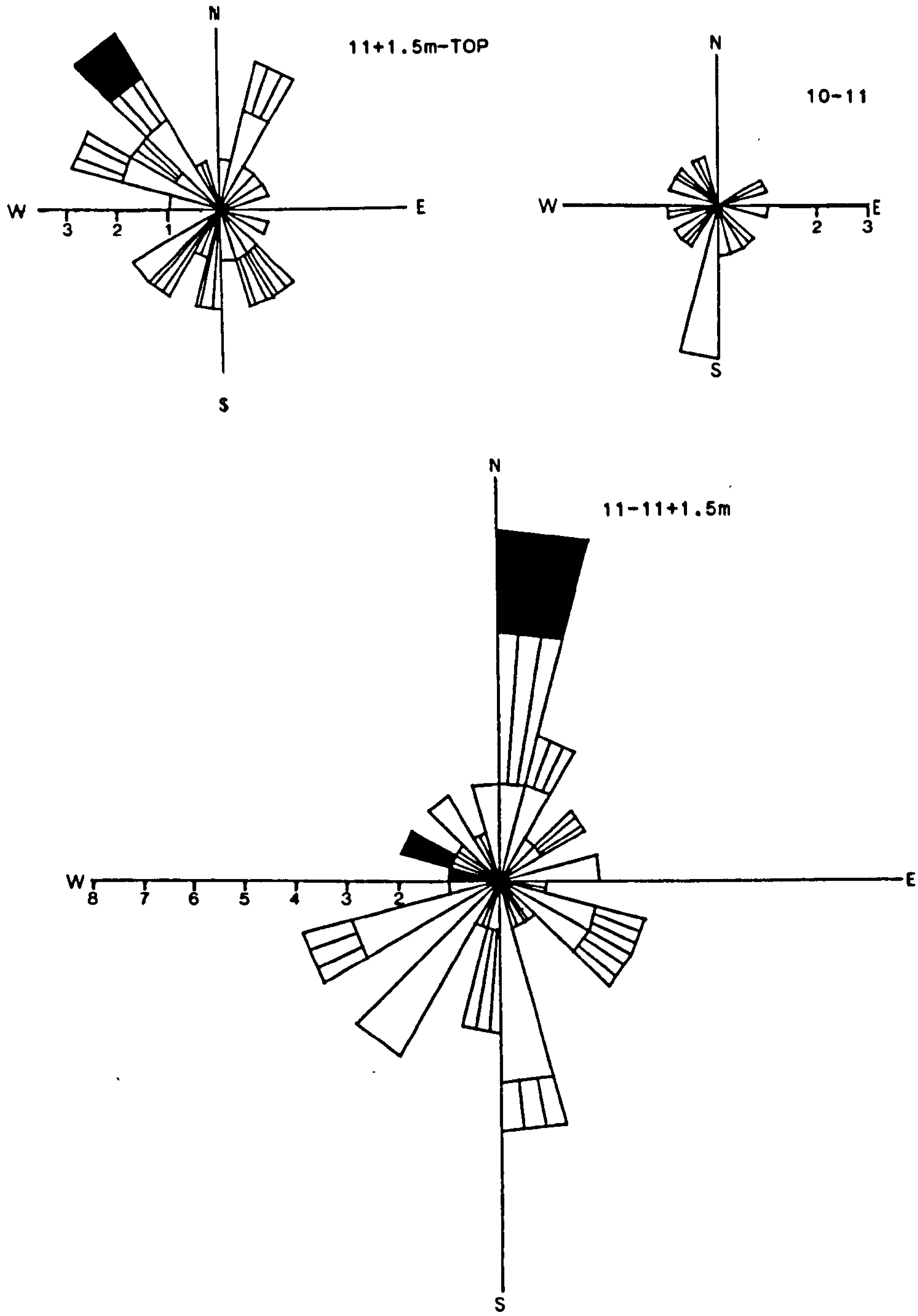


FIGURE 5.6 Orientations of belemnites measured between flint band 10 and the top of the section at Weybourne Hope. Ornamentation: striped = point end of guard upwards, blank = point end of guard downwards, solid = horizontal guard.

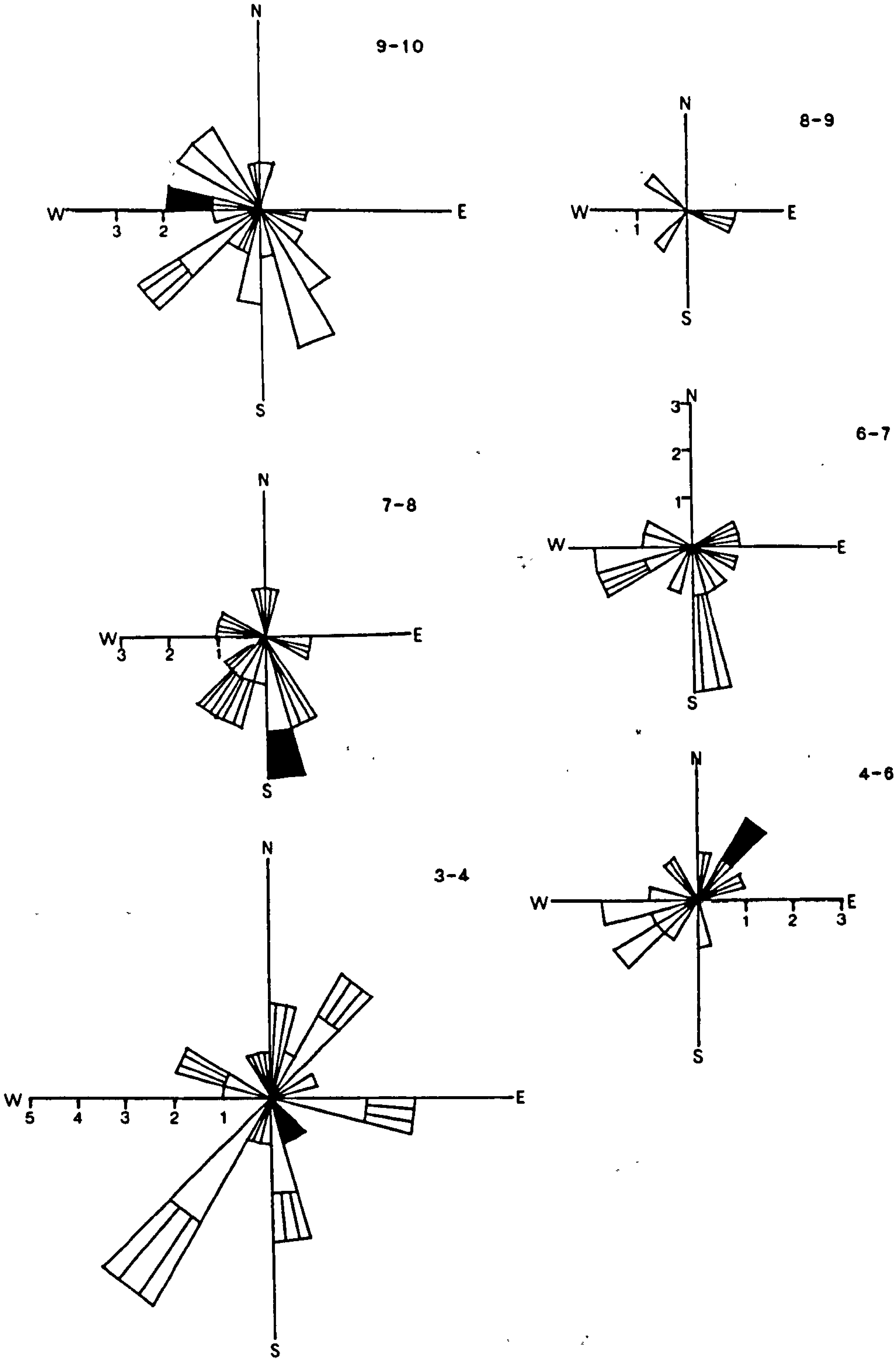


FIGURE 5.7 Orientations of belemnites measured between flint bands 3 and 10 and of all 230 specimens with data from Weybourne Hope. Ornamentation: striped = point end of guard upwards, blank = point end of guard downwards, solid = horizontal guard.

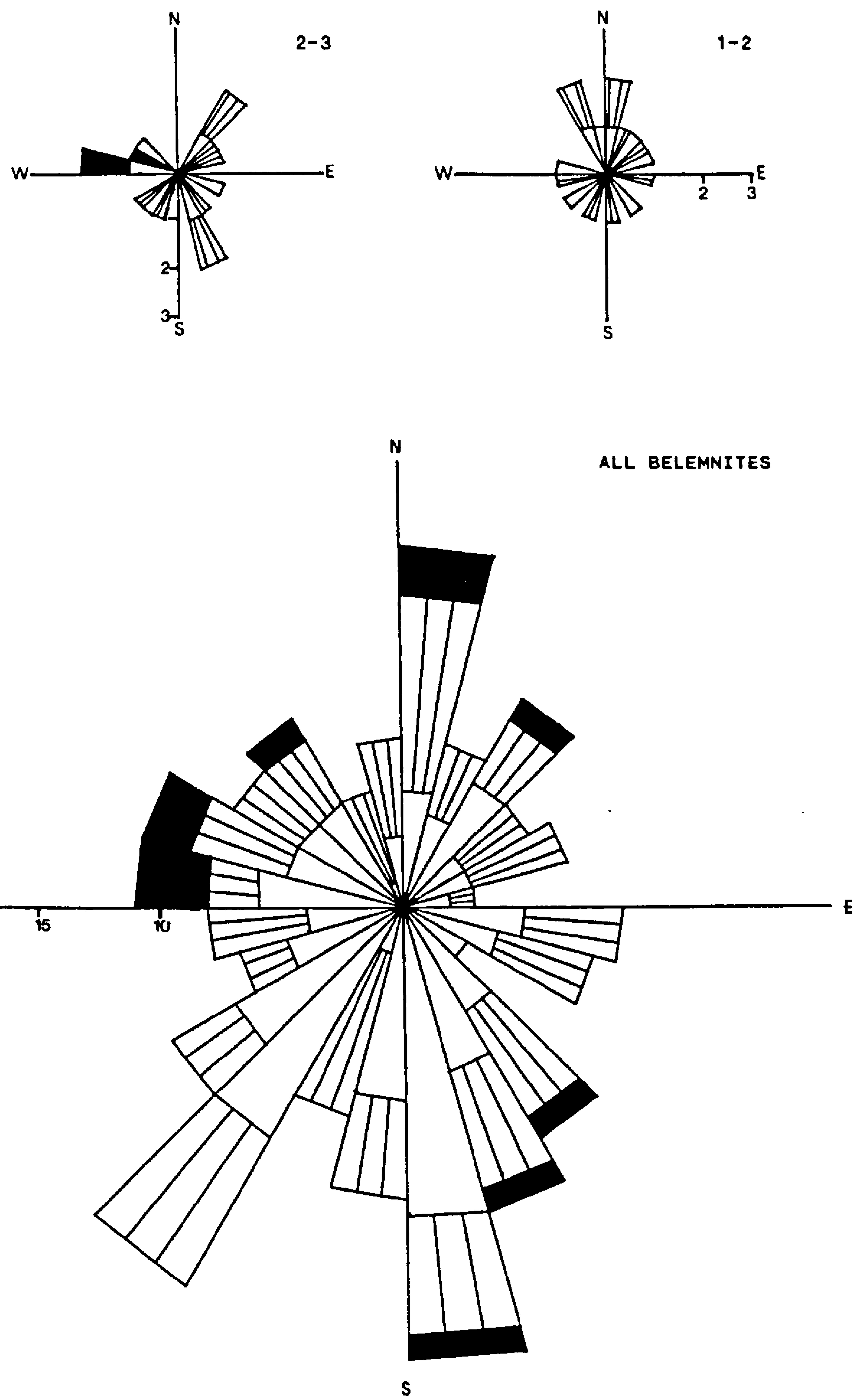


FIGURE 5.8 Orientations of belemnites measured between flint bands 1 and 3 at Weybourne Hope. Ornamentation: striped = point end of guard upwards, blank = point end of guard downwards, solid = horizontal guard.

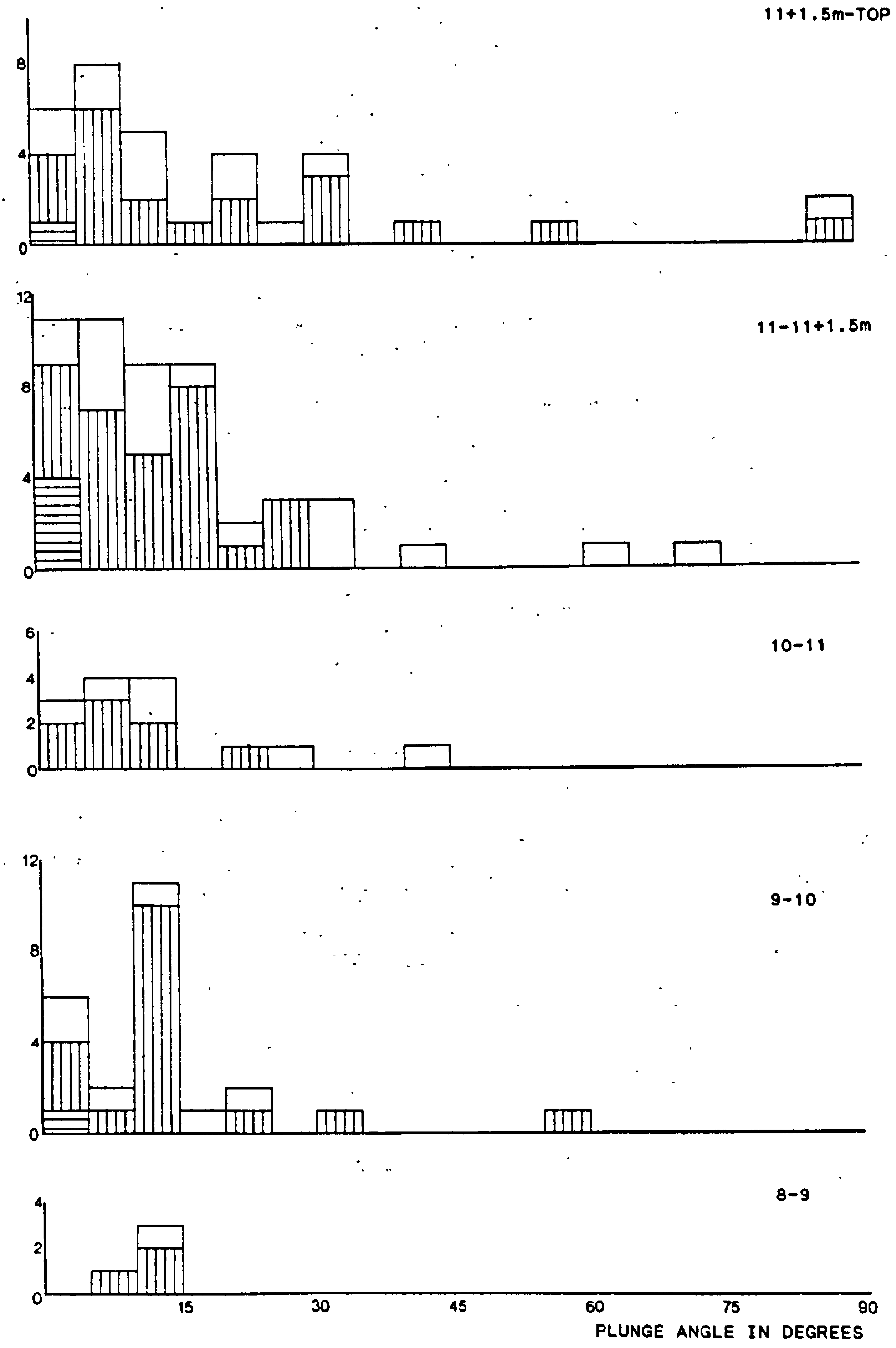


FIGURE 5.9 Plunge angles of belemnites measured between flint band 8 and the top of the section at Weybourne Hope. Ornamentation: vertical striping = point end of guard downwards, blank = point end of guard upwards, horizontal striping = horizontal guard.

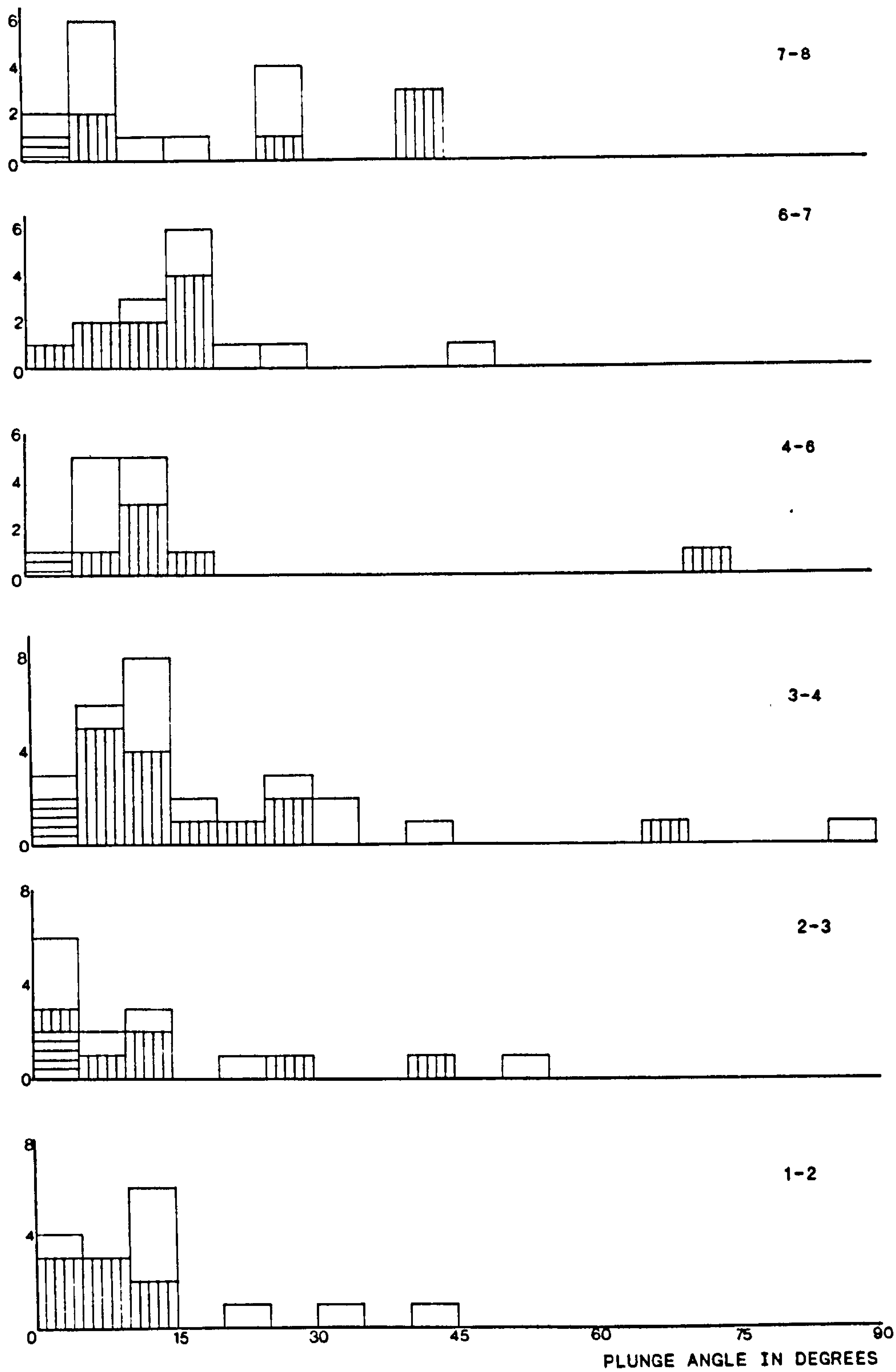
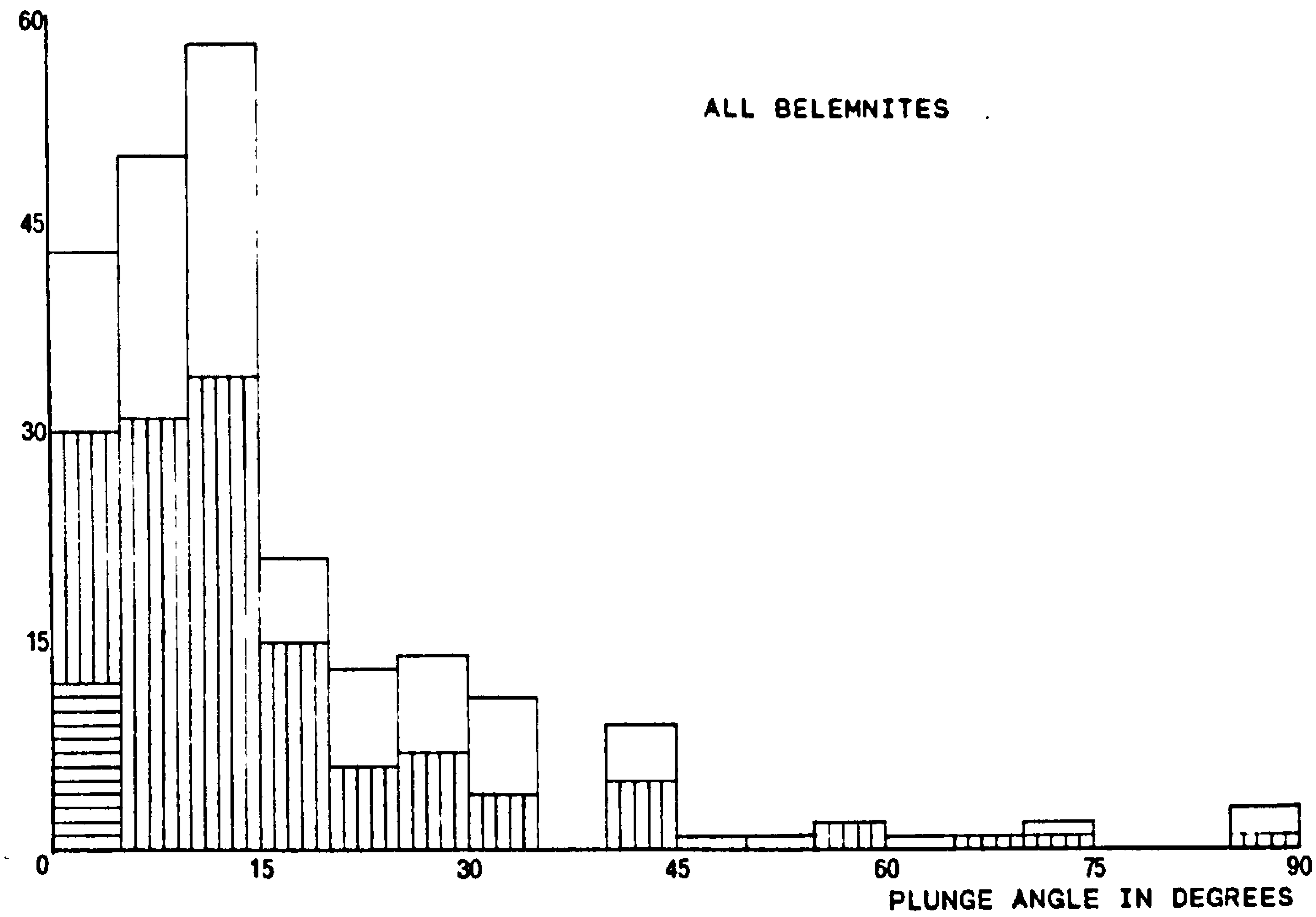


FIGURE 5.10 Plunge angles of belemnites measured between flint bands 1 and 8 at Weybourne Hope. Ornamentation: vertical striping = point end of guard downwards, blank = point end of guard upwards, horizontal striping = horizontal guard.



<u>FIGURE 5.11</u> Plunge angles of all 230 belemnite guards measured from Weybourne Hope. Ornamentation: vertical striping = point end of guard downwards, blank = point end of guard upwards, horizontal striping = horizontal guard.

angles in excess of 45 degrees, the average value being just over 16 degrees. Twelve guards (5.2%) had no plunge (H), 93 (40.4%) were point end of guard upwards (PU), the other 125 (54.4%) posterior of guard downwards (PD).

FB	NUMBER MEASURED	AVERAGE PLUNGE (DEGREES)
11+1.5m-TOP	33	20.4
11-11+1.5m	51	15.1
10-11	14	12.9
9-10	24	13.2
8-9	4	11.3
7-8	17	18.6
6-7	15	17.2
4-6	13	14.6
3-4	28	19.6
2-3	15	13.8
1-2	16	12.8
AVERAGE	230	16.2

TABLE 5.5 Average plunge angles of belemnites measured from the section at Weybourne Hope. (Abbreviations as in Table 5.1.)

5.3.3 KESWICK QUARRY

5.3.3.1 Borings

5.3.3.1.1 Records per Quadrant (Figure 5.12)

With the exception of the statistically suspect data obtained from the twelve belemnites collected between flint bands H and D (Figures 5.12) all subgroups exhibited a similar distribution pattern. A higher proportion of specimens had borings in their NE and NW quadrants than in the SE and SW. Of the complete

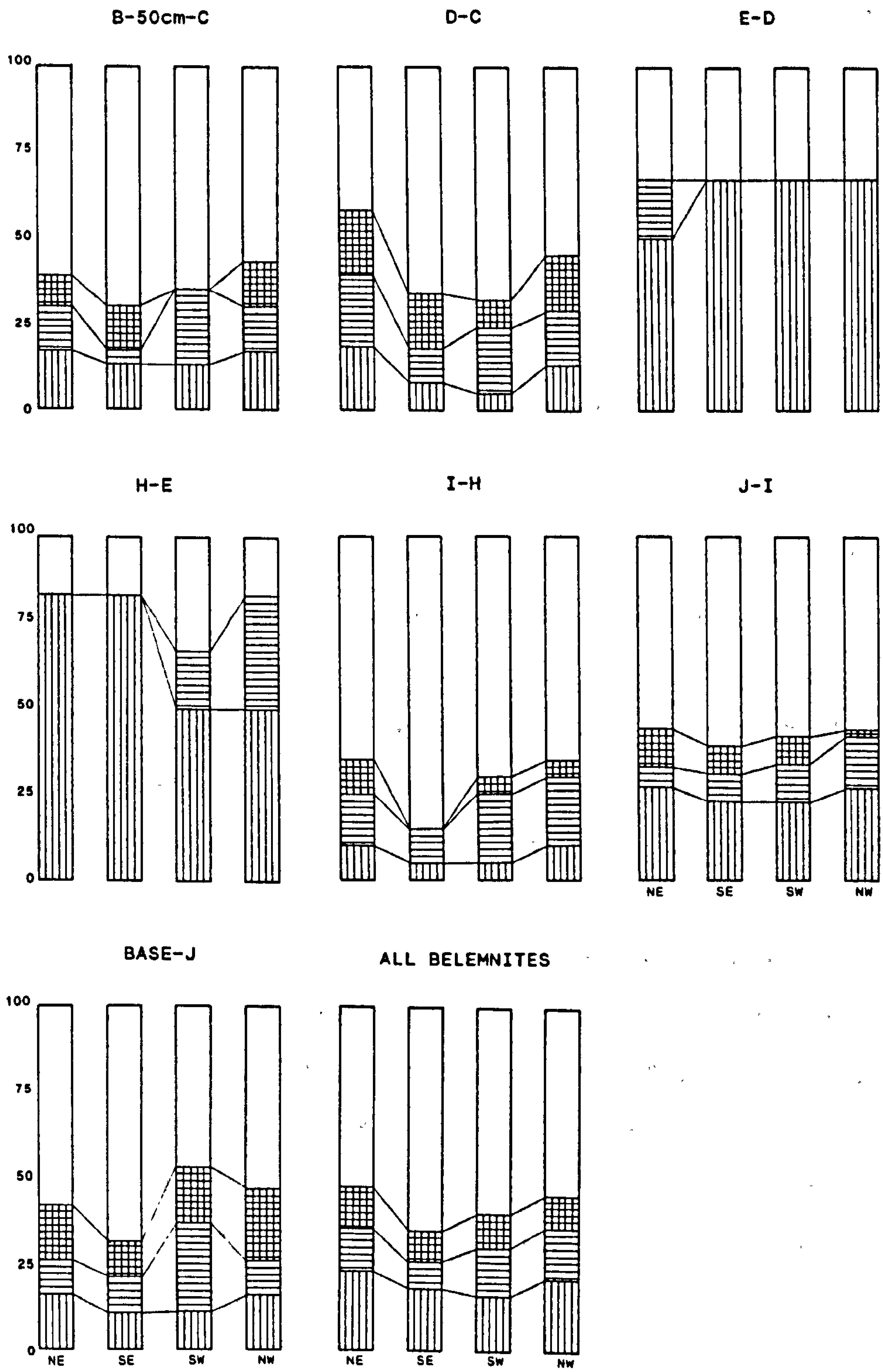


FIGURE 5.12 Percentages of belemnites collected between specific flint bands and of the complete population of 160 belemnites from Keswick with numerous (>10) (vertical striping), few (2-9) (horizontal striping), one (cross-hatching), and zero (blank) borings in their NE, SE, SW, and NW quadrants, respectively. Numbers on left side are percentages, letters at base of figures indicate specific quadrants.

population of 160 guards with data, 42% had at least a single boring, made up by the following percentages per quadrant: NE 47.0, SE 35.0, SW 40.0, NW 45.5. The overall percentage distributions (Figure 5.12) were:

NE (N. 23.0, F. 12.5, 1. 12.0, O. 52.5)
SE (N. 18.0, F. 8.0, 1. 9.0, O. 65.0)
SW (N. 16.0, F. 14.0, 1. 10.0, O. 60.0)
NW (N. 21.0, F. 15.0, 1. 9.5, O. 54.5).

5.3.3.1.2 Overall Distribution Patterns

With the exception of the two small groups, of six belemnites each, collected between flint bands H and D, of which 66.7% occurred within group 1 for both subsets, a similar distribution was identified at all levels of the quarry (Table 5.6). In every case the highest percentage of specimens (34.8-50.0) were assigned to group 10, i.e. forms without borings. Between 10.0 and 31.6% of guards had borings in all quadrants (group 1), in contrast to the complete absence of forms with patterns fitting into group 7. The overall population contained 58 (36.2%) individuals in group 10, 40 (25.0%) in group 1, and 16 (10.0%) in group 8 (forms with borings in NE/NW quadrants only). The other 46 (28.8%) specimens were contained in groups 2-6, or 9.

PERCENTAGE OF BELEMNITES IN EACH GROUP

FB	1	2	3	4	5	6	7	8	9	10	N
B-50cm-C	17.4	0	8.7	8.7	4.3	0	0	13.0	13.0	34.8	23
D-C	15.8	5.3	7.9	0	18.4	5.3	0	13.2	5.3	28.9	38
E-D	66.7	0	0	0	0	0	0	0	0	33.3	6
H-E	66.7	0	16.7	0	0	0	0	0	0	16.7	6
I-H	10.0	5.0	5.0	5.0	10.0	0	0	10.0	5.0	50.0	20
J-I	29.2	2.1	2.1	4.2	4.2	2.1	0	10.4	8.3	37.5	48
BASE-J	31.6	0	5.3	10.5	0	0	0	5.3	5.3	42.1	19
AVERAGE	25.0	2.5	5.6	4.4	7.5	1.9	0.0	10.0	6.9	36.2	160

TABLE 5.6 Percentages of belemnites collected between specific flint bands at Keswick with boring traces falling into groups 1-10. AVERAGE is for all 160 belemnites. Flint bands as in Figure 5.1.

Of the complete population, 74 (46.3%) were found to occur within category A (Table 5.7), 28 (17.5%) in B, and 58 (36.2%) in C. In the subgroups, with the exception of the suspect values between flints H and D, category A contained 30.0-56.2%, category B 5.3-31.6%, and category C 28.9-50.0% of collected belemnites.

PERCENTAGE OF BELEMNITES IN EACH CATEGORY

FB	A	B	C	N
B-50cm-C	47.8	17.4	34.8	23
D-C	39.5	31.6	28.9	38
E-D	66.7	0	33.3	6
H-E	83.3	0	16.7	6
I-H	30.0	20.0	50.0	20
J-I	47.9	14.6	37.5	48
BASE-J	52.6	5.3	42.1	19
AVERAGE	46.3	17.5	36.2	160

TABLE 5.7 Percentages of belemnites collected between individual flint bands at Keswick with borings in categories A, B, or C (section 5.3.1.2). (Abbreviations as in Table 5.6.)

5.3.3.2 Epifauna

5.3.3.2.1 Records per Quadrant (Figure 5.13)

The distribution of the epifauna from Keswick was grossly analogous to that found at Weybourne. The percentages of quadrants with recorded epifauna were: NE 37, SE 39, SW 33, NW 45, average 38%. The complete percentage distributions of all 160 belemnites (Figure 5.13) were:

NE (N. 1.0, F. 18.0, 1. 18.0, O. 63.0)
SE (N. 1.0, F. 13.0, 1. 25.0, O. 61.0)
SW (N 1.0, F. 13.0, 1. 19.0, O. 67.0)
NW (N 1.0, F. 19.0, 1. 25.0, O. 55.0).

5.3.3.2.2 Overall Distribution Patterns

The epifaunal distribution patterns on the guards of all 160 belemnites collected from Keswick were spread fairly evenly throughout all 10 groups (Table 5.8) with only two groups, 8 and 10, containing more than 10% of the fauna (16.2 and 26.2%, respectively).

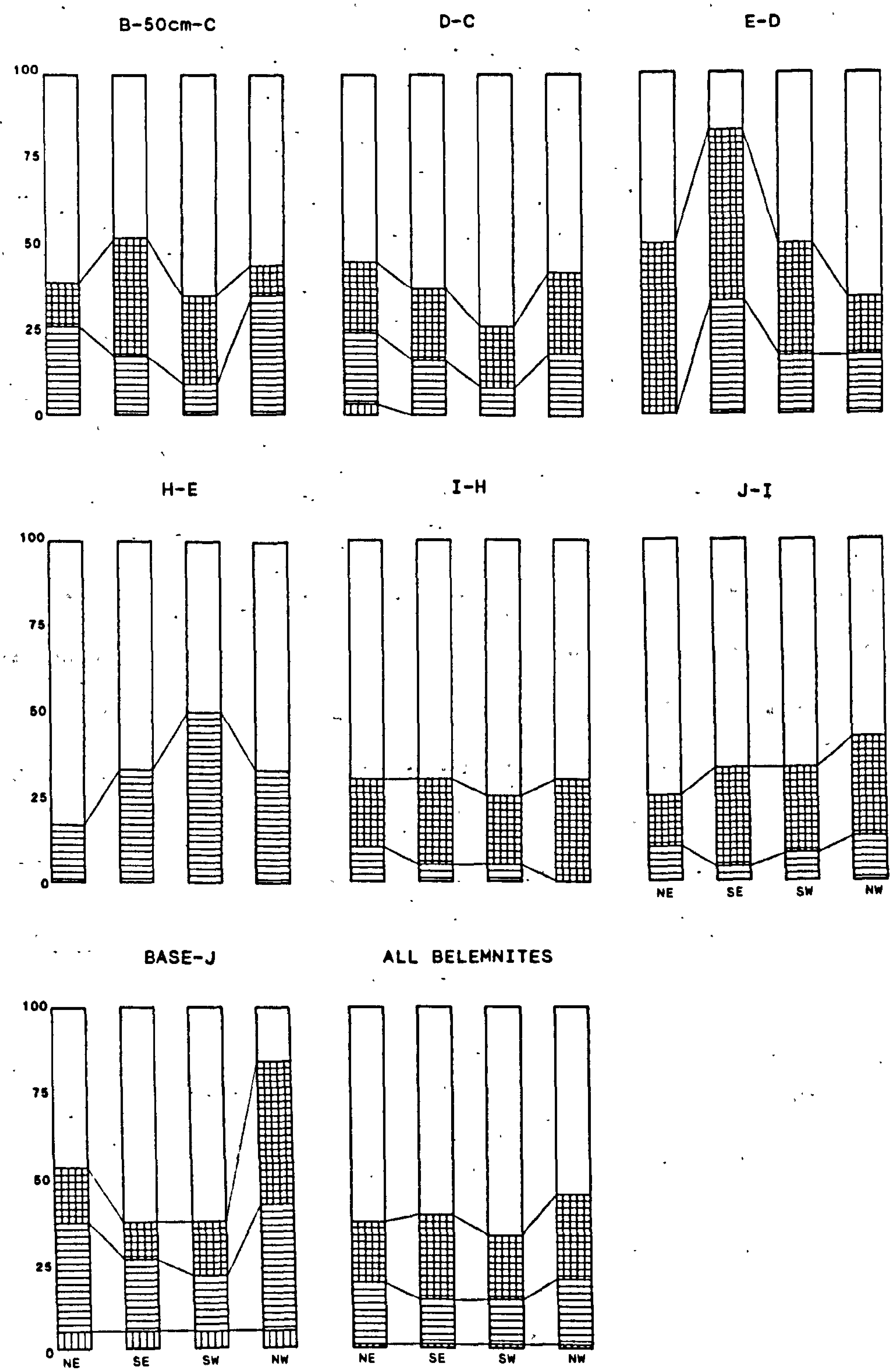


FIGURE 5.13 Percentages of belemnites collected between specific flint bands and of the complete population of 160 belemnites from Keswick with numerous (>10) (vertical striping), few (2-9) (horizontal striping), one (cross-hatching), and zero (blank) epifaunal remains in their NE, SE, SW, and NW quadrants, respectively. Numbers on left side are percentages, letters at base of figures indicate specific quadrants.

PERCENTAGE OF BELEMNITES IN EACH GROUP

FB	1	2	3	4	5	6	7	8	9	10	N
B-50cm-C	8.7	0	13.0	4.3	8.7	17.4	8.7	8.7	8.7	21.7	23
D-C	15.8	2.6	7.9	10.5	2.6	0	5.3	18.4	2.6	34.2	38
E-D	0	50.0	0	0	16.7	0	0	0	33.3	0	6
H-E	0	33 3	0	0	0	0	0	16.7	16.7	33.3	6
I-H	5.0	10.0	0	5.0	5.0	0	5.0	20.0	15.0	35.0	20
J-I	2.1	2.1	8.3	18.8	4.2	8.3	2.1	14.6	12.5	27.1	48
BASE-J	21.1	5.3	10.5	5.3	15.8	0	5.3	26.3	0	10.5	19
AVERAGE	8.7	6.3	7.5	10.0	6.3	5.0	4.4	16.2	9.4	26.2	160

TABLE 5.8 Percentages of belemnites collected between specific flint bands at Keswick with epifauna falling into groups 1-10. (Abbreviations as in Table 5.6.)

At all levels of the quarry (excluding the chalk between flints D and H) most belemnites were found to fall in category A (40.0-60.9%) (Table 5.9), with relatively equal percentages in B (17.4-42.1) and C (10.5-35.0). The complete population gave the following percentages: category A 51.3, category B 22.5, category C 26.2.

PERCENTAGE OF BELEMNITES IN EACH CATEGORY

FB	A	B	C	N
B-50cm-C	60.9	17.4	21.7	23
D-C	44.7	21.1	34.2	38
E-D	83.3	16.7	0	6
H-E	50.0	16.7	33.3	6
I-H	40.0	25.0	35.0	20
J-I	54.2	18.7	27.1	48
BASE-J	47.4	42.1	10.5	19
AVERAGE	51.3	22.5	26.2	160

TABLE 5.9 Percentages of belemnites collected between individual flint bands at Keswick with epifauna in categories A, B, or C (section 5.3.1.2). (Abbreviations as in Table 5.6.)

5.3.3.4 Belemnite Orientations (Figures 5.14-5.16)

As at Weybourne, the 213 measured belemnites from this quarry showed no evidence of preferential orientation. The complete plot (Figure 5.16) has relatively uniform distribution. This is a good representation of the collecting which was about equally split between the north and south faces and the long east face of the quarry.

5.3.3.5 Plunge Angles (Figures 5.17-5.18)

A similar pattern was observed to that seen at Weybourne. Only 22 (10.3%) of guards had plunges in excess of 45 degrees, the population average being only 19.9 degrees (Table 5.10). Of the 213 guards measured, 122 (57.3%) were orientated point end of guard downwards, 77 (36.2%) were point end of guard upwards, the other 14 (6.5%) were horizontal.

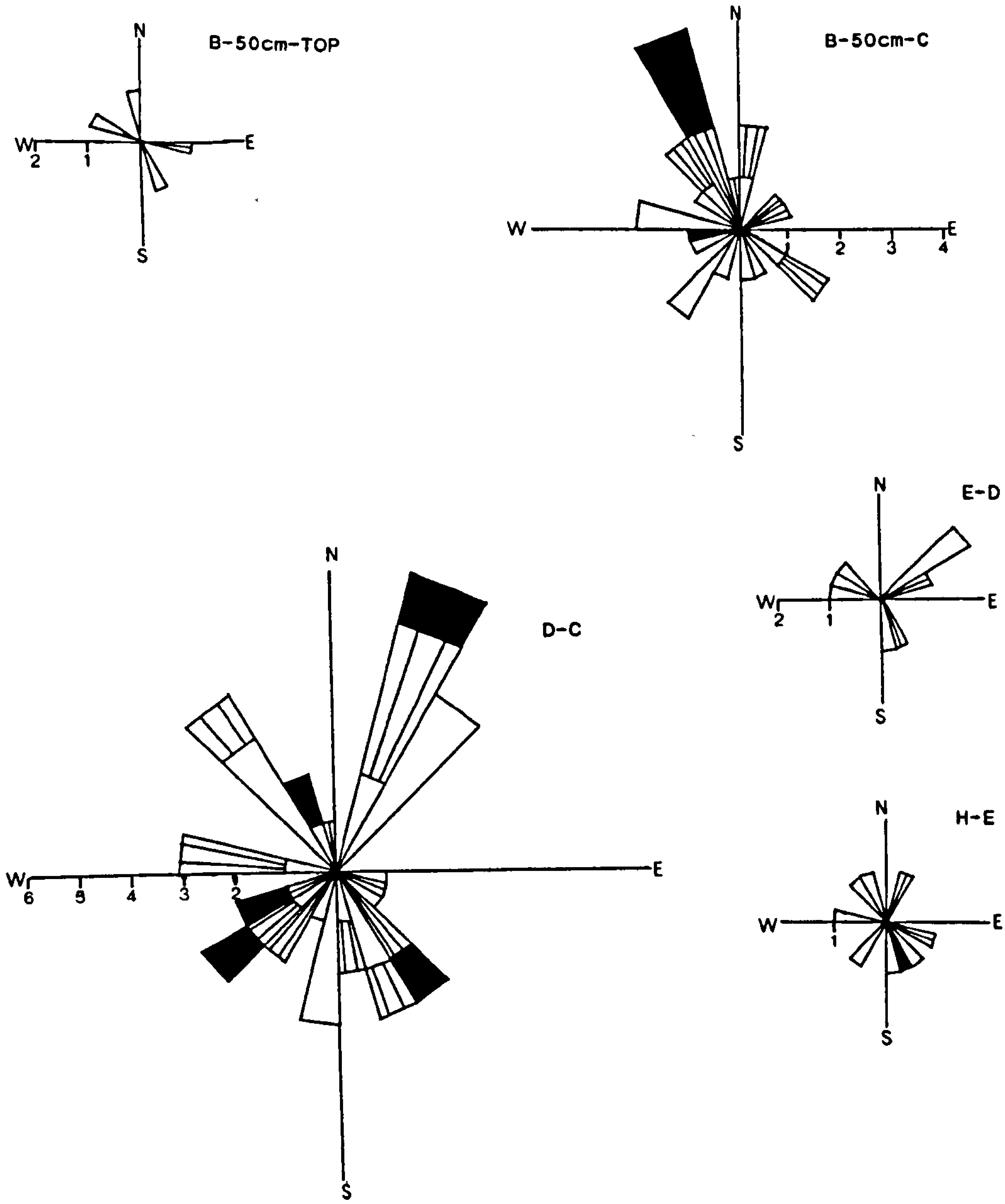


FIGURE 5.14 Orientations of belemnites measured between flint band H and the top of the section at Keswick. Ornamentation: striped = point end of guard upwards, blank = point end of guard downwards, solid = horizontal guard.

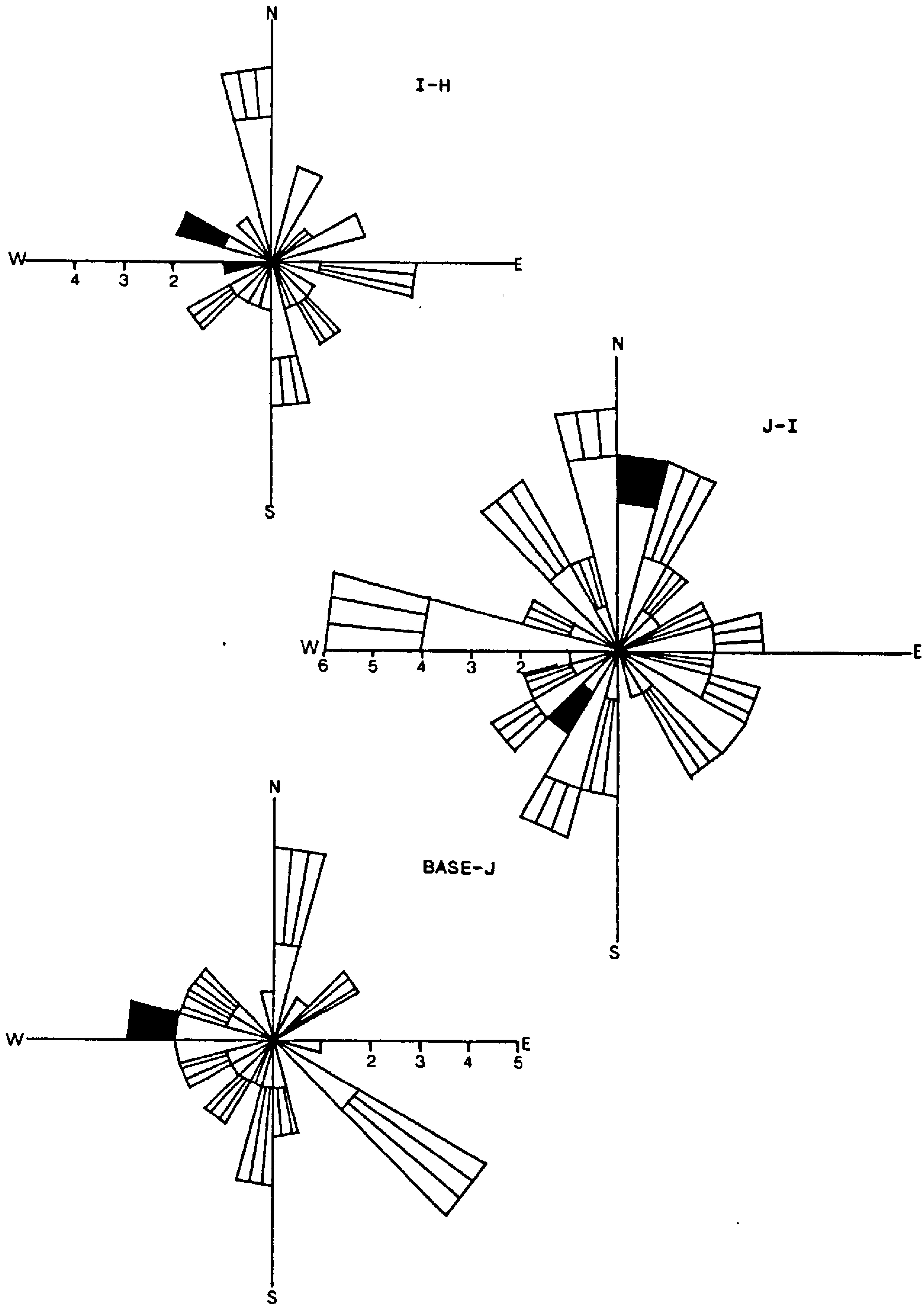


FIGURE 5.15 Orientations of belemnites measured between the base of the section and flint band H at Keswick. Ornamentation: striped = point end of guard upwards, blank = point end of guard downwards, solid = horizontal guard.

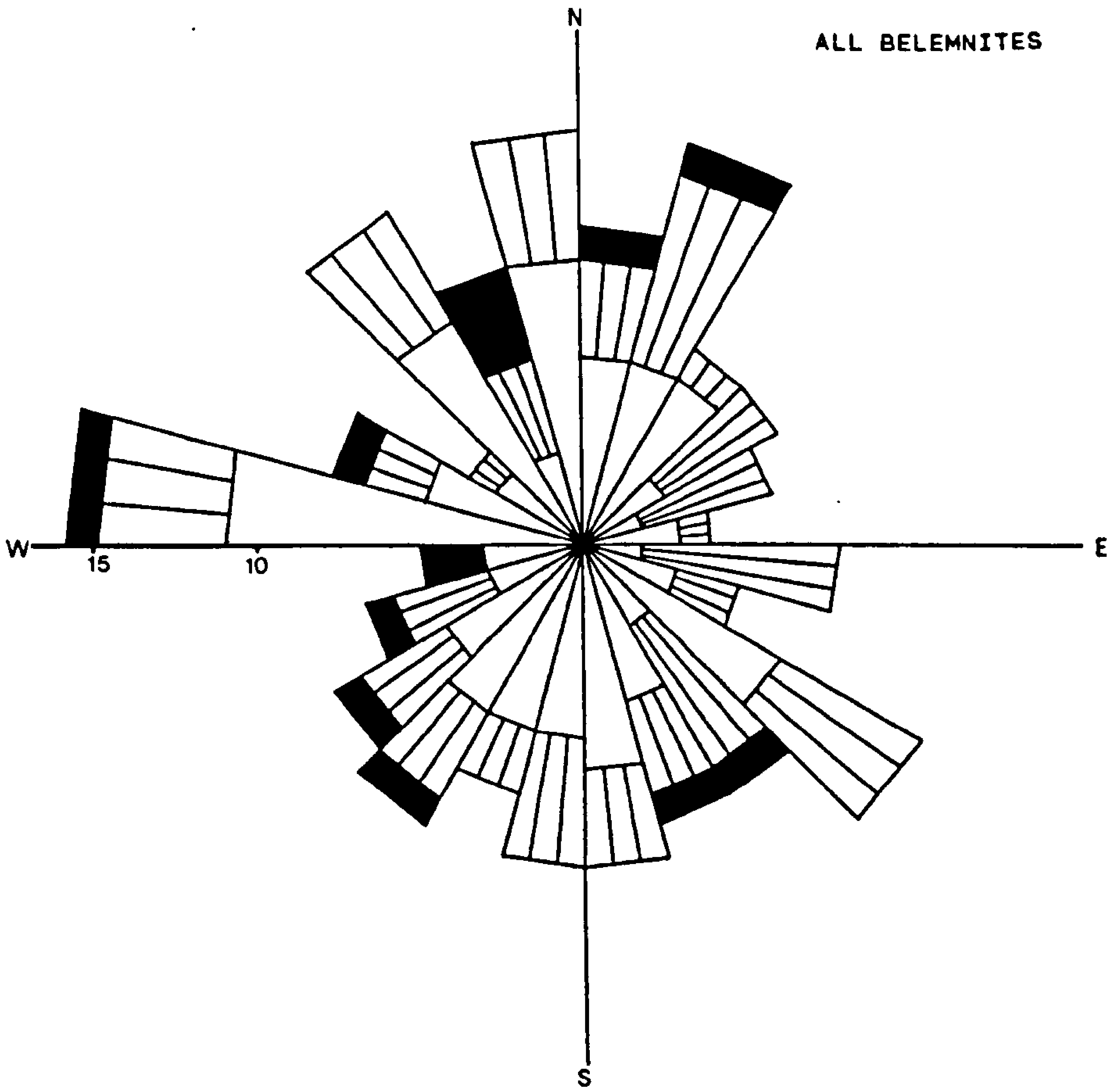


FIGURE 5.16 Orientations of all 213 measured belemnite guards collected from Keswick. Ornamentation: striped = point end of guard upwards, blank = point end of guard downwards, solid = horizontal guard.

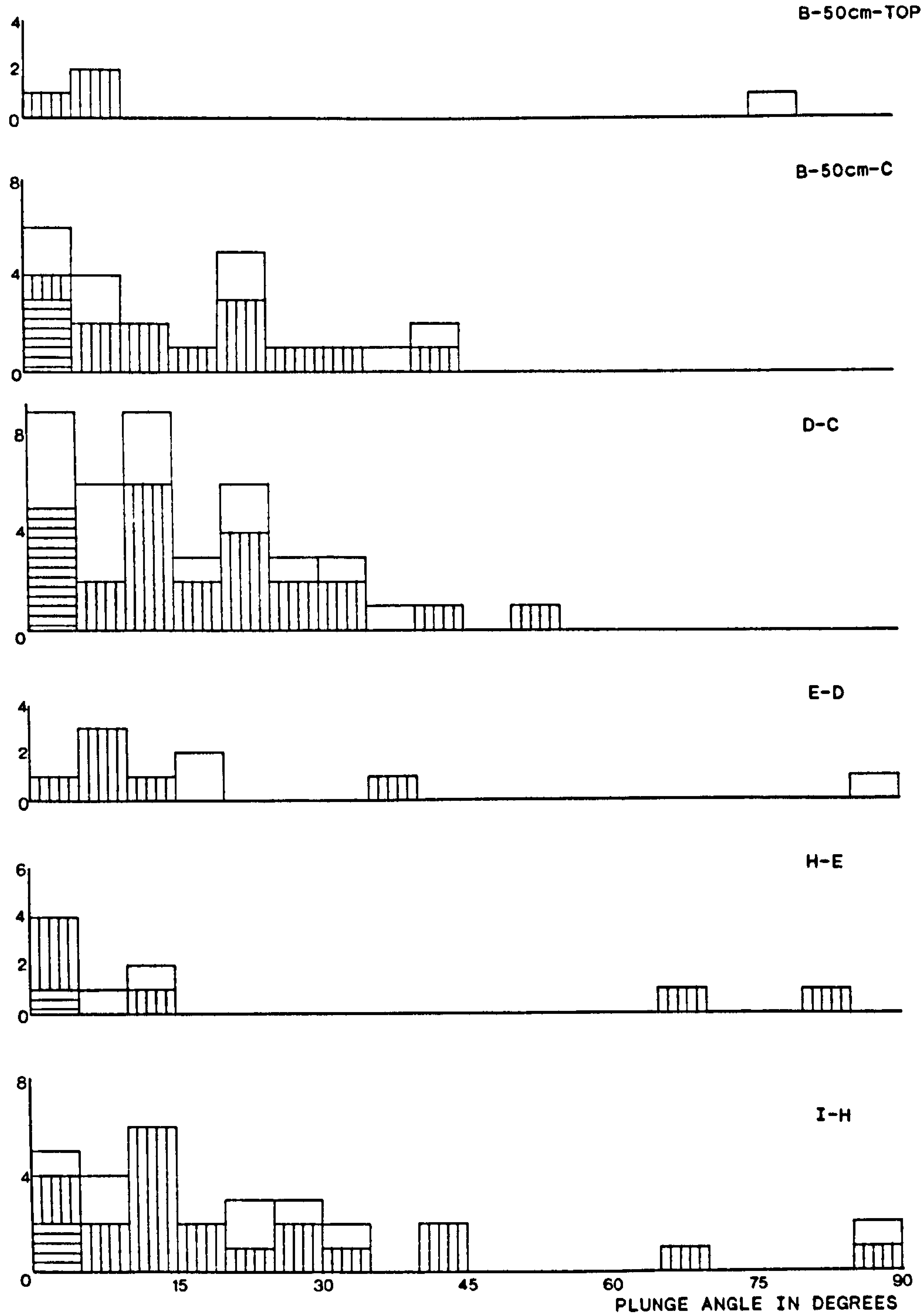


FIGURE 5.17 Plunge angles of belemnites measured between flint band I and the top of the section at Keswick. Ornamentation: vertical striping = point end of guard downwards, blank = point end of guard upwards, horizontal striping = horizontal guard.

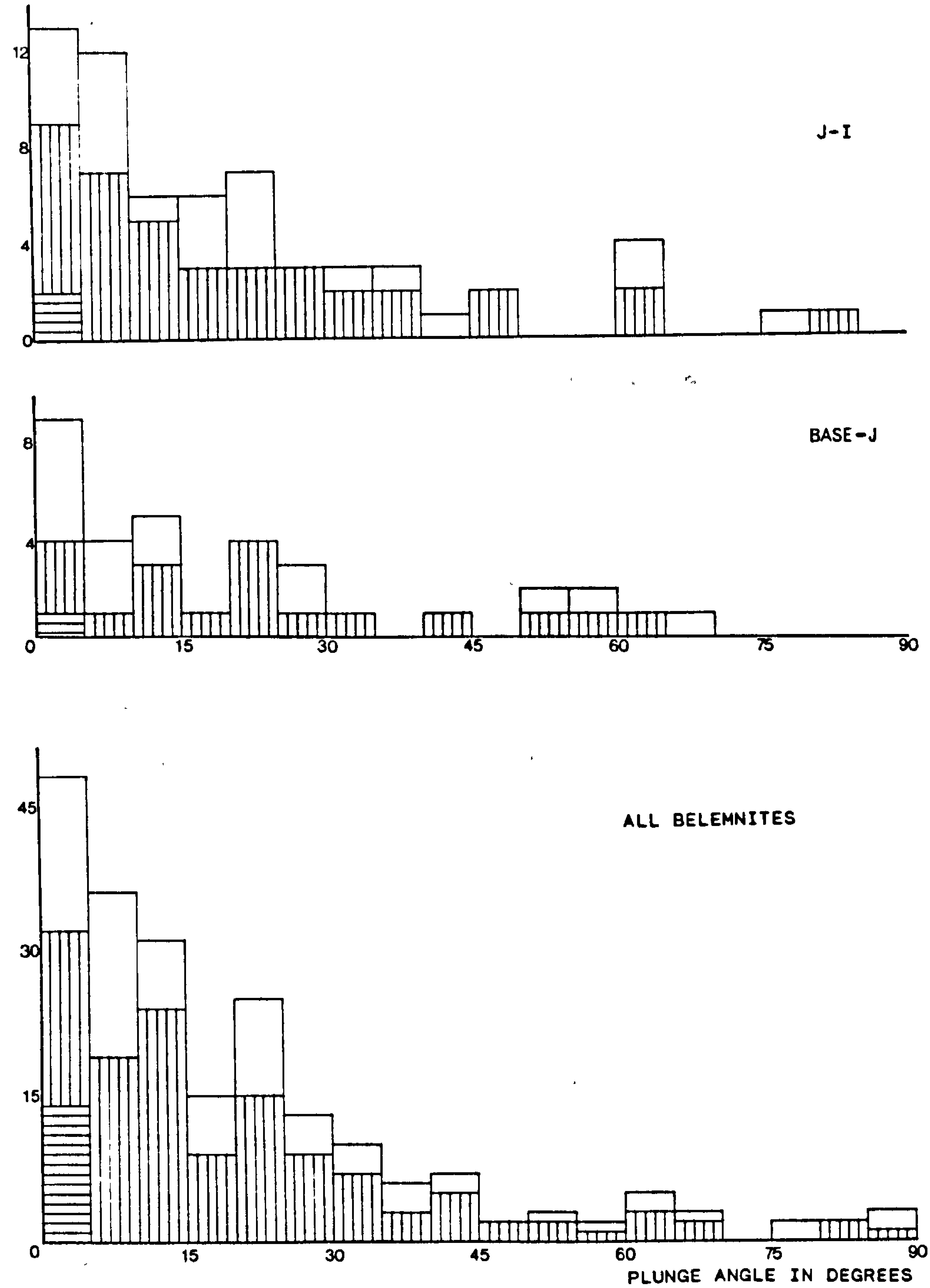


FIGURE 5.18 Plunge angles of belemnites measured between the base of the section and flint band I and of all 213 measured guards from Keswick. Ornamentation: vertical striping = point end of guard downwards, blank = point end of guard upwards, horizontal striping = horizontal guard.

FB	NUMBER MEASURED	AVERAGE PLUNGE (DEGREES)
B-50cm-TOP	4	23.8
B-50cm-C	23	16.3
D-C	42	15.9
E-D	9	21.9
H-E	9	21.1
I-H	30	23.0
J-I	62	20.9
BASE-J	34	21.4
AVERAGE	213	19.9

TABLE 5.10 Average plunge angles of belemnites measured from the section at Keswick. (Abbreviations as in Table 5.6.)

5.3.4 EATON TUNNELS

Because only nine belemnites were collected from Eaton no worthwhile boring or epifaunal distribution data were obtained, and only the orientation information, from thirty seven measured guards, was considered.

5.3.4.1 Belemnite Orientations (Figure 5.19)

The population of 37 belemnites, mostly from the small faces above the tunnel mouths, showed no preferred orientations.

5.3.4.2 Plunge Angles (Figure 5.20)

Only two (5.4%) of the measured specimens had plunge angles in excess of 45 degrees, the average value being 17.4 degrees (Table 5.11). Proportions with particular orientations were point downwards 17

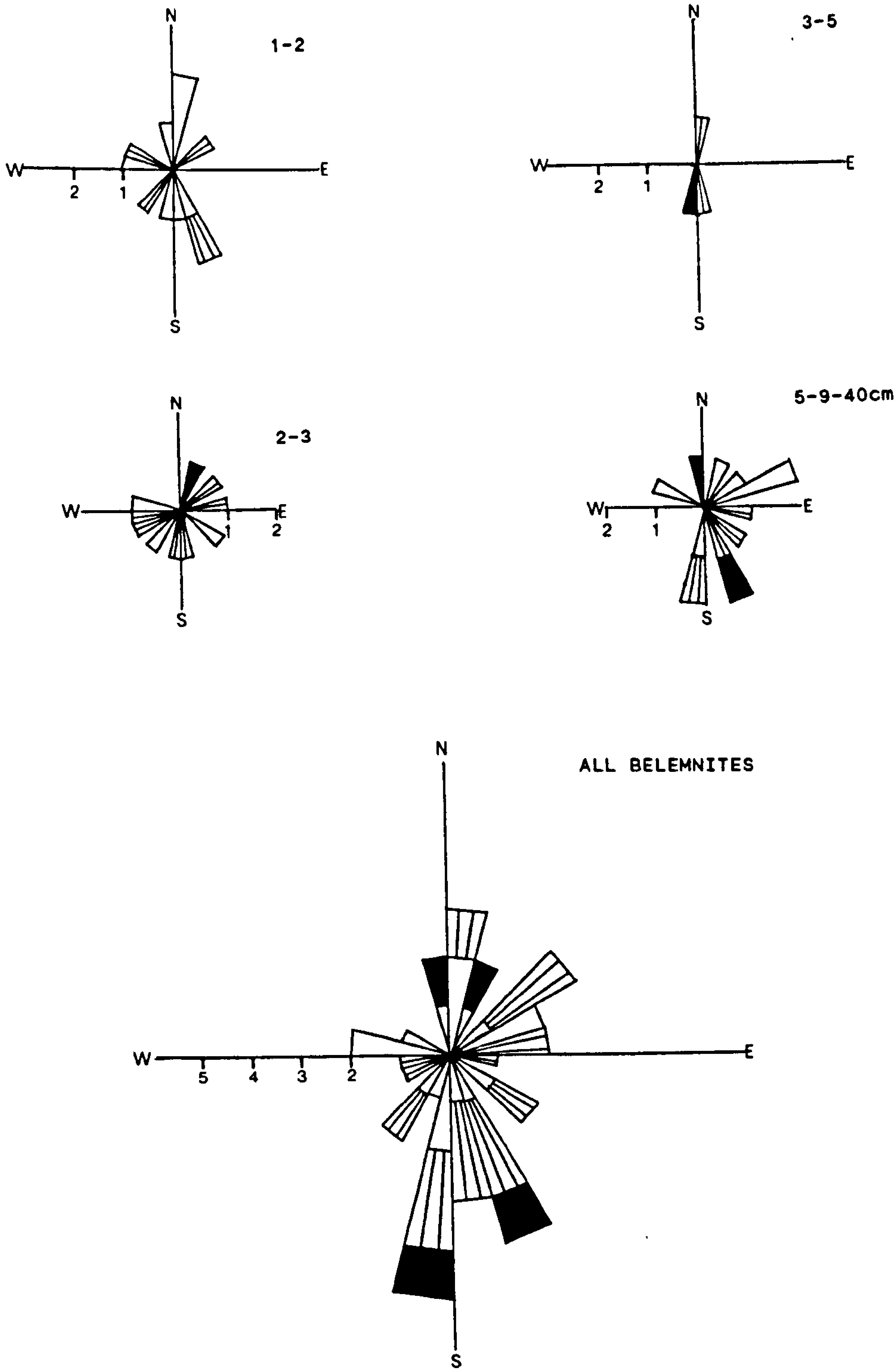


FIGURE 5.19 Orientations of belemnites measured at Eaton Tunnels. Ornamentation: striped = point end of guard upwards, blank = point end of guard downwards, solid = horizontal guard.

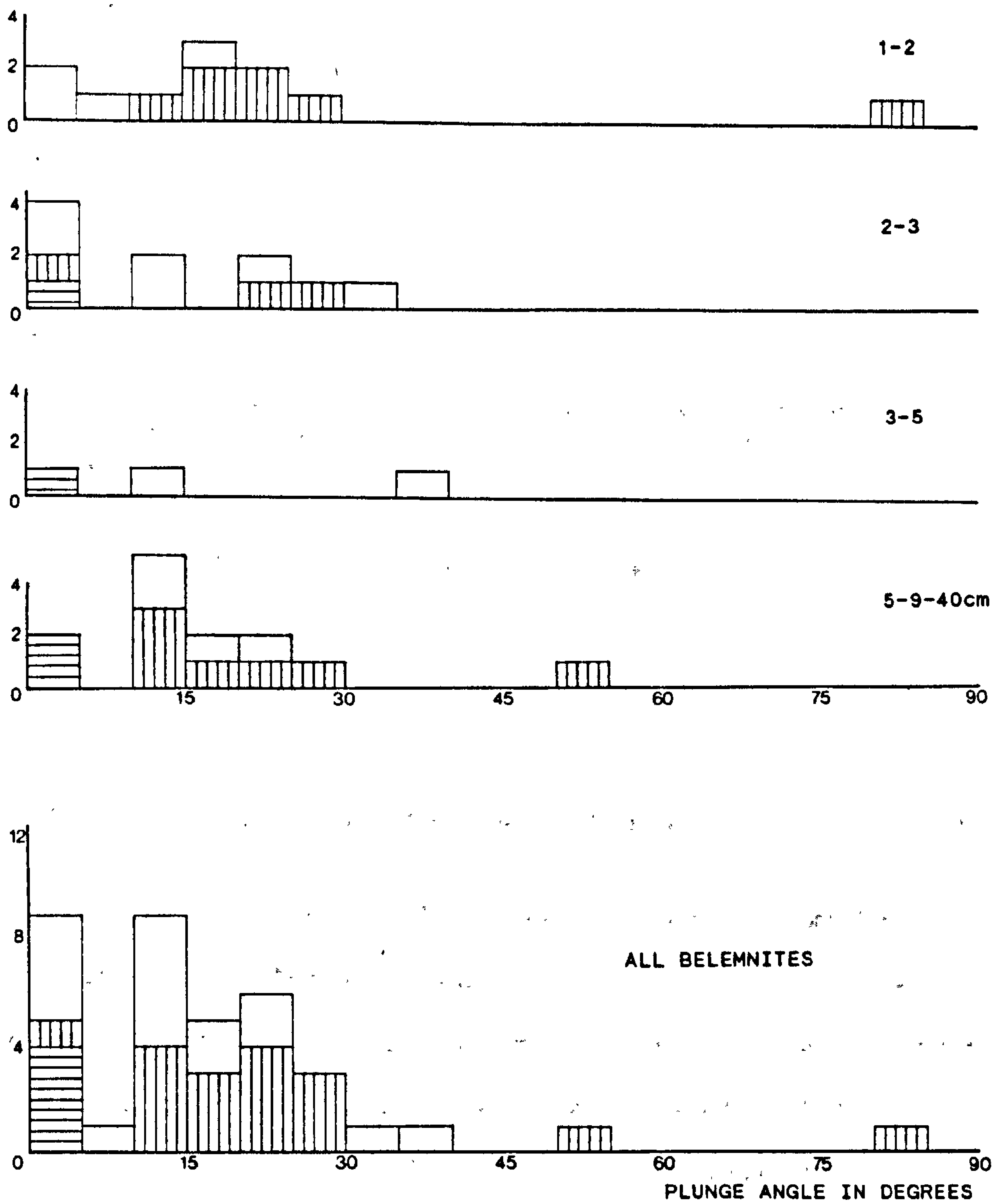


FIGURE 5.20 Plunge angles of belemnites measured at Eaton Tunnels. Ornamentation: vertical striping = point end of guard downwards, blank = point end of guard upwards, horizontal striping = horizontal guard.

(46.0%), point upwards 16 (43.2%), horizontal 4 (10.8%).

FB	NUMBER MEASURED	AVERAGE PLUNGE (DEGREES)
1-2	11	21.1
2-3	10	13.8
3-5	3	16.7
5-9-40cm	13	17.1
AVERAGE	37	17.4

TABLE 5.11 Average plunge angles of belemnites measured from the section at Eaton Tunnels. (See Figure 5.1 for flint band notation.)

5.3.5 CAISTOR ST. EDMUND QUARRY

5.3.5.1 Borings

5.3.5.1.1 Records per Quadrant (Figures 5.21 and 5.22)

The distribution of borings in guards from Caistor was found to be largely equivalent to that observed in the Weybourne Chalk, i.e. more borings in the NE and NW quadrants than the SE and SW. The complete plot of all 451 belemnites collected (Figure 5.22) gave the following percentages with at least a single boring: NE 81, SE 71, SW 71 NW 80, average 76%. The overall percentage distributions (Figure 5.22) were:

NE (N. 51.0, F. 25.0, 1. 5.0, 0. 19.0)
SE (N. 39.0, F. 23.0, 1. 9.0, 0. 29.0)
SW (N. 41.0, F. 20.0, 1. 10.0, 0. 29.0)
NW (N. 52.0, F. 23.0, 1. 5.0, 0. 20.0).

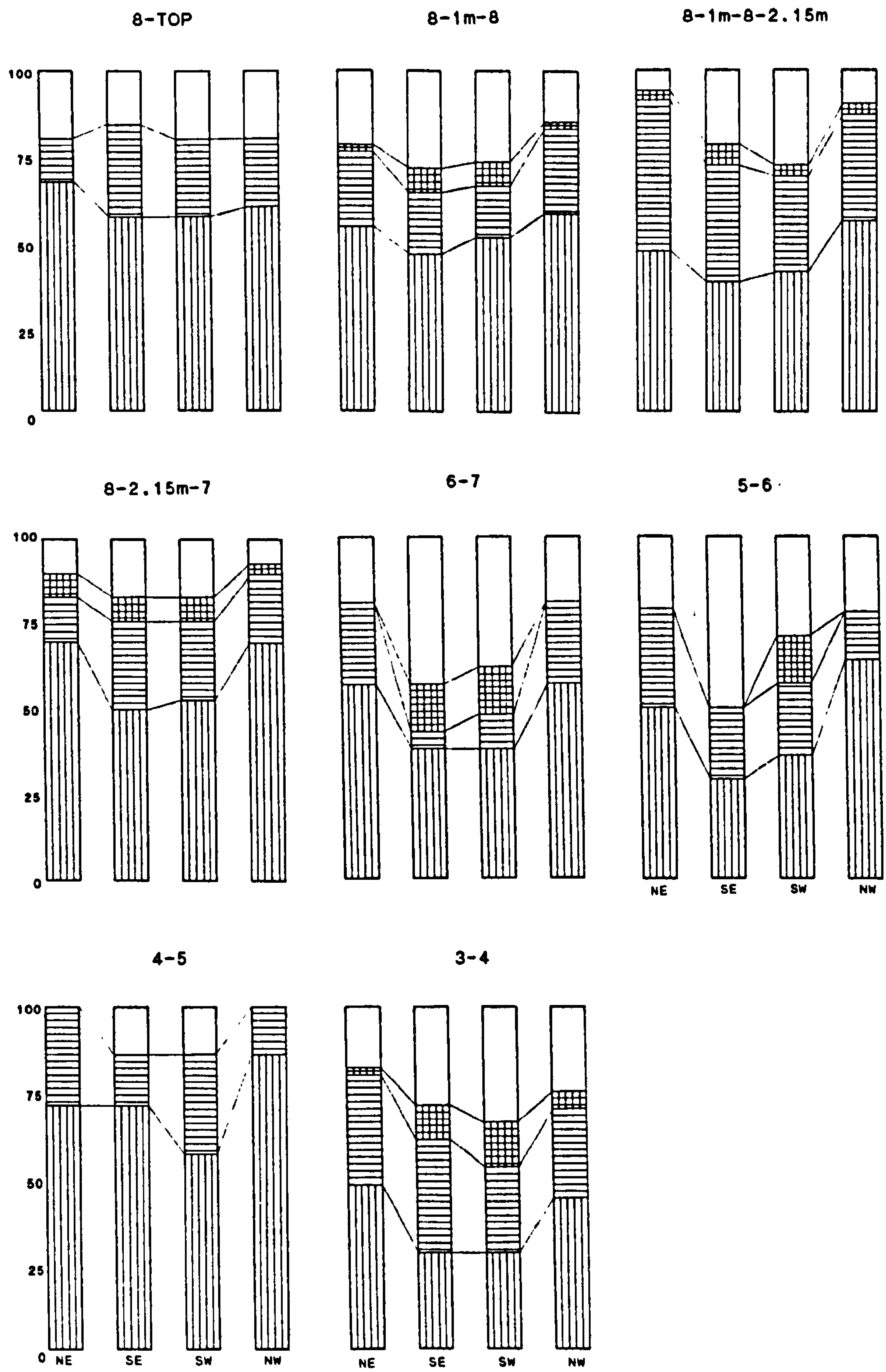


FIGURE 5.21 Percentages of belemnites collected between flint band 3 and the top of the section at Caistor St. Edmund with numerous (>10) (vertical striping), few (2-9) (horizontal striping), one (cross-hatching), and zero (blank) borings in their NE, SE, SW, and NW quadrants, respectively. Numbers on left side are percentages, letters at base of figures indicate specific quadrants.

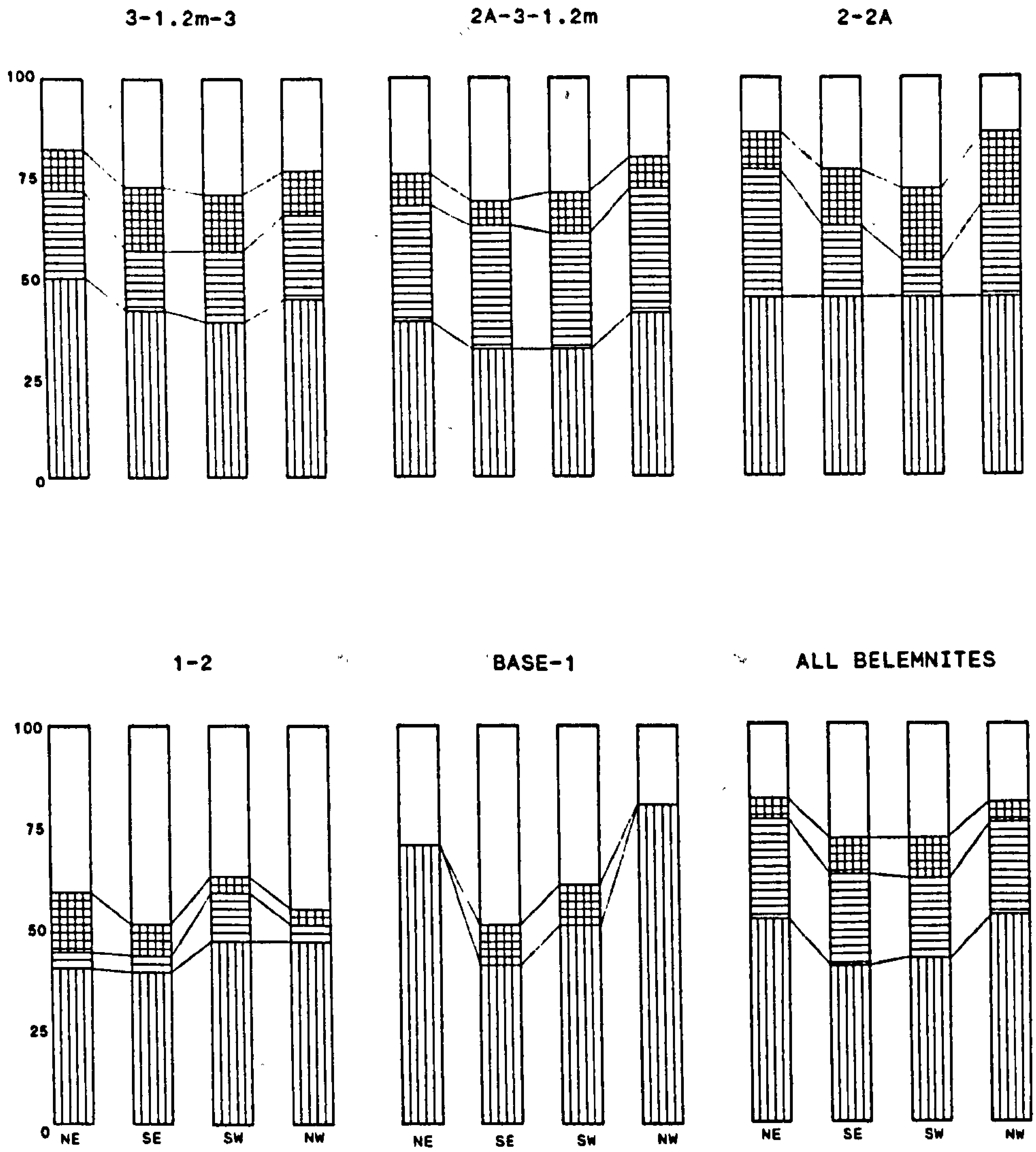


FIGURE 5.22 Percentages of belemnites collected between the base of the section and flint band 3 and of the complete population of 451 belemnites from Caistor St. Edmund with numerous (>10) (vertical striping), few (2-9) (horizontal striping), one (cross-hatching), and zero (blank) borings in their NE, SE, SW, and NW quadrants, respectively. Numbers on left side are percentages, letters at base of figures indicate specific quadrants.

5.3.5.1.2 Overall Distribution Patterns

Without exception, the highest proportion of belemnites (40.0-85.7%) collected from all levels of the quarry had group 1 characteristics (Table 5.12). The only other groups with considerable contents were 5 (0.0-30.0%), and 10 (0.0-26.9%). Of the whole population, 272 (60.3%) had group 1 distribution characteristics, 49 (10.9%) group 5, and 47 (10.1%) group 10.

	PERCENTAGE OF BELEMNITES IN EACH GROUP										
FB	1	2	3	4	5	6	7	8	9	10	N
8-TOP	70.0	3.3	0	6.7	3.3	3.3	0	3.3	3.3	6.7	30
8-1m-8	54.6	10.9	5.4	3.6	12.7	1.8	0	3.6	0	7.3	55
8-1m-8-2.15m	65.6	6.3	3.1	3.1	18.8	0	0	0	0	3.1	32
8-2.15m-7	76.7	3.3	3.3	3.3	6.7	0	0	3.3	0	3.3	30
6-7	57.1	0	4.8	0	19.0	0	0	0	0	19.0	21
5-6	42.9	21.4	14.3	7.1	0	0	0	0	0	14.3	14
4-5	85.7	0	0	0	14.3	0	0	0	0	0	7
3-4	60.2	1.1	2.2	4.3	11.8	1.1	1.1	2.2	4.3	11.8	93
3-1.2m-3	61.3	1.6	3.2	4.8	11.3	3.2	0	1.6	3.2	9.7	62
2A-3-1.2m	59.2	2.0	2.0	6.1	8.2	2.0	4.1	4.1	2.0	10.2	49
2-2A	68.2	4.5	4.5	0	9.1	0	0	0	0	13.7	22
1-2	42.3	3.8	0	15.4	0	0	0	7.7	3.9	26.9	26
BASE-1	40.0	0	0	10.0	30.0	10.0	0	0	0	10.0	10
AVERAGE	60.3	3.3	3.3	5.1	10.9	1.6	0.7	2.4	2.0	10.4	451

TABLE 5.12 Percentages of belemnites collected between specific flint bands at Caistor St. Edmund with boring traces falling into groups 1-10. AVERAGE is for all 451 belemnites. Flint bands as in Figure 1.15.

The majority of belemnites (60.0-86.7%) from all levels of the quarry were assigned to category A (Table 5.13), with fairly equal percentages in B (6.7-30.0) and C (0.0-26.9). Of the complete population, 344

(76.3%), 60 (13.3%), and 47 (10.1%) belemnites respectively, were found to fit into categories A, B, and C.

PERCENTAGE OF BELEMNITES IN EACH CATEGORY

FB	A	B	C	N
8-TOP	86.7	6.7	6.7	30
8-1m-8	76.4	16.4	7.2	55
8-1m-8-2.15m	78.1	18.8	3.1	32
8-2.15m-7	86.7	10.0	3.3	30
6-7	61.9	19.0	19.0	21
5-6	78.6	7.1	14.3	14
4-5	85.7	14.3	0	7
3-4	74.2	14.0	11.8	93
3-1.2m-3	77.4	12.9	9.7	62
2A-3-1.2m	77.6	12.2	10.2	49
2-2A	77.3	9.1	13.6	22
1-2	65.4	7.7	26.9	26
BASE-1	60.0	30.0	10.0	10
AVERAGE	76.3	13.3	10.4	451

TABLE 5.13 Percentages of belemnites collected between specific flint bands at Caistor St. Edmund with boring traces in categories A, B, and C. Flint bands as in Figure 1.15.

5.3.5.2 Epifauna

5.3.5.2.1 Records per Quadrant (Figures 5.23 and 5.24)

The distribution of the epifaunal remains was very like that discovered at other localities. Again the percentage of quadrants with epifauna was much lower than those with borings. The average percentages with at least one epifaunal specimen in a quadrant for the complete population were NE 22.5, SE 19, SW 17, NW 26. The total plot of all 451 belemnites (Figure 5.24) gave the following overall percentage distributions:

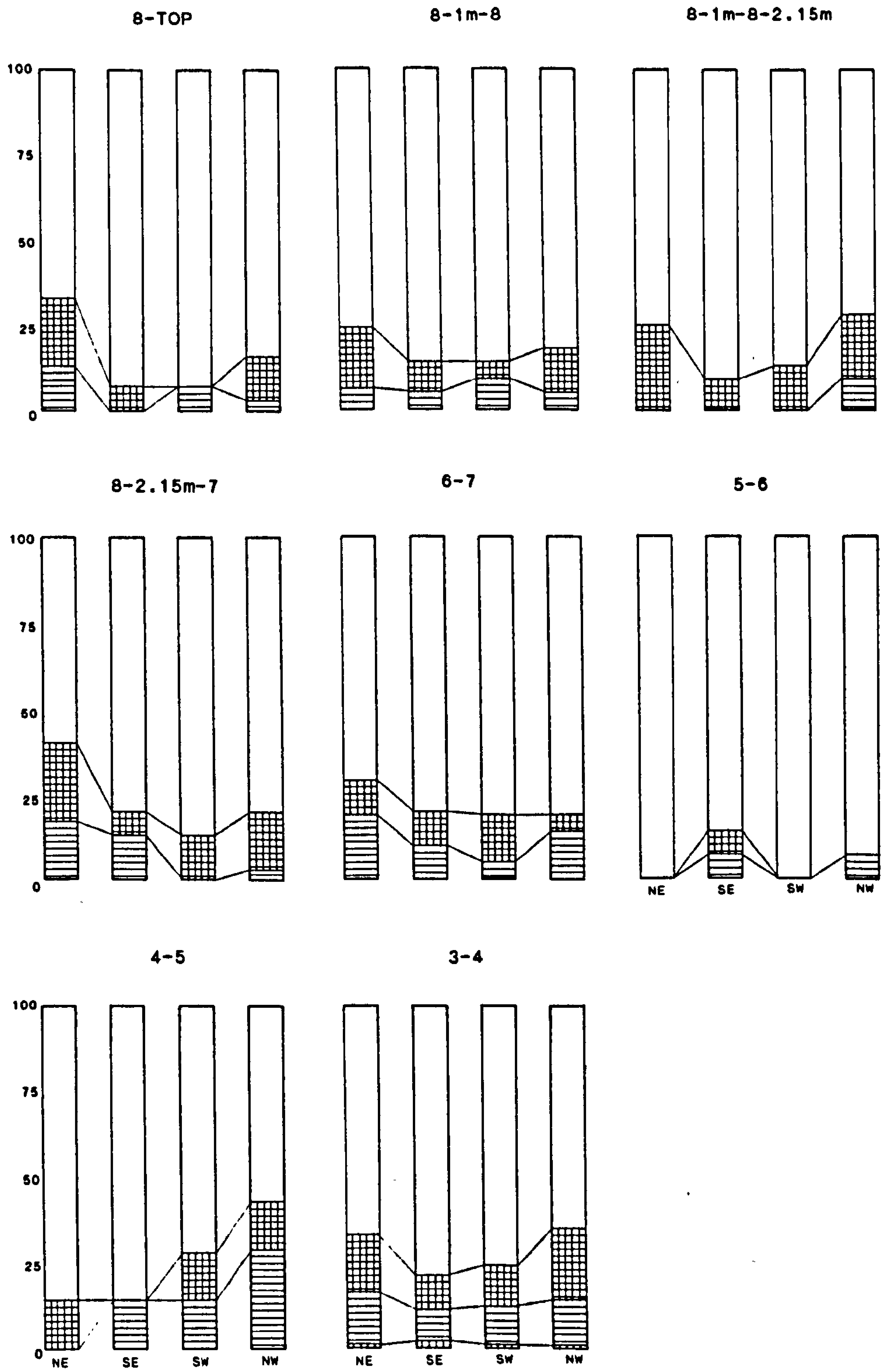


FIGURE 5.23 Percentages of belemnites collected between flint band 3 and the top of the section at Caistor St. Edmund with numerous (>10) (vertical striping), few (2-9) (horizontal striping), one (cross-hatching), and zero (blank) epifaunal remains in their NE, SE, SW, and NW quadrants, respectively. Numbers on left side are percentages, letters at base of figures indicate specific quadrants.

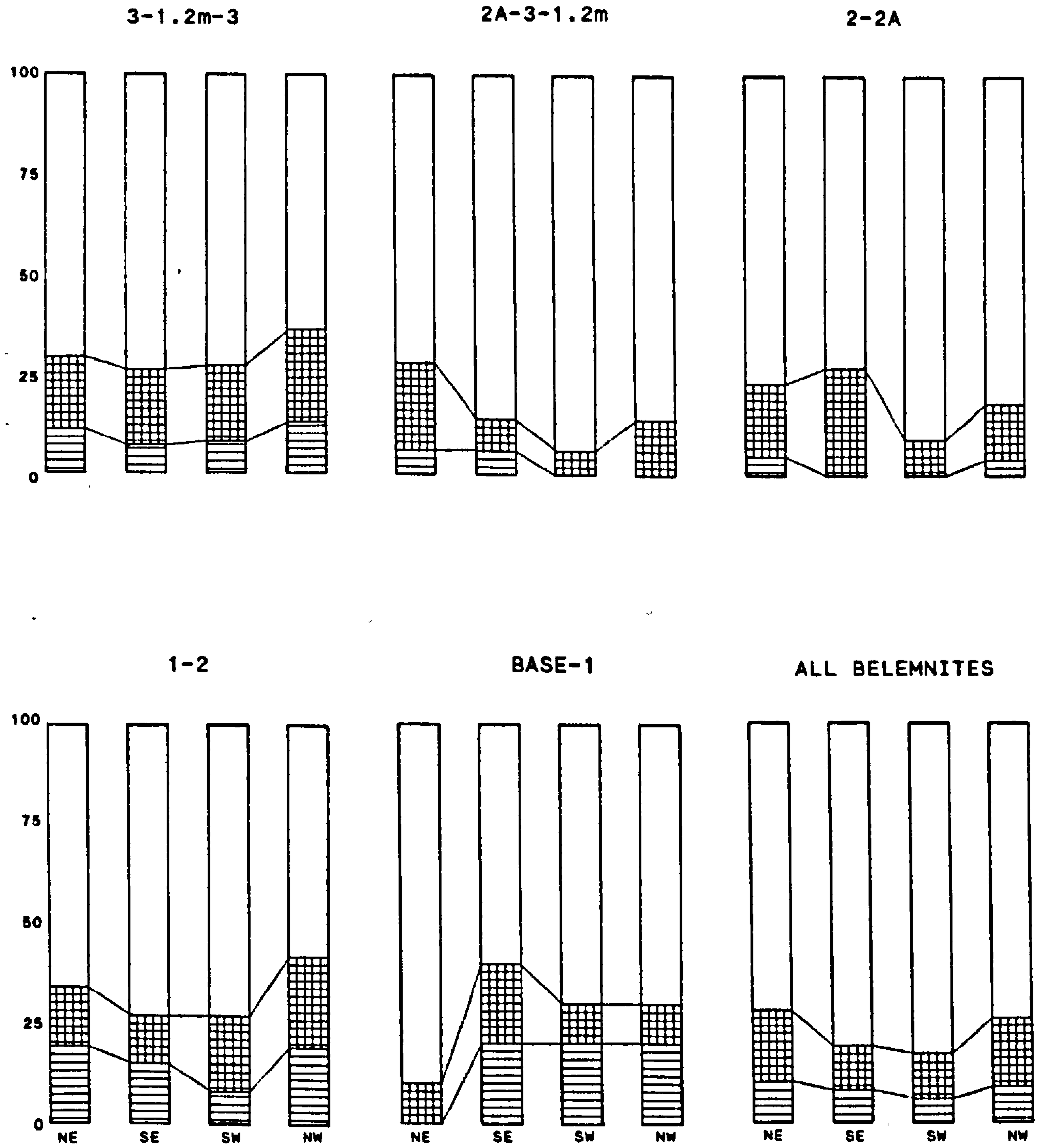


FIGURE 5.24 Percentages of belemnites collected between the base of the section and flint band 3 and of the complete population of 451 belemnites from Caistor St. Edmund with numerous (>10) (vertical striping), few (2-9) (horizontal striping), one (cross-hatching), and zero (blank) epifaunal remains in their NE, SE, SW, and NW quadrants, respectively. Numbers on left side are percentages, letters at base of figures indicate specific quadrants.

NE (N. 0.2, F. 10.0, 1. 18.0, 0. 71.8)
SE (N. 0.4, F. 8.0, 1. 11.0, 0. 80.6)
SW (N. 0.2, F. 6.0, 1. 11.0, 0. 82.8)
NW (N. 0.2, F. 9.0, 1. 17.0, 0. 73.8).

5.3.5.2.2 Overall Distribution Patterns

Of the belemnites, 192 (42.6%) had no epifauna and were assigned to group 10 (Table 5.14), with 88 (19.5%) in group 8, and 54 (12.0%) in group 9. The subgroups (except that between flints 4 and 5 of which 21.5% occurred in group 1) showed similar distributions with the largest proportions of belemnites recorded in groups 10 (29.0-78.6%), 8 (10.0-32.7%), and 9 (6.3-20.0%).

	PERCENTAGE OF BELEMNITES IN EACH GROUP										
FB	1	2	3	4	5	6	7	8	9	10	N
8-TOP	0	0	0	3.3	10.0	0	3.3	23.3	6.7	53.3	30
8-1m-8	1.8	1.8	3.6	1.8	5.5	0	1.8	14.6	12.7	58.4	55
8-1m-8-2.15m	3.1	0	3.1	3.1	3.1	0	3.1	28.1	6.3	50.0	32
8-2.15m-7	3.3	0	6.7	10.0	3.3	0	0	26.7	10.0	40.0	30
6-7	4.8	4.8	0	4.8	4.8	0	0	19.0	14.3	47.6	21
5-6	0	0	0	0	0	0	0	7.1	14.3	78.6	14
4-5	0	0	0	14.3	0	0	0	42.8	28.6	14.3	7
3-4	21.5	3.2	4.3	7.5	11.8	0	1.1	11.8	9.7	29.0	93
3-1.2m-3	8.1	1.6	4.8	4.8	3.2	4.8	1.6	24.2	12.9	33.9	62
2A-3-1.2m	2.0	0	0	2.0	2.0	0	0	32.7	14.3	47.0	49
2-2A	4.5	0	0	4.5	4.5	4.5	0	18.2	13.7	50.0	22
1-2	3.9	0	11.5	11.5	15.4	3.9	0	3.8	15.4	34.6	26
BASE-1	0	20.0	0	10.0	0	0	0	10.0	20.0	40.0	10
AVERAGE	7.1	1.8	3.3	5.3	6.2	1.1	1.1	19.5	12.0	42.6	451

TABLE 5.14 Percentages of belemnites collected between specific flint bands at Caistor St. Edmund with epifauna falling into groups 1-10. Flint bands as in Figure 1.15.

The percentages of belemnites in the three general distribution categories varied throughout the section

(Table 5.15) and ranged between 13.3 and 50.0 in A, 7.1 and 42.9 in B, and 14.2 and 78.6 in C. The overall average values were A 31.7%, B 25.7%, C 42.6%.

PERCENTAGE OF BELEMNITES IN EACH CATEGORY

FB	A	B	C	N
8-TOP	13.3	33.3	53.3	30
8-1m-8	23.6	20.0	56.4	55
8-2.15m-8-1m	18.8	31.2	50.0	32
8-2.15m-7	30.0	30.0	40.0	30
6-7	28.6	23.8	47.6	21
5-6	14.3	7.1	78.6	14
4-5	42.9	42.9	14.2	7
3-4	47.3	23.7	29.0	93
3-1.2m-3	38.7	27.4	33.9	62
2A-3-1.2m	18.4	34.7	46.9	49
2-2A	27.3	22.7	50.0	22
1-2	46.2	19.2	34.6	26
BASE-1	50.0	10.0	40.0	10
AVERAGE	31.7	25.7	42.6	451

TABLE 5.15 Percentages of belemnites collected between specific flint bands at Caistor St. Edmund with epifauna in categories A, B, and C. Flint bands as in Figure 1.15.

5.3.5.3 Belemnite Orientations (Figures 5.25-5.28)

The subgroups from this quarry all showed polymodal orientations, as did the total plot (Figure 5.28) of all 465 measured belemnites, which included fourteen uncollected specimens.

5.3.5.4 Plunge Angles (Figures 5.29-5.32)

In general, the plunge angles showed a similar trend to those from other localities. However, the average angle was somewhat higher, at 24.9 degrees

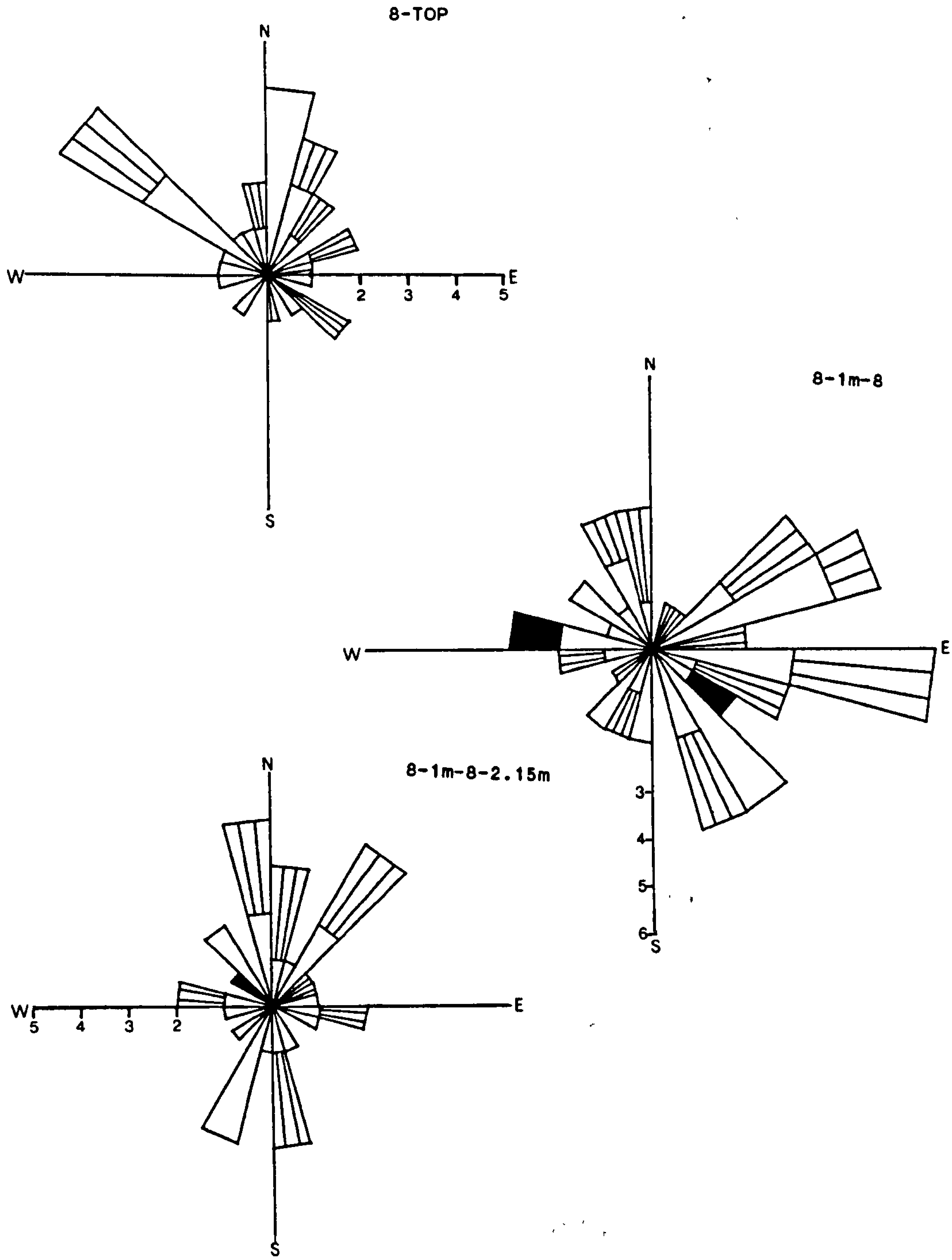
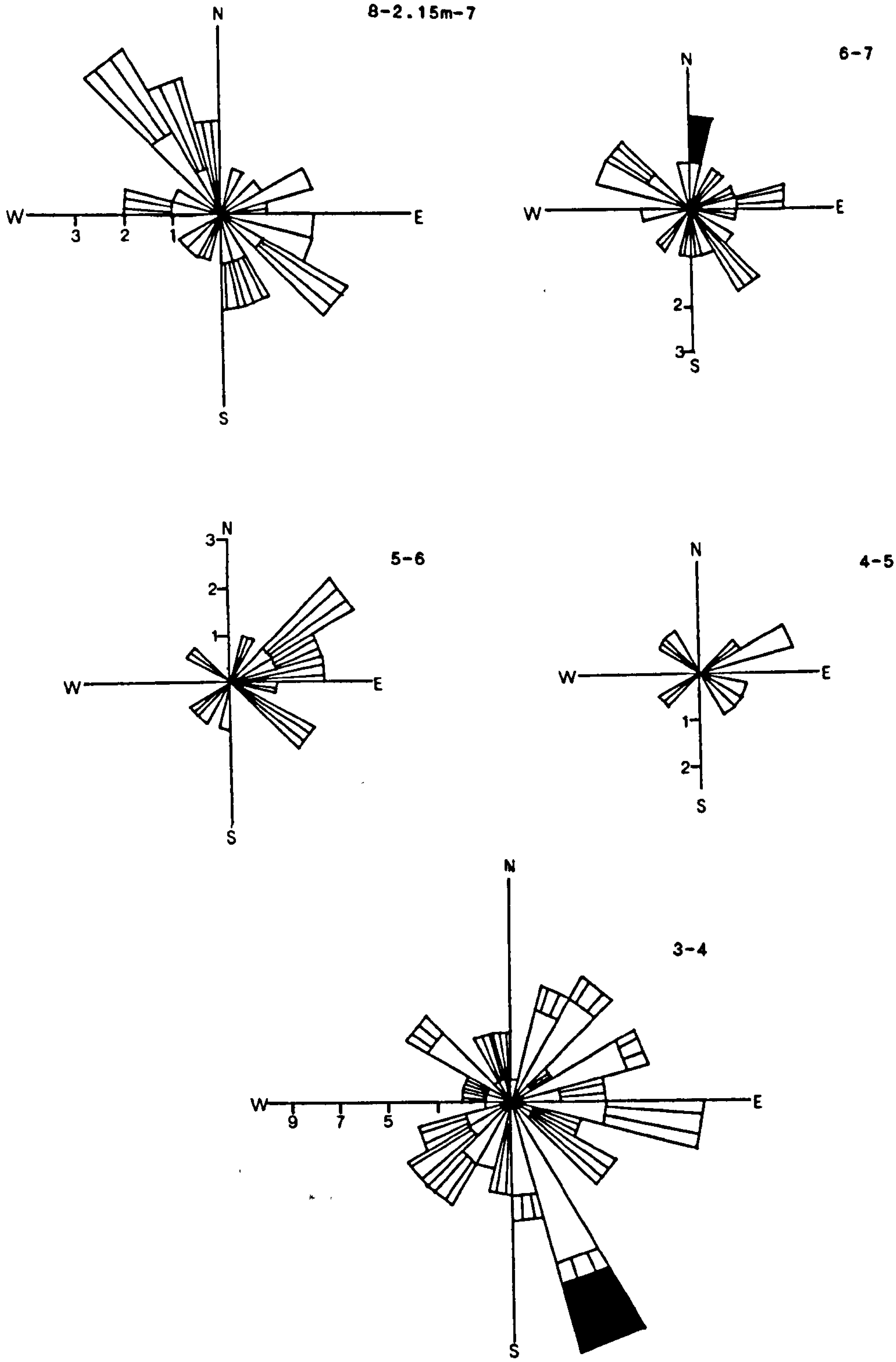


FIGURE 5.25 Orientations of belemnites measured between flint band 8 and the top of the section at Caistor St. Edmund. Ornamentation: striped = point end of guard upwards, blank = point end of guard downwards, solid = horizontal guard.



<u>FIGURE 5.26</u> Orientations of belemnites measured between flint bands 3 and 8 at Caistor St. Edmund. Ornamentation: striped = point end of guard upwards, blank = point end of guard downwards, solid = horizontal guard.

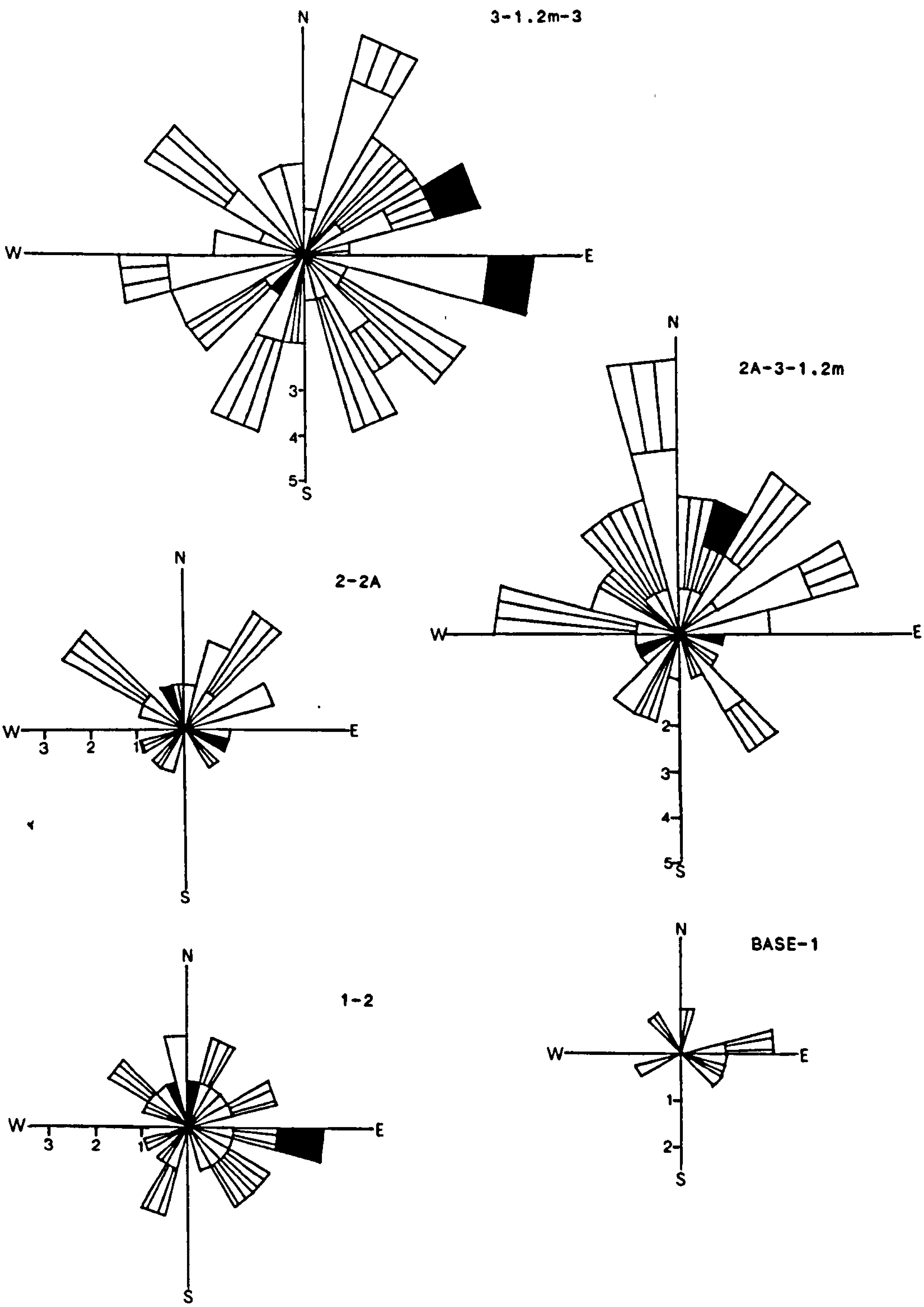


FIGURE 5.27 Orientations of belemnites measured between the base of the section and flint band 3 at Caistor St. Edmund. Ornamentation: striped = point end of guard upwards, blank = point end of guard downwards, solid = horizontal guard.

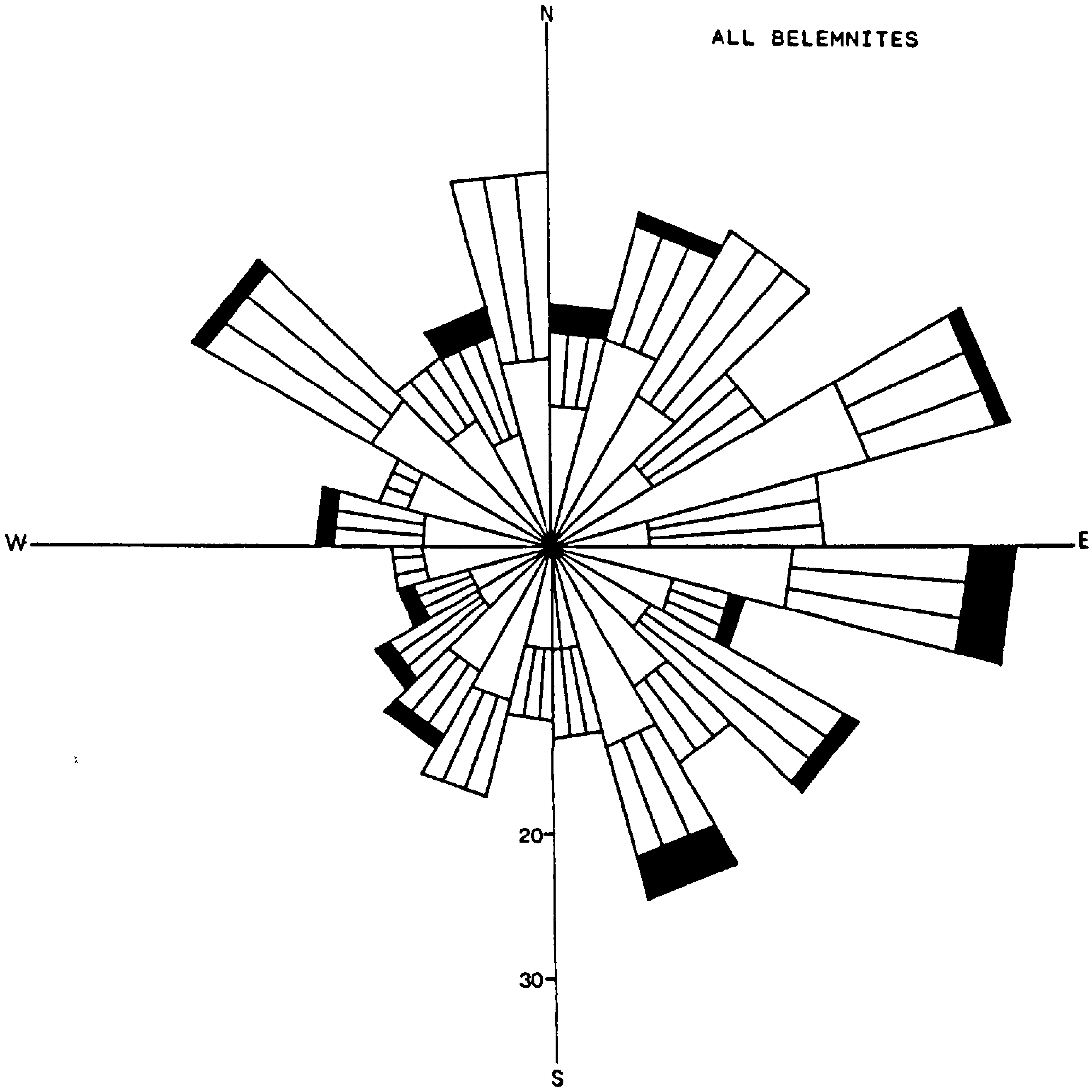


FIGURE 5.28 Orientations of all 465 measured belemnites from Caistor St. Edmund. Ornamentation: striped = point end of guard upwards, blank = point end of guard downwards, solid = horizontal guard.

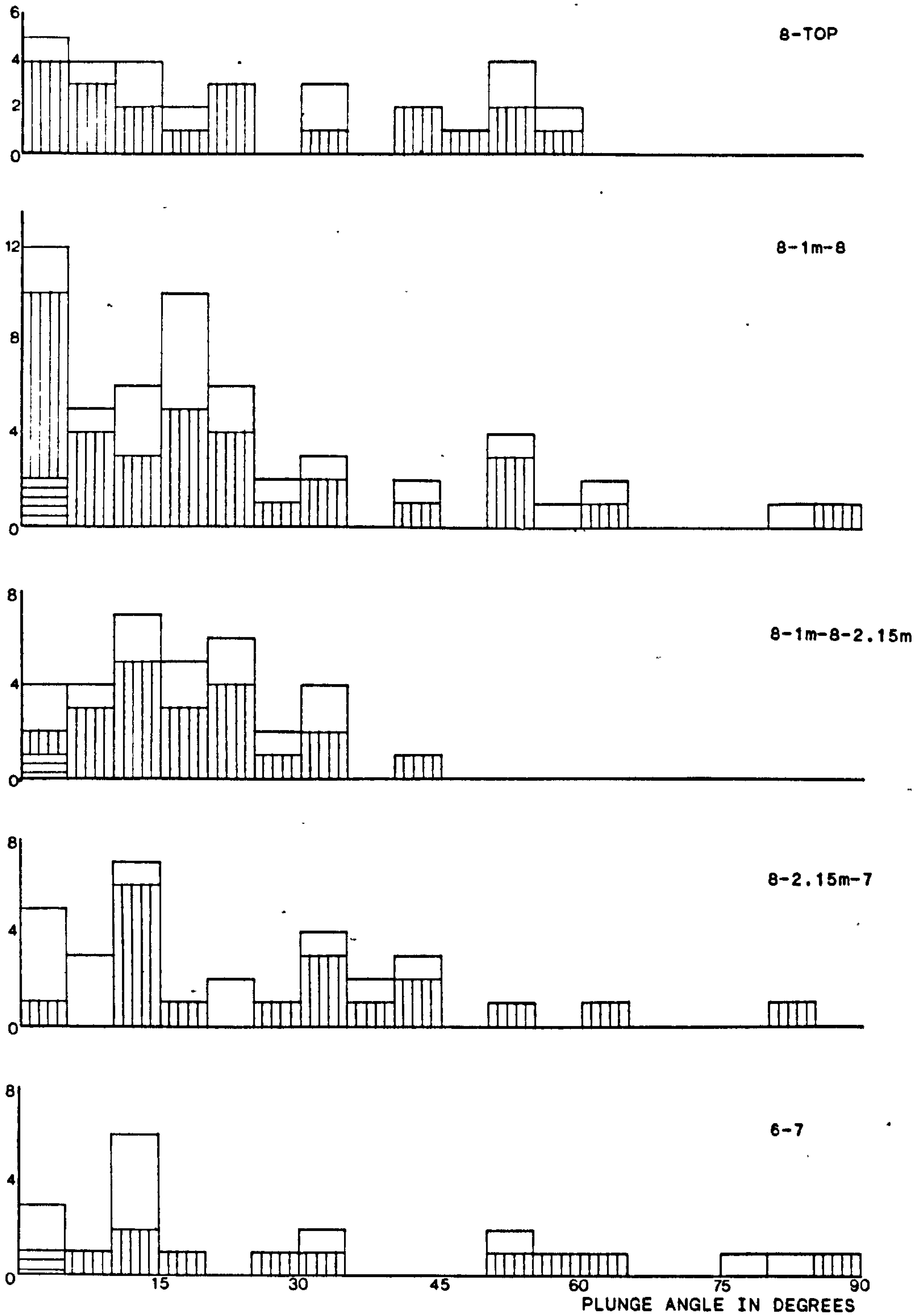


FIGURE 5.29 Plunge angles of belemnites measured between flint band 6 and the top of the section at Caistor St. Edmund. Ornamentation: vertical striping = point end of guard downwards, blank = point end of guard upwards, horizontal striping = horizontal guard.

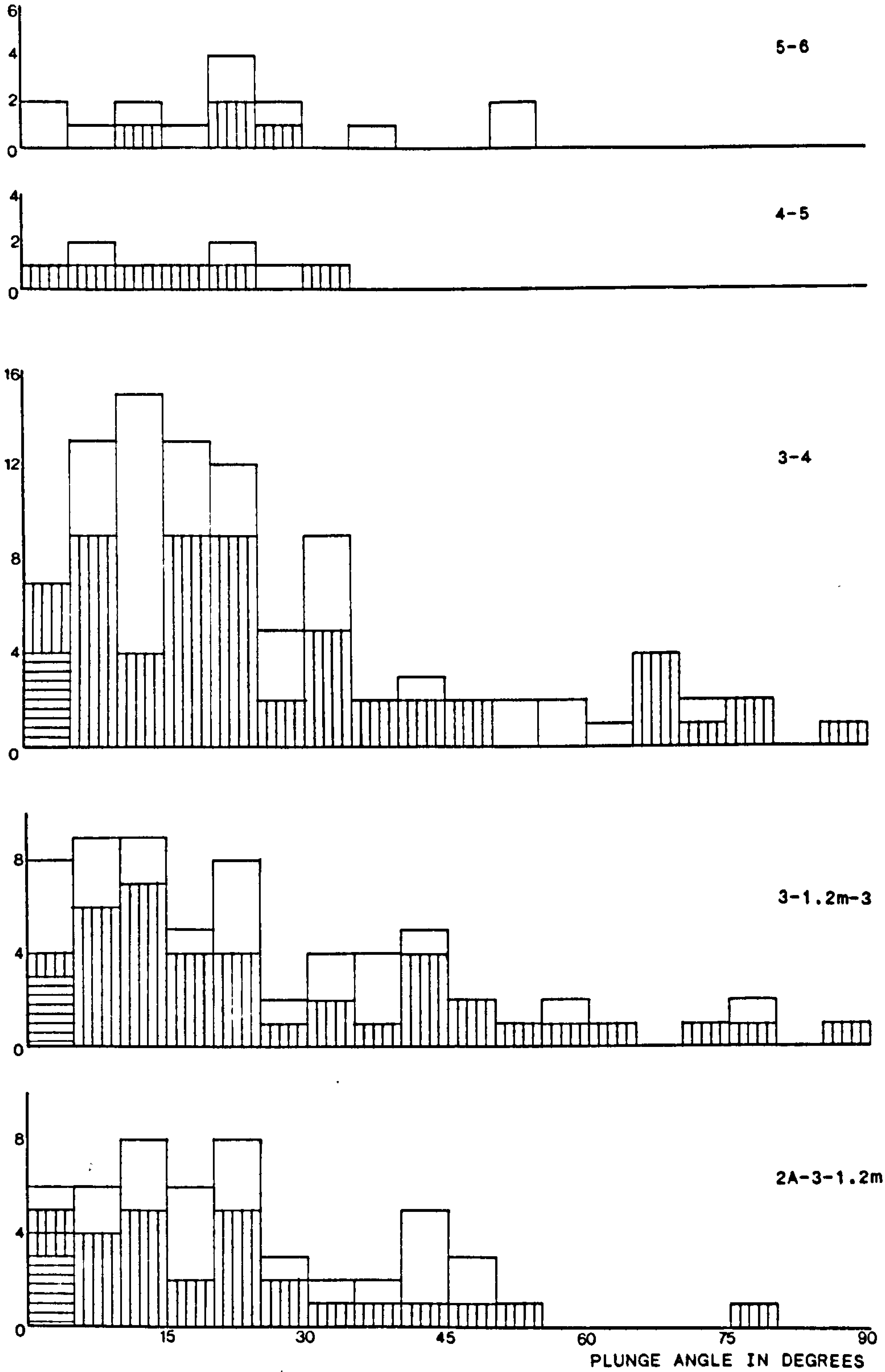


FIGURE 5.30 Plunge angles of belemnites measured between flint bands 2A and 6 at Caistor St. Edmund. Ornamentation: vertical striping = point end of guard downwards, blank = point end of guard upwards, horizontal striping = horizontal guard.

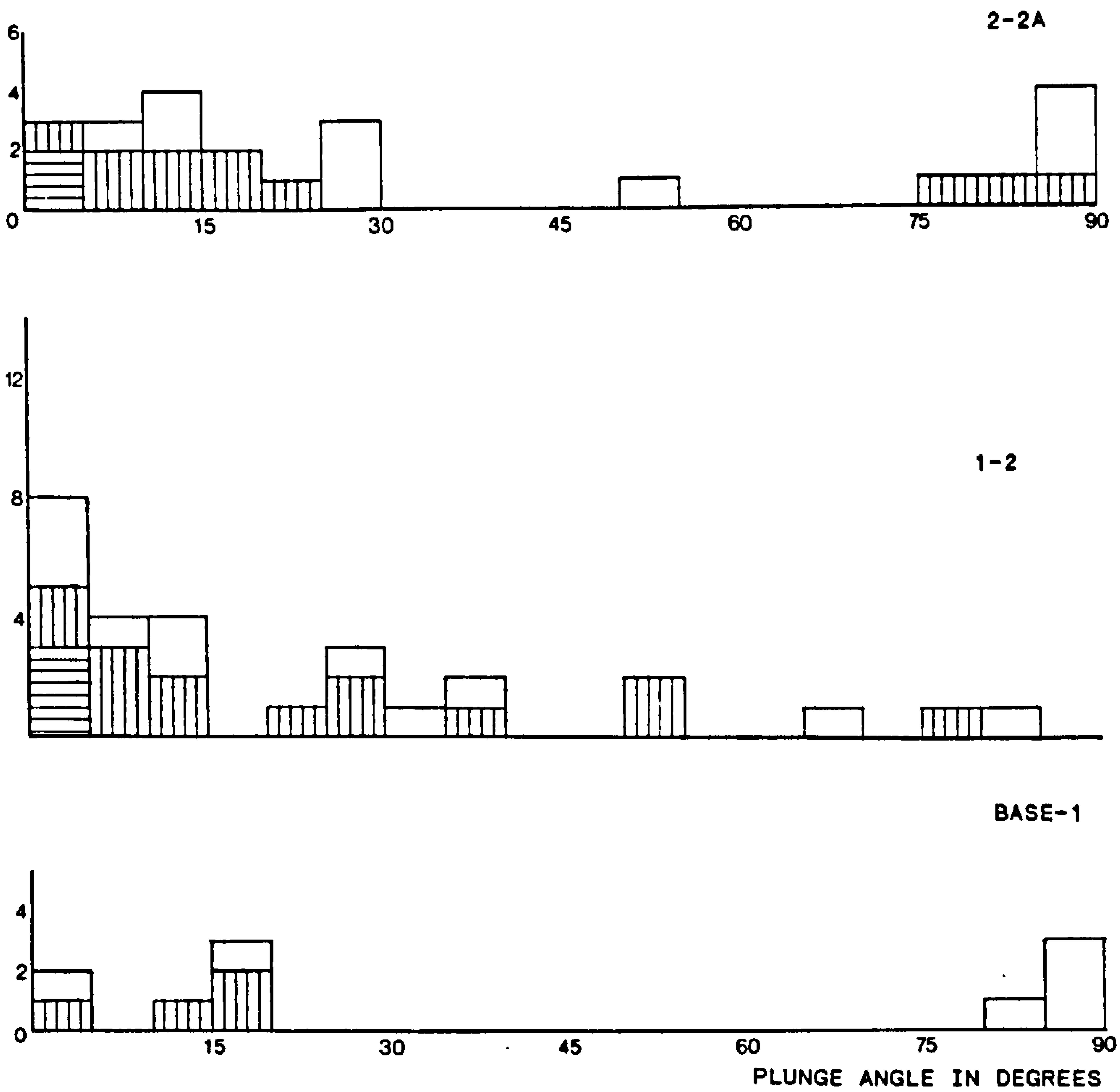


FIGURE 5.31 Plunge angles of belemnites measured between the base of the section and flint band 2A at Caistor St. Edmund. Ornamentation: vertical striping = point end of guard downwards, blank = point end of guard upwards, horizontal striping = horizontal guard.

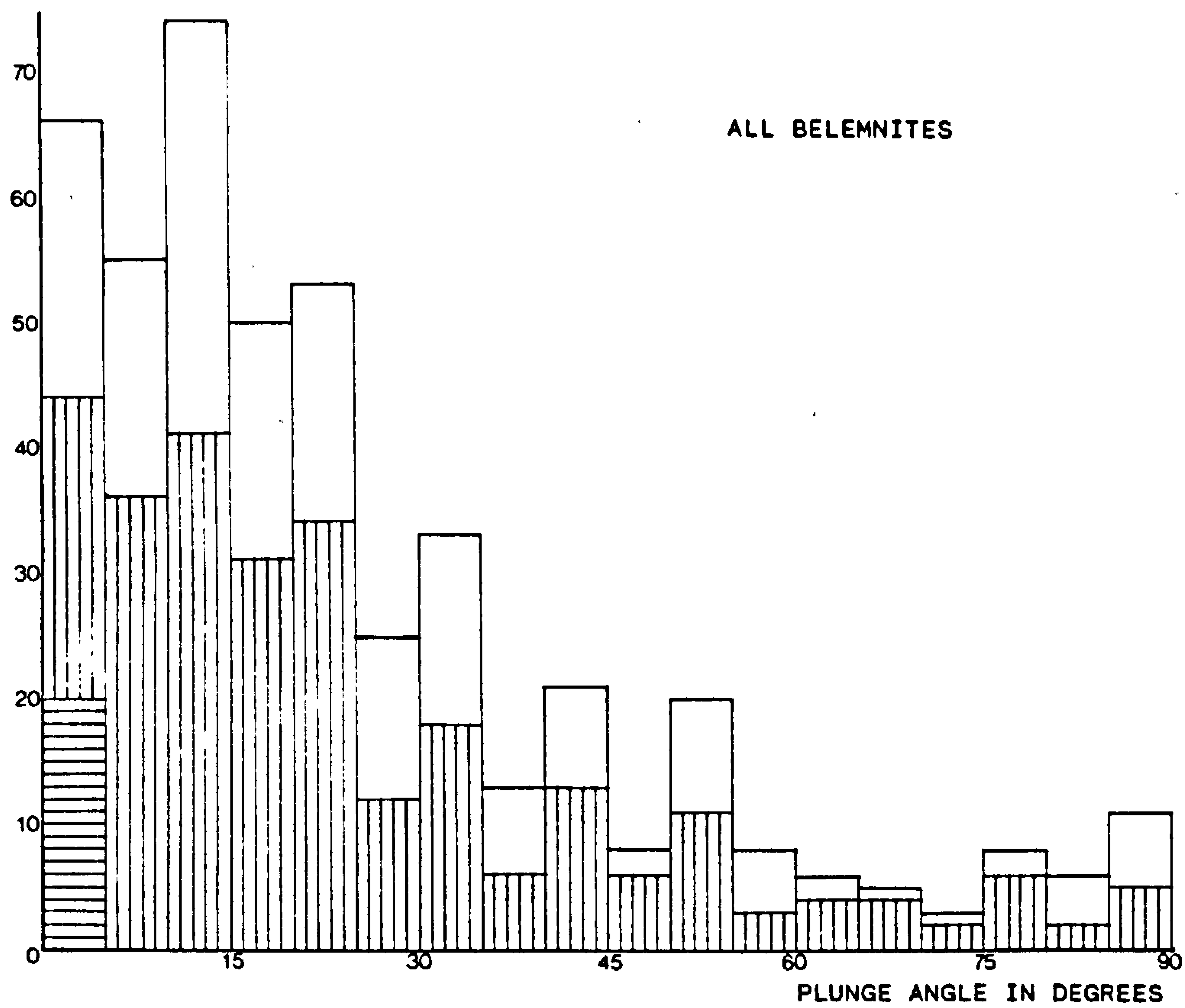


FIGURE 5.32 Plunge angles of all 465 measured belemnites from Caistor St. Edmund. Ornamentation: vertical striping = point end of guard downwards, blank = point end of guard upwards, horizontal striping = horizontal guard.

(Table 5.16) and 75 (16.1%) of belemnites had plunges in excess of 45 degrees, a figure several percentage points above that of the other study groups. The proportions of guards with particular orientations were point downwards 258 (55.5%), point upwards 187 (40.2%), horizontal 20 (4.3%).

FB	NUMBER MEASURED	AVERAGE PLUNGE (DEGREES)
8-TOP	30	25.0
8-1m-8	55	22.7
8-1m-8-2.15m	33	17.4
8-2.15m-7	31	24.0
6-7	21	31.9
5-6	15	22.8
4-5	9	16.9
3-4	95	25.9
3-1.2m-3	64	25.8
2A-3-1.2m	51	22.5
2-2A	23	33.8
1-2	28	22.7
BASE-1	10	41.5
AVERAGE	465	24.9

<u>TABLE 5.16</u> Average plunge angles of belemnites measured from the quarry at Caistor St. Edmund. Flint bands as in Figure 1.15.

5.3.6 BORINGS SUMMARY

The per quadrant and overall distribution patterns of borings in belemnite guards from Weybourne Hope, Keswick, and Caistor St. Edmund were found to be similar. In all three cases, the NE and NW quadrants had been attacked on more occasions than the SE or SW. Average population percentages of specimens exhibiting boring damage were:

Weybourne (Figure 5.3) NE 74.0, SE 47.0, SW 43.0, NW 68.0, average 58.0%,
Keswick (Figure 5.12) NE 47.0, SE 35.0, SW 40.0, NW 45.5, average 42.1%, and
Caistor (Figure 5.22) NE 81.0, SE 71.0, SW 71.0, NW 80.0, average 76.0%.

A higher proportion of belemnites (36.2%) at Keswick were devoid of borings compared with 15.4% at Weybourne, and 10.4% at Caistor. The percentage of belemnites with overall boring distribution falling into the general categories A (borings in SE or SW quadrants), B (borings in NE or NW quadrants only), or C (without borings) showed similar variation. The Weybourne population gave 56.2, 28.4, and 15.4% respectively, Keswick 46.3, 17.5, and 36.2% respectively, and Caistor 76.3, 13.3, and 10.4% respectively.

The average number of borings per specimen calculated by giving values of 10 to each quadrant with N recorded elements, 5 to each with F, and 1 to those with a single record were: Weybourne 16.0, Keswick 10.8, Caistor 23.3, with an overall average of 19.0.

The section at Keswick correlates with the lower part of that at Weybourne. Hence, the considerable difference in the average number of borings per belemnite between them (10.8 at Keswick, 16.0 at

Weybourne) is surprising. Several factors may have caused belemnites from Keswick to have been bored less often than those from Weybourne, including differences in belemnite abundances, sea-floor conditions, and water depths between the two localities.

Belemnites were collected at very similar frequencies from both sections, as were all other major fossil groups (brachiopods, bivalves, echinoids, and bryozoans). That water depths and sea-floor conditions were much the same is indicated by the correlation of the oyster-rich hardgrounds that crop out at Harford Bridges (stratigraphically just above, and only a few hundred metres away from Keswick) with those that occur in the Weybourne section at a level only slightly above the Keswick chalk.

Hence, it appears that no significant differences were present between the conditions at either locality.

A considerable proportion of the belemnites collected from Keswick had suffered from diagenetic silicification which had destroyed any original evidence of shallow boring activity. Of the 160 collected guards, more than 35 had epifaunal remains but were devoid of visible borings. If they are removed from the population the average number of borings per specimen of the remainder rises to 14.0, much closer to the Weybourne figure of 17.1 borings per specimen calculated using the same condition.

This suggests that the lower population average value at Keswick (10.8 borings per guard) compared with that at Weybourne (16.0 borings per guard) is largely due to the relatively poorer preservation state of borings in the belemnites from Keswick compared to those from Weybourne. Some of the Weybourne forms have suffered considerable surface erosion by salt and water, whilst this has, in a few cases, probably destroyed a few of the shallowest borings it appears to have affected guards far less than the silicification of Keswick forms.

The belemnites from Caistor gave a much higher average value of 23.3 borings per specimen, with only 10 (2.2%) having epifauna but no borings. Although partly due to the better preservation of borings in Caistor material compared with that from Weybourne and Keswick, the differences in the average number of borings per specimen are enough to suggest that belemnites in the lower Beeston Chalk (from Caistor) were attacked more often than those in the underlying Weybourne Chalk. Belemnites were, on average, twice as common at Caistor than at Weybourne and Keswick and it appears that the increase in the number of guards available for boring may have caused a proportionally greater increase in the number of organisms responsible for the borings. Another reason may have been that the sedimentation rate at Caistor was lower than that at Weybourne or Keswick, with more belemnites exposed for longer periods.

5.3.7 EPIFAUNAL REMAINS SUMMARY

The records of epifauna per quadrant showed a distribution consistent with that for the borings, but at lower values. The percentages for belemnites with at least one coloniser were:

Weybourne (Figure 5.5) NE 35.0, SE 19.0, SW 24.0, NW 23.0, overall average 26.0%,

Keswick (Figure 5.3) NE 37.0, SE 39.0, SW 33.0, NW 45.0, overall average 38.0%, and

Caistor (Figure 5.24) NE 28.0, SE 19.0, SW 17.0, NW 26.0, overall average 22.5%.

The overall distribution patterns indicated that a higher percentage of belemnites had epifaunal remains at Keswick (73.8) than at Weybourne (61.4) or Caistor (57.4), as did the population averages of epifaunal remains per guard (Keswick 4.2, Weybourne 2.3, Caistor 2.3).

The epifaunal remains gave the opposite distribution to that furnished by the boring data, with Keswick belemnites supporting more epifauna (average 4.2 specimens per guard) than Weybourne and Caistor (both averaging 2.3 per guard). As conditions at Weybourne and Keswick were similar (see above) it might be expected that an equivalent number of epifaunal colonisers would be be found on belemnites from both. The discrepancy can be partly explained, at least, by the relatively greater erosion suffered by the coastally exposed Weybourne guards with consequent destruction of epifauna, compared with the silicified Keswick guards, with shallow borings destroyed but epifauna still remaining on their surfaces.

The average value of 2.3 epifaunal remains per guard from Caistor cannot be explained by the non-preservation of original epifauna because very little erosion, necessary to abrade away remains, was encountered on any fossil material from the faces. It appears that there were fewer colonisers in the lower Beeston Chalk compared to the Weybourne Chalk, possibly due, in part, to a higher number of guards, and other taxa, being available for colonisation, but may be also due to the increased activities of boring organisms at Caistor which may have deterred or prevented epifauna from attaching to the guards.

5.3.8 ORIENTATIONS AND PLUNGE ANGLES

The orientations of the four studied populations (Weybourne, Keswick, Eaton, and Caistor) all showed random (polymodal) distributions (Figures 5.8, 5.16, 5.19, and 5.28), whilst the plunge angles were low, averaging 16.2 degrees from specimens from Weybourne, 19.9 degrees from Keswick specimens, 17.4 degrees from Eaton specimens, and 24.9 degrees from Caistor specimens respectively.

The ecological significance of all the belemnite population data will be discussed in section 5.5.

5.3.9 POPULATION SUMMARY

The average values in this summary are those calculated from all the belemnites recorded from every locality in the *Belemnitella mucronata* Zone.

5.3.9.1 BORINGS

5.3.9.1.1 Records per Quadrant

The 859 belemnites collected from which boring information was obtained gave the following percentage distributions per quadrant:

NE (N. 40.8, F. 25.4, 1. 6.5, O. 27.3)
SE (N. 29.9, F. 19.5, 1. 8.5, O. 41.8)
SW (N. 30.1, F. 18.6, 1. 9.2, O. 42.1)
NW (N. 40.7, F. 24.5, 1. 5.5, O. 29.3).

5.3.9.1.2 Overall Distribution Patterns

The percentages of specimens within each of the groups (1-10) were: 1. 45.5, 2. 3.0, 3. 6.4, 4. 4.5, 5. 12.9, 6. 1.9 7. 0.9, 8. 5.2, 9. 3.3, 10. 16.5, and in the general distribution categories (A, B, C): A. 65.5, B. 18.0, C. 16.5.

5.3.9.2 EPIFAUNA

5.3.9.2.1 Records per Quadrant

The following percentage distributions, per quadrant, were found from the collected belemnites with epifaunal information:

NE (N. 0.3, F. 12.6, 1. 19.1, 0. 68.0)
SE (N. 0.4, F. 9.0, 1. 13.8, 0. 76.8)
SW (N. 0.3, F. 7.5, 1. 15.1, 0. 77.1)
NW (N. 0.3, F. 10.6, 1. 18.5, 0. 70.6).

5.3.9.2.2 Overall Distribution Patterns

The percentages of specimens within each of the groups (1-10) were: 1. 6.8, 2. 3.2, 3. 4.2, 4. 6.6, 5. 5.9, 6. 2.5, 7. 1.9, 8. 19.3, 9. 11.4, 10. 38.1, and in the general distribution categories (A, B, C): A. 36.7, B. 25.2, C. 38.1.

5.3.9.3 PLUNGE ANGLES

The average plunge angle calculated from the 995 belemnites with data was 21.3 degrees. Of these, 549 (55.2%) were point downwards, 393 (39.5%) were point upwards, and 53 (5.3%) were horizontal. Twelve of 65 (6.5%) specimens with measured plunge in excess of 60 degrees were uncollected and so without epifaunal or boring data. Of the remaining 53, 5 (9.5%) had no remains, 4 (7.5%) had borings and/or epifauna on the upper parts of the guards as orientated in the chalk face, whilst the other 44 (83.0%) had epifauna and/or borings on all portions of the guard.

The ecological significance of all the belemnite population data will be discussed in section 5.5.

5.3.10 BELEMNITE BORING IDENTIFICATIONS

Borings were dominated by the stellate shaped Dendrina belemniticola and the ramified Calcideletrix sp. Both were often present together in considerable numbers on collected guards. Of the 185 bored belemnites collected from Weybourne, 151 (81.6%) contained both Calcideletrix sp. and Dendrina belemniticola, as did 56 (43.8%) and 337 (83.0%) from Keswick and Caistor, respectively.

Other, less common borings included the simple, unbranched, tunnel-like ?Nygmites sp. found in 73 (39.5%), 44 (34.4%), and 141 (34.7%) guards from Weybourne, Keswick, and Caistor, and branched forms with numerous circular apertures in each branch, Talpina sp., were identified in 15 (8.1%), 21 (16.4%), and 130 (32.0%) specimens. Only two other types of borings were found in more than a handful of belemnites, Entobia sp. made by sponges (14 (7.6%) of the Weybourne, 10 (7.8%) of the Keswick, and 41 (10.1%) of the Caistor remains) and the slit-like holes produced by barnacles (Rogerella sp.) observed in 8 (4.3%) of the Weybourne, 21 (16.4%) of the Keswick, and 19 (4.7%) of the Caistor guards, respectively. Seven examples (2 from Weybourne, 5 from Caistor) of the characteristic brachiopod pedicle attachment scar (Podichnus sp.) were also noted.

Although not recognised during the identification of borings, small scratches produced by grazing regular echinoids are often very plentiful on guards, particularly around the edges of borings such as ?Nygmites and Talpina (Paul Whittlesea personal communication, April 1989).

In almost all belemnites the initial boring activity seems to have been of a shallow nature with organisms forming small Calcideletrix and Dendrina. Both were usually discrete and apparently formed contemporaneously as it was unusual to find one without the other. Of the 655 belemnites from the study populations with Calcideletrix or Dendrina recorded, 544 (83.1%) contained both. Guards with only Calcideletrix and Dendrina, together, accounted for 41.1% (76) of bored forms at Weybourne, 19.5% (25) at Keswick, and 26.8% (109) at Caistor, respectively (Table 5.17).

BORING GROUP	WH	KS	CS	N
CA	1.6	4.7	1.8	16
DB	5.4	7.8	5.4	42
CA+DB	41.1	19.5	26.8	210
CA+DB+?N	23.8	13.3	18.2	135
CA+DB+TA	2.7	3.9	16.3	76
CA+DB+?N+TA	3.2	0.8	8.1	40
CA+DB+MISC.	10.8	6.3	13.6	83
CA+MISC.	2.2	8.6	2.5	25
DB+MISC.	3.3	6.2	3.4	28
MISC.	5.9	28.9	3.9	64
TOTAL	100.0	100.0	100.0	719

TABLE 5.17 Percentages of bored belemnites with specific borings in their guards from the sections at Weybourne Hope (WH), Keswick (KS), and Caistor St. Edmund (CS). CA = Calcideletrix sp., DB = Dendrina belemniticola, ?N = ?Nygmites sp., TA = Talpina sp., MISC. = Miscellaneous boring remains.

Later, deeper and larger borings of ?Nygmites, Rogerella, and Talpina mostly occurred in guards with early Calcideletrix and Dendrina, often cutting through the earlier forms. Combinations of Calcideletrix + Dendrina + ?Nygmites and Calcideletrix + Dendrina + Talpina were relatively common from Weybourne and Caistor, but less so from Keswick, recorded on 206 (28.7%) and 133 (18.5%) of all collected belemnites, respectively. The last, most destructive borings, Entobia, formed large connected chambers and holes, and on a few occasions destroyed up to half of a guard.

The relative position of barnacle borings, Rogerella, in the sequence is unclear.

The higher proportion of bored belemnites at Keswick (28.1% [36]) with deeper borings only (Entobia, ?Nygmites, Rogerella, Talpina) compared with Weybourne

(5.9% [11]) and Caistor (3.9% [16]) reflects the relative preservation state of material from each locality. The shallow borings have been preferentially destroyed and obscured by silicification at Keswick compared with the larger, deeper forms. Weybourne specimens often had surficial erosion damage which did not affect the deeper borings, whilst the beautifully preserved, virtually unworn guards from Caistor had the most complete boring records.

The few belemnites from other localities showed similar boring distributions, with Calcideletrix and Dendrina, (recorded on 25 and 26 guards each), most common, and rarer Entobia, ?Nygmites, Rogerella, and Talpina.

5.3.10.1 SUMMARY

In summary, most belemnites that were bored were initially attacked by shallow boring organisms that produced Calcideletrix sp. and Dendrina belemniticola, and later, if still exposed, by more destructive, deeper borers that left traces including Entobia sp., ?Nygmites sp., and Talpina sp.

5.3.11 BELEMNITE EPIFAUNA IDENTIFICATIONS

Far fewer belemnites (133 from Weybourne, 141 from Keswick, 254 from Caistor) had epifaunal remains than had borings, but those which did had a varied suite of forms. Two brachiopods were identified, of which the craniacean _Ancistocrania_ _parisiens_, was most widespread, found on 37 (7.0%) of the epifauna bearing population, whilst ?_Diomyodon_ sp. was noted on five belemnites from Caistor. Bivalves included common _Atreta_ _nilssoni_, which occurred on 43 (32.3%) specimens from Weybourne, 57 (40.4%) specimens from Keswick, and 77 (30.3%) specimens from Caistor, and juvenile _Pycnodonte_ _vesiculare_ and _Gyropleura_ _inequirostrata_, which were recognised on 23 and 14 of all guards, respectively.

Serpulids were often present, although only "_Serpula_" _accumulata_ was regularly encountered, appearing on 17 (12.8%) specimens from Weybourne, 21 (14.9%) specimens from Keswick, and 12 (4.7%) specimens from Caistor. Rarer forms included _Sclerostyla_ spp. (all three localities), _Cementula_ _spiraserpula_, _Neomicrorbis_ _crenatostriatus_, _N_. spp. (all Keswick and Caistor), _Vepreculina_ _tuberculifera_ (Weybourne and Caistor), _V_. spp. (Weybourne and Keswick), _Vermiliopsis_ _fluctuata_ (Caistor), and two records, each, of _Filogranula_ _cincta_ (Caistor) and _Sclerostyla_ _macropus_ (Keswick). The remainder of the identified serpulid fauna comprised single records of Neomicrorbis crenatostriatus (Weybourne), Glomerula gordialis (very common in bulk samples (chapter two) but, unusually found attached in this case), Pentaditrupa subtorquata (both Keswick), and Cementula sp. (Caistor).

Five guards with the sponge Porosphaera sessilis on them were collected, in contrast to the common occurrences of the basal attachments of the corals Coelosmilia spp. and Moltkia spp. found on 33 (24.8%) and 11 (8.3%) epifauna bearing belemnites from Weybourne, 34 (24.1%) and 26 (18.4%) from Keswick, and 35 (13.8%) and 56 (22.0%) from Caistor. Remains of the hemi-spherical chambered foraminiferan Bullopora sp. were very abundant, particularly on guards collected from the upper levels of Caistor. Of the 254 epifauna-bearing belemnites from Caistor, 106 (41.7%) had Bullopora, as did 27 (20.3%) from Weybourne and 33 (23.4%) from Keswick.

A large suite of epifaunal anascans was identified, although more than half only from single individuals. The most common were various "Membranipora" spp., found on 38 guards, and several Aechmella anglica and Aplousina fulgora. The only other anascans encountered on more than two specimens were Dionella trifaria (Weybourne and Keswick), Herpetopora laxata, H. spp., and various Onychocella spp. (from all three localities). Dionella sp., Leptocheilopora magna, "Membranipora" palpebra var. nuntians (all from Keswick), Tricephalopora spp. (Keswick and Caistor), and Ubaghsia crassa (Caistor) occurred twice. Single examples of "Biflustra" sp., Pliophloea cf. subvitrea (both Weybourne), Andriopora major, Castanopora castanea, C. sp., Dionella trigonopora, Ellisina ringens, "Membranipora" exhaurensis, a member of the "M". tenebrosa group, "Membraniporella" monastica, Onychocella gibbosum, O. nysti (all Keswick), and Homalostega clathrata (Caistor) were identified.

The rectangulatan Disporella irregularis (all three localities) was observed on eight guards, as was a single D. sp. (Keswick), whilst tubuloporinans were represented by 15 and 24 records of Diastopora spp. and Stomatopora spp. (from all three localities), respectively, dual occurrences of Idmonea sp. (Weybourne and Caistor) and Stomatopora pedicellata (Weybourne and Keswick), and a single specimen referred to Proboscina sp. (Caistor).

The epifauna on the few belemnites collected from miscellaneous localities included several Atreta nilssoni, Pycnodonte vesiculare, "Serpula" accumulata, Porosphaera sessilis, Bullopora sp. Coelosmilia spp., Moltkia spp., Herpetopora spp., "Membranipora" spp., and Stomatopora spp.

5.3.11.1 SUMMARY

Although a wide variety of epifaunal colonisers were identified on the belemnites collected from all the sections in the Belemnitella mucronata Zone, only a few forms were commonly encountered. They included the bivalve Atreta nilssoni, various serpulids, of which only "Serpula" accumulata was common, the basal attachments of the corals Coelosmilia sp. and Moltkia spp., and the foraminiferan Bullopora sp. A large suite of anascan bryozoans was present, of which "Membranipora" was the most abundant genus, found on 46 occasions. Of the four tubuloporinan genera recognised, only Diastopora and Stomatopora were encountered on more than two belemnites.

In contrast to the borings, there seems to have been no regular sequence in the settlement and growth of epifauna. Overgrowth of early encrusters by later forms was very rarely observed, and on most guards the overall density of coverage was low. This was probably due, in many cases, to the host substrates remaining exposed for insufficient time to enable large epifaunal colonies to grow on them, whilst the low density of coverage meant that there was usually enough space for all epizoans without the need for overgrowth of pre-existing or contemporaneous forms.

5.4 OTHER FOSSIL GROUPS

Apart from belemnites, the most common macrofossils collected were various brachiopods, bivalves, and echinoids. Many specimens had their relative orientations noted prior to removal from the chalk face in order to see whether any particular orientations, with possible ecological significance, were present for particular species etc. Borings and epifauna were identified, but distribution patterns were not produced. It was impossible to produce information on relative abundance per quadrant as done for the belemnites.

The fossils were split into thirteen divisions, some containing single, common species, others with several taxa or groups. Thus, the abundant brachiopod Carneithyris carnea and the oyster Pycnodonte vesiculare were each considered separately, whilst less numerous brachiopods including Kingena pentangulata, Magas chitoniformis, and Neolithyrina obesa were all assigned to the "miscellaneous brachiopods" division. The data from the fossils obtained from the seven most productive localities: Weybourne Hope, Keswick, Eaton Tunnels, Harford Bridges, Caistor St. Edmund, Frettenham (JSS. Aggregates Ltd.), and Frettenham (W.M. Howes) will be described separately, those from all other loclities ("miscellaneous localities") together.

The ecological significance of all the results will be discussed in section 5.5.

5.4.1 WEYBOURNE HOPE

No orientation information was recorded for 275 of the 391 non-belemnite faunal elements found at Weybourne (Table 5.18). Of the remainder, 21 of 45 (46.7%) brachiopods _Cretirhynchia_ ?_norvicensis_ (juv.) and _C_. spp. were preserved with the pedicle valve above, 18 (40.0%) with the pedicle valve below, and 6 (13.3%) lying on their sides, whilst of 48 recorded orientations for _Echinocorys_ spp. and _Micraster_ spp., 29 (60.4%) specimens were the right way up, i.e. in assumed original life position, 6 (12.5%) were upside down, and 13 (27.1%) lay on their sides.

	PVT	PVB	OIS	RWU	USD	ND
Cretirhynchia ?_norvicensis_(juv)	14	12	4			4
Cretirhynchia spp.	7	6	2			33
Miscellaneous brachiopods	3	2	1			6
Inoceramus spp.						9
Pycnodonte vesiculare			8	4	2	81
Other oysters						3
Miscellaneous bivalves						21
Echinocorys spp.			13	23	5	63
Micraster spp.				6	1	8
Miscellaneous echinoderms			1	1		29
Miscellaneous fossils						1
TOTAL	24	20	30	34	8	275

TABLE 5.18 Numbers of fossils with particular orientations from Weybourne. Abbreviations: PVT = pedicle valve above, PVB = pedicle valve below, OIS = on its side, RWU = right way up, USD = upside down, ND = no orientation data.

Borings were rare in non-belemnites. The only forms recorded were Calcideletrix sp., Dendrina belemniticola (both five times), Entobia sp. eight times, ?Nygmites sp. twice, and Dictyoporus nodosus once. They occurred in a single Cretirhynchia ?norvicensis (juv), eight Pycnodonte vesiculare, three tests of Echinocorys sp., and a single serpulid (Proliserpula ampullacea).

Epifauna was more common, particularly on echinoids. Thirty two specimens of collected Echinocorys spp. and seven of Micraster spp. bore it. Epifaunal forms included the brachiopod Ancistocrania parisiens and the bivalves Atreta nilssoni, Gyropleura inequirostrata, and Pycnodonte vesiculare, each noted twice. Of the serpulids, only "Serpula" accumulata (seven records) was identified on more than two tests. Others included Cementula spiraserpula, Sclerostyla sp., Vepreculina fimbriata, V. tuberculifera, and V. sp. The epifaunal sponge Porosphaera sessilis was recognised on six occasions, P. sp. once, the hemispherical Bullopora sp. four times, and attachment remains of the corals Coelosmilia sp. and Moltkia spp. on six and five tests, respectively.

The bryozoan epifauna on echinoids was dominated by anascans, of which Aechmella anglica, Aplousina fulgora, Dionella trifaria, Leptocheilopora magna, "Membranipora" palpebra var. nuntians, "M". spp., and "Membraniporella" monastica were found more than once, along with single examples of Dionella sp., Ellisina ringens, Herpetopora sp., a member of the "Membranipora" langei group, "M". withersi, Onychocella inelegans, and O. sp.

Other bryozoans included isolated occurrences of the articulatan Cryptostomella compacta, the cancellatans Crisina sp. and Sulcocava sp., six of the rectangulatan Disporella irregularis, eight and nine, respectively of the tubuloporinans Diastopora spp. and Stomatopora spp., two of Proboscina sp., and a solitary Stomatopora pedicellata.

The other macrofossils with epifauna collected comprised a single Cretirhynchia ?norvicensis (juv), four C. spp., thirteen Pycnodonte vesiculare, and a large specimen of the serpulid Proliserpula ampullacea. Their identified epifauna comprised five Atreta nilssoni, seven juvenile Pycnodonte vesiculare, five "Serpula" accumulata, a single mould of a hexactinellid sponge, and an isolated Coelosmilia sp. Bryozoans included single records of the anascans Aechmella anglica, Aplousina fulgora, a member of the "Membranipora" tenebrosa group, Onychocella inelegans, and Tricephalopora sp., the rectangulatan Disporella irregularis, and two "Membranipora" sp.

5.4.2 KESWICK

Of the 80 measurements of orientations from non-belemnite faunal elements from Keswick (Table 5.19) 72 were of Cretirhynchia ?norvicensis (juv) and C. spp., of which 28 (38.9%) were pedicle valve above, 21 (29.2%) pedicle valve below, and 23 (31.9%) on their sides.

	PVT	PVB	OIS	RWU	USD	ND
Cretirhynchia ?norvicensis(juv)	23	17	19			28
Cretirhynchia spp.	5	4	4			38
Miscellaneous brachiopods		1				12
Inoceramus spp.						8
Pycnodonte vesiculare						8
Miscellaneous bivalves						8
Echinocorys spp.			1	5	1	19
Miscellaneous echinoderms						17
Miscellaneous fossils						8
TOTAL	28	22	24	5	1	142

TABLE 5.19 Numbers of fossils with particular orientations from Keswick. (Abbreviations as in Table 5.18.)

The only borings in non-belemnites from Keswick were two Entobia sp., a single ?Nygmites sp., two Rogerella sp., and one Talpina sp., in three echinoids, a solitary Cretirhynchia ?norvicensis (juv), and one Pycnodonte vesiculare.

Epifauna on eleven specimens of Echinocorys spp. included three Atreta nilssoni, five Pycnodonte vesiculare, two "Serpula" accumulata, one Sclerostyla sp., two Vepreculina sp., two Porosphaera sessilis, two

Bullopora sp., and one specimen each of Coelosmilia sp. and Moltkia sp. Anascans included four examples of "Membranipora" spp., and individual records of Aechmella anglica, Castanopora dibleyi, Herpetopora sp., and Leptocheilopora magna. Other bryozoans identified were single examples of the cancellatan Bicavea sp. and the dactylethratan Clausa globulosa, two of the rectangulatan Disporella irregularis, together with five and two, respectively, of the tubuloporinans Diastopora spp. and Stomatopora spp.

The only other epifauna, isolated specimens of "Membranipora" sp. and Proboscina sp., occurred on a specimen of the serpulid Glomerula plexus.

5.4.3 EATON TUNNELS

Very few of the fossils found at Eaton had their orientations noted. Of the sixteen that did, twelve Cretirhynchia ?norvicensis (juv) and C. spp. had the following orientations: pedicle valve above 7, pedicle valve below 3, on their sides 2. The only borings, in two tests of Echinocorys sp., were a single Entobia sp. and two Rogerella sp., whilst the four tests with epifaunal specimens had solitary remains of Ancistocrania parisiens, Pycnodonte vesiculare, "Serpula" accumulata, Vepreculina sp., Porosphaera sessilis, Coelosmilia sp., Moltkia sp., Aplousina fulgora, "Membranipora" sp., and Proboscina sp., and two of Stomatopora sp.

5.4.4 HARFORD BRIDGES

Of four miscellaneous brachiopods with orientation data, three were pedicle valve above, the other pedicle valve below. No non-belemnites were bored. Epifauna, on three Pycnodonte vesiculare, two other oysters (Hyotissa semiplana), and a test of Echinocorys sp., comprised two records of Atreta nilssoni, three of Pycnodonte vesiculare, one each of the serpulids Neomicrorbis crenatostriatus and Vepreculina tuberculifera, two Porosphaera sessilis, and one Moltkia sp. Several bryozoans including the anascans Dionella trifaria, Herpetopora sp., and Onychocella sp., and the tubuloporinans Diastopora sp., Idmonea sp., and Stomatopora sp. were also recognised, none on more than two specimens.

5.4.5 CAISTOR ST. EDMUND

Of the 276 fossils with noted orientations (Table 5.20), 82 were Carneithyris carnea, of which 48 (58.5%) were pedicle valve above, 16 (19.5%) pedicle valve below, and 18 (22.0%) on their sides. Whilst for the 52 specimens of Cretirhynchia arcuata and C. spp., with information, the values were pedicle valve above 21

(40.4%), pedicle valve below 29 (5.8%), on their sides 2 (3.8%). The other numerically important group, the 122 specimens of Echinocorys spp. with data gave: 53 (43.4%) right way up, 28 (23.0%) upside down, 41 (33.6%) on their sides.

	PVT	PVB	OIS	RWU	USD	ND
Carneithyris carnea	48	16	18			83
Cretirhynchia arcuata	17	20	1			12
Cretirhynchia spp.	4	9	1			34
Miscellaneous brachiopods	10	2	3			38
Inoceramus spp.			1			79
Pycnodonte vesiculare			2	1		51
Other oysters			1			21
Miscellaneous bivalves						45
Echinocorys spp.			41	53	28	96
Miscellaneous echinoderms						11
Miscellaneous fossils						17
TOTAL	79	47	68	54	28	487

TABLE 5.20 Numbers of fossils with particular orientations from Caistor. (Abbreviations as for Table 5.18.)

The 49 non-belemnites from Caistor with borings included eight Carneithyris carnea, a single Cretirhynchia sp., seven fragments of Inoceramus spp., and nineteen tests of Echinocorys spp. The borings themselves comprised four records of Calcideletrix sp., twenty one Entobia sp., three ?Nygmites sp., nine Rogerella sp., and one Talpina sp.

The most common epifaunal hosts, excepting belemnites, were tests of Echinocorys spp., 62 of which had been colonised. The suite of identified epifauna included the brachiopods Ancistocrania parisiens and ?Diomyodon sp., both found on five tests, and the bivalves Atreta nilssoni (on thirteen), Gyropleura inequirostrata (on five), Pycnodonte vesiculare (on two), and Spondylus dutempleanus (on one). Thirteen different serpulids were recognised. Of them, Neomicrorbis sp., "Serpula" accumulata, Vepreculina fimbriata, V. tuberculifera, V. spp., and Vermiliopsis fluctuata were noted more than once, with single occurrences of Cementula spiraserpula, C. sp., Conorca trochiformis, Filogranula cincta, Glomerula gordialis, Neomicrorbis subrugosus, and Sclerostyla sp. Remaining non-bryozoan epifaunal elements included five records of Porosphaera sessilis, six of the hemispherical foraminiferan Bullopora sp., two of the coral Coelosmilia sp., and fourteen of Moltkia spp.

The only components of the large anascan fauna that occurred more than once were Aechmella anglica, Dionella trifaria, D. sp., "Membranipora" spp., Onychocella norfolcia, and O. spp. The other forms were Aechmella nitescens, Aplousina sp., Castanopora magnifica, Ellisina ringens, Herpetopora laxata, H. sp., Leptocheilopora magna, L. sp., "Membranipora" exhaurensis, "M". furina, "M". palpebra var. nuntians, "Membraniporella" monastica, Onychocella nysti, and Tricephalopora sp.

The cancellatans Bicavea sp., Crisina sp., and Homoeosolen sp. were rarely encountered, whilst the rectangulatan Disporella irregularis was identified seventeen times. Tubuloporinans were common, in particular Diastopora spp. (35 records), Proboscina spp. (thirteen), and Stomatopora spp. (eight). Rarer forms were Actinopora sp., Idmonea sp., and Stomatopora gracilis.

The non-bryozoan epifauna on other fossils was made up of six Atreta nilssoni, four Pycnodonte vesiculare, one each of Ancistocrania parisiens, ?Diomyodon sp., Gyropleura inequirostrata, Ostrea sp., Spondylus dutempleanus, "Serpula" accumulata, and Vermiliopsis fluctuata, three Moltkia sp., and four Bullopora sp. Six anascans were present, "Membranipora" sp. twice, the others (Aechmella anglica, Aplousina fulgora, Dionella sp., Homalostega sp., and Ubaghsia sp.) once. The rectangulatan Disporella irregularis, and the tubuloporinans Diastopora spp., Proboscina spp., and Stomatopora spp., recognised on a few occasions only, were the only other bryozoans found.

5.4.6 FRETTENHAM (JSS. Aggregates Ltd.)

Only twelve of the 42 fossils found at this old pit had their orientations measured and, hence, no worthwhile data were obtained. The only boring a single Calcideletrix sp. occurred in a valve of Carneithyris carnea. Six fossils (two Ostrea sp., and single Carneithyris carnea, Cretirhynchia arcuata, C. sp., and Inoceramus sp.) had epifauna on their surfaces. The only recognised forms of which were rare examples of Ancistocrania parisiens, Atreta nilssoni, Porosphaera sessilis, Bullopora sp., Coelosmilia sp., Moltkia sp., and Proboscina sp.

5.4.7 FRETTENHAM (W.M. Howes Ltd.)

As at the previous locality, very few fossils had their orientations recorded. Of the seven that did, six were Carneithyris carnea (3 pedicle valve above, 3 pedicle valve below). No borings were recorded in non-belemnite faunal elements, and only a single Pycnodonte vesiculare (PV) had epifauna consisting of juvenile PV, Ancistocrania parisiens, and Onychocella nysti.

5.4.8 MISCELLANEOUS LOCALITIES

Only fourteen of the forty nine fossils from miscellaneous localities had their orientations noted, with no worthwhile data resulting. Borings, in a single Carneithyris carnea and a fragment of Inoceramus sp., comprised one each of Calcideletrix sp. and ?Nygmites sp. Nine fossils supported epifauna, composed of two records of Atreta nilssoni, two Pycnodonte vesiculare, two "Serpula" accumulata, one Porosphaera sessilis, two

Bullopora sp., one Coelosmilia sp., and one Moltkia sp. Of the identified anascans, only "Membranipora" spp. (twice) was recorded more than once. The other forms were Aechmella anglica and Castanopora magnifica. Remaining bryozoans were the rectangulatan Disporella irregularis and the tubuloporinan Diastopora sp.

5.4.9 SUMMARY

Of the 1580 non-belemnite faunal elements recorded from all sections, 526 had their orientations noted (Table 5.21). Of these, 95 were the terebratulid Carneithyris carnea (Table 5.21), of which 55 (57.9%) were pedicle valve above, 21 (22.1%) pedicle valve below, and 19 (20.0%) on their sides. The combined information from 175 rhynchonellids (Cretirhynchia arcuata, C. ?norvicensis (juv), and C. spp.) gave 79 (45.1%)pedicle valve above, 59 (33.7%) pedicle valve below, and 37 (21.2%) on their sides. The other group with useful orientation data were echinoids (Echinocorys spp. and Micraster spp.), of which 93 (48.4%) were right way up, 60 (31.3%) upside down, and 39 (20.3%) on their sides.

	PVT	PVB	OIS	RWU	USD	ND	TOTAL
Carneithyris carnea	55	21	19			98	193
Cretirhynchia arcuata	19	20	2			12	53
Cretirhynchia ?norvicensis(juv)	45	30	25			39	139
Cretirhynchia spp.	19	21	7			122	169
Miscellaneous brachiopods	15	8	5			62	90
Inoceramus spp.			1			114	115
Pycnodonte vesiculare			10	5	2	161	178
Other oysters			2			31	33
Miscellaneous bivalves						82	82
Echinocorys spp.			58	87	38	196	379
Micraster spp.			2	6	1	9	18
Miscellaneous echinoderms			1	1		71	73
Miscellaneous fossils			1			57	58
TOTAL	153	100	133	99	41	1054	1580

TABLE 5.21 Numbers of fossils with particular orientations noted from all localities. PVT = pedicle valve above, PVB = pedicle valve below, OIS = on their sides, RWU = right way up, USD = upside down, ND = no orientation data.

Compared with the 748 (84.0%) collected Belemnitella mucronata with borings, much lower proportions of bored specimens were found in all other groups. Indeed, of the 950 non-belemnites collected, only 63 (6.6%) were bored (Table 5.22). Actual values for specific groups ranged from the 23.5% (8/34) of collected Inoceramus spp., to just 2.8% (6/212) of all forms of Cretirhynchia.

The most common borings were Entobia sp. and Rogerella sp., recorded on 33 and 13 occasions, with rarer Calcideletrix sp., Dendrina belemniticola, ?Nygmites sp., and Talpina sp.

	WH	KS	ET	HBR	CS	FR1	FR2	MISC	TOTAL
Belemnitella	185	128	8	1	406	3	8	9	748
Carneithyris carnea	0	0	0	0	8	1	0	1	10
Cretirhynchia arcuata	0	0	0	0	3	0	0	0	3
Cretirhynchia ?norvicensis(juv)	0	1	0	0	0	0	0	0	1
Cretirhynchia spp.	1	0	0	0	1	0	0	0	2
Miscellaneous brachiopods	0	0	0	0	1	0	0	0	1
Inoceramus spp.	0	0	0	0	7	0	0	1	8
Pycnodonte vesiculare	8	1	0	0	0	0	0	0	9
Other oysters	0	0	0	0	0	0	0	0	0
Miscellaneous bivalves	0	0	0	0	1	0	0	0	1
Echinocorys spp.	3	2	2	0	19	0	0	0	26
Micraster spp.	0	0	0	0	0	0	0	0	0
Miscellaneous echinoderms	0	1	0	0	0	0	0	0	1
Miscellaneous fossils	1	0	0	0	0	0	0	0	1
TOTAL	198	133	10	1	446	4	8	11	811

TABLE 5.22 Numbers of fossils with boring remains collected by locality. Abbreviations: WH = Weybourne Hope, KS = Keswick, ET = Eaton Tunnels, HBR = Harford Bridges, CS = Caistor St. Edmund, FR1 = Frettenham (JSS. Aggregates Ltd.), FR2 = Frettenham (W.M. Howes), MISC = Miscellaneous localities.

As with borings, Belemnitella, of which 61.8% (551/891) had epifauna, were the most common host substrate. However, epifauna was relatively more plentiful on other components of the fauna, with a non-belemnite population average of 20.1% (191/950) of specimens with preserved remains. Considerable variations were found in the proportions of particular taxa that had been colonised. Both Inoceramus spp. and echinoids (Echinocorys spp. and Micraster spp.) were readily utilised with 47.1% (16/34) and 46.9% (120/256) of collected individuals bearing epifauna, respectively. A lower proportion (25.6%) [30/117] of Pycnodonte vesiculare were colonised, with Carneithyris carnea and rhynchonellids (Cretirhynchia arcuata, C.

?*norvicensis* (juv), and *C*. spp.) very rarely used; only 6.8% (8/117) of the former, and 3.3% (7/212) of the latter having preserved epifauna.

A wide range of epifaunal species was identified. Most common were *Atreta nilssoni*, "*Membranipora*" spp., and *Diastopora* spp., recorded on forty seven, forty two, and fifty eight specimens. Other forms regularly present were the brachiopod *Ancistocrania parisiens*, the bivalve *Pycnodonte vesiculare*, several serpulids, although, only "*Serpula*" *accumulata* was found more than ten times, the sponge *Porosphaera sessilis*, the foraminiferan *Bullopora* sp., and the corals *Coelosmilia* spp. and *Moltkia* spp. Of the large anascan fauna collected, excepting "*Membranipora*" spp., only *Aechmella anglica* and *Dionella* sp. were noted more than fifteen times, whilst the tubuloporinans *Proboscina* spp. and *Stomatopora* spp. occurred on excess of twenty fossils.

	WH	KS	ET	HBR	CS	FR1	FR2	MISC	TOTAL
Belemnitella	133	141	6	1	254	3	6	7	551
Carneithyris carnea	0	0	0	0	7	1	0	0	8
Cretirhynchia arcuata	0	0	0	0	0	1	0	0	1
Cretirhynchia ?norvicensis(juv)	1	0	0	0	0	0	0	0	1
Cretirhynchia spp.	4	0	0	0	0	1	0	0	5
Miscellaneous brachiopods	0	0	0	0	2	0	0	1	3
Inoceramus spp.	0	0	0	0	14	1	0	1	16
Pycnodonte vesiculare	13	0	0	3	2	0	1	1	21
Other oysters	1	0	0	2	3	2	0	1	9
Miscellaneous bivalves	0	0	0	0	3	0	0	0	3
Echinocorys spp.	32	11	4	1	62	0	0	2	112
Micraster spp.	7	0	0	0	0	0	0	1	8
Miscellaneous echinoderms	0	0	0	0	1	0	0	2	3
Miscellaneous fossils	1	1	0	0	0	0	0	0	2
TOTAL	192	153	10	7	348	9	7	16	742

TABLE 5.23 Numbers of fossils with epifaunal remains collected per locality (Abbreviations as in Table 5.22.)

5.5 ECOLOGY OF THE CAMPANIAN CHALK OF NORFOLK

5.5.1 ECOLOGICAL INFORMATION AND LIFE HABITS OF FOSSIL GROUPS

5.5.1.1 Belemnites

These were a very important part of the macrofauna in the *mucronata* Zone with about 1020 specimens of *Belemnitella mucronata* found. The information obtained from them (orientations, plunge angles, boring and epifaunal distributions, etc.) has given considerable insight into the environment in which they were buried.

Orientation data from each of the studied populations (Weybourne, Keswick, Eaton, Caistor) showed polymodal, i.e. random, patterns (section 5.3.8), as did many of the subgroups measured between individual flint bands. This suggests that bottom currents were not of sufficient strength to have re-orientated exposed guards into any preferred direction.

The only parts of the animal to survive were the solid calcite guards that acted as counterweights for the soft-parts during life, enabling a horizontal life orientation. Measured plunge angles of guards were usually low, averaging 21.3 degrees (16.2 Weybourne, 19.9 Keswick, 17.4 Eaton, 24.9 Caistor), with only 65 (6.5%) having plunges in excess of sixty degrees. This suggests that most guards reached the sediment still attached to the rest of the animal after its death, since isolated guards dropping vertically into the sediment might be expected to stick and remain at high angles. Of the 53 guards with plunge angles >60 degrees and with boring and/or epifaunal data, 44 (83.0%) were affected on all parts of the guard. Hence, they must have been bored and exposed whilst lying on the sediment. This suggests that, in most cases, their observed high angles relative to bedding were caused by something other than their falling vertically, possibly by bioturbation, or by their rolling into burrows or crevices caused by earthquake shocks etc. on the sea-bed.

Borings were common, averaging 19 per guard, with 45.5% of collected specimens having them in every quadrant, and only 16.5% without any. Epifaunal remains were less abundant, averaging 2.7 per guard, with only 6.8% of specimens having epifauna on every quadrant, and 38.1% devoid of them. However, only 77 (9.0%) of the population of 859 belemnites had neither.

The vast majority of guards cannot have been buried immediately after they reached the sea bed.

In most cases the initial activity was by the shallow boring organisms that produced Calcideletrix sp. and Dendrina belemniticola, both of which are very rare in other substrates. If the guard remained exposed, other, deeper borers (those that formed ?Nygmites sp. and Talpina sp.) attacked them and a wide variety of epizoans including brachiopods, bivalves, serpulids, sponges, corals, encrusting, and erect (basally attached) bryozoans colonised it. In most cases the epifauna was small and sparsely developed on individual guards.

About three quarters (75.4%) of guards had epifauna/borings in their SE and SW quadrants as collected. This indicates that they must have been rolled over at some time to enable other quadrants to be exploited, and with almost half of all specimens with records in all four quadrants, some must have been moved several times, possibly involving reworking clear of sediment cover, by the action of bioturbators and current activity etc.

Factors which suggest that the relative abundance of collected belemnites was representative of the original population density include the absence of calcite fibres from disassociated guards in bulk sample residues (down to 63 microns) and the great rarity of guards with severe boring damage, the most afflicted example found having lost only about 50% of the original guard. The relative abundances of belemnites per cubic metre of chalk were calculated for the sections at Weybourne, Keswick, and Caistor using the formula of McKinney (1986, p. 80). Average values of about 25 per cubic metre were calculated for the first two sections (Weybourne and Keswick), with Caistor some way above this at about 45 per unit volume. Even allowing for a sedimentation rate as high as 0.5-1 mm per year (section 5.2.4) these figures give an average of only a single guard for every 4-8 square metres of sea-bed every ten years at Weybourne and Keswick and one for every 2.5-5 square metres of sea-bed every decade at Caistor.

Hence, belemnites were rare nektonic forms in the Norfolk Campanian. When a guard did appear on the sea bed it was attacked by a specific suite of boring organisms, and often used as a substrate by a wide variety of epizoans.

5.5.1.2 Brachiopods

based on their mode of life brachiopods were placed into three groups viz:- attached by a pedicle, free living, and cemented types. Forms that attached to the substrate using a pedicle included common, small *Terebratulina* spp. and rarer *Argyrotheca* spp., both able to utilise very small clasts with their root-like pedicles, and the much larger *Neolithyrina obesa* and *Kingena pentangulata* which were confined to larger substrates (Surlyk, 1972, p. 21).

Brachiopods that lived freely on the sediment as adults included the terebratulid *Carneithyris carnea*, which may have retained a thin, functional pedicle (Asgaard, 1975, p. 361) (an idea supported by the larger number preserved with the pedicle valve uppermost (Table 5.21)), rhynchonellids of the genus *Cretirhynchia* with their expanded lateral parts of the shell particularly well adapted to a free living adult life (Surlyk, 1972, p. 24), and *Magas chitoniformis*. Other forms, including *Isocrania* spp. were, initially, attached, as juveniles, to small substrates but became independent of them during growth (Surlyk, 1972, p. 27, 1973, p. 221). The remaining forms *Ancistocrania parisiens* and ?*Diomyodon* sp. were firmly cemented by their ventral valves and were, thus, restricted to large, hard substrates, i.e. macrofossil remains.

Brachiopods were very rarely affected by borings (4.3%) or had epifauna (4.5%). In the case of small forms this can be explained by their short life and rapid burial after death, but larger forms such as Carneithyris and Cretirhynchia might be expected to have been ideal substrates for a rich epifauna. Why they were not is unclear, but it may be explained in part by the possession, in life, of a thick periostracum which disintegrated after death with consequent loss of any epifauna that managed to colonise it (Surlyk, 1972, p. 49), or to the existence of unfossilised encrusting sponges which prevented the attachment of other epifaunal organisms as reported on recent Terebratulina retusa and T. sepentrionalis (Surlyk, 1972, p. 49).

The scarsity of borings may be related to the lack of protection and depth of boring possible in brachiopod shells compared with frequently bored belemnite guards and echinoid tests, or to coverage by encrusting sponges etc., but is something of a mystery. However, the form of the shallow borings in belemnite guards, particularly those of Dendrina with their small chambers radiating in all directions from a central opening are reminiscent of feeding traces. It is possible that the organisms that produced them, almost always in belemnite guards, were deriving nutrition from the guards which they did not find in other faunal remains, but quite how is uncertain.

Data on relative abundance for all Cretirhynchia (Figures 1.8, 1.12, and 1.16) and Carneithyris carnea (Figure 1.17) suggest that the former occurred at average concentrations of only one specimen per 5 square metres of sea-floor every ten years, although the latter gave values up to four times greater. Many brachiopod fragments were recognised in bulk samples, which suggests that the true populations were higher than those calculated by the volumetric data.

5.5.1.3 Bivalves

The most common bivalves were oysters (with Pycnodonte vesiculare well represented) that were almost always attached as juveniles, to belemnites, echinoids, baculitid ammonites etc., but often independent of them as adults. Pectinids that lay on the sediment, or were covered by only a thin veneer of sediment, were occasionally found, as were spondylids including the attached Spondylus dutempleanus and the free-living S. spinosus. Both these species had long spines that curved around the commissure probably as a means of defence, but also helping to discourage any epifauna from settling on the shell. Large Inoceramus spp. were common at certain levels of the Beeston

Chalk. Although their exact mode of life remains a mystery, their size (up to 1 m in diameter) suggests that they were immobile and lay on the sea bed, possibly with a permanent gape. Other forms, including very numerous Atreta nilssoni and rarer Gyropleura inequirostrata, were almost always epifaunal and needed a hard substrate.

Borings were rare, except in oysters and Inoceramus spp. in which about 10 and 25% of collected specimens, respectively, had traces, usually of sponge-produced Entobia sp. Epifauna, particularly juvenile Pycnodonte vesiculare, was often present on oysters, as it was on Inoceramus spp. which supported a varied, if not particularly abundant, suite of forms.

Volumetric data showed that bivalves, except for oysters, were mostly very rare. Pycnodonte in particular, was locally very abundant in the hardground complex in the middle of the Weybourne Chalk (Figure 1.9) and relatively so in the lower Beeston Chalk at Caistor (Figure 1.18) where blocky chalk was present. The oysters were seemingly able to exploit the unusually firm substrates that had developed.

5.5.1.4 Echinoderms

A varied suite of echinoderm remains was found. Disassociated asteroid ossicles occurred throughout, but how many individuals there were is difficult to gauge due to the wide range in numbers of ossicles per individual in different genera or growth stages. Most bulk samples contained only a few (<20) ossicles which suggests that asteroids were not usually very abundant, although large concentrations have been reported from various localities (A.S. Gale personal communication, April 1988). Similarly, crinoid columnals and arm plates, mostly of *Bourgueticrinus* spp., occurred regularly throughout, although no calyx plates were found, a not uncommon phenomenon at other levels of the chalk.

Echinoids were present at all levels. The regular cidarids were represented by rare test fragments, relatively common spine bosses, and many loose spines. Irregular forms included the infaunal *Micraster* spp. and common *Echinocorys* spp. *Echinocorys* ploughed through the top layer of the sediment and after death many remained in life position, their tests becoming a very important epifaunal substrate. Borings, usually *Entobia* sp. and *Rogerella* sp. were less widespread. Interestingly, although none of the *Micrasters* was bored, eight out of the thirteen collected specimens had epifauna. This suggests that they were exposed at the time of death. The other echinoderm remains included sporadic ophiuroid plates.

Echinoderms were usually scattered through sections and bulk samples and were rarely abundant at any particular level, except at Caistor (Figure 1.18) where, especially near the base of the quarry, several "Echinocorys beds" were found. Many of the tests were in closely packed groups, usually of similar sized, adult, individuals. Of the 218 specimens of Echinocorys spp. from Caistor, approximately 100 occurred in "nests" of up to sixteen tests, with a variety of orientations. The lack of small forms at any level is significant because it implies that the population distribution had a very positive skew with a very high proportion of specimens reaching maturity. The "nests" themselves may represent storm accumulations in shallow hollows in the sea bed or up against obstructions on the sediment surface. This supported by the occurrence of other fossils within the "nest". Overall, echinoderms were regularly present throughout the Campanian, but rarely in abundance.

5.5.1.5 Bryozoa

Bryozoans were a very important part of the collected fauna, occurring commonly as epifauna and in bulk samples. Three different groups were identified based upon their supposed modes of life. These were encrusters, i.e. forms that were firmly cemented to their substrates, erect forms that were anchored at their bases, but grew upwards, and rare species that were able to live completely free on the sediment. Encrusters, on belemnites, brachiopods, bivalves, serpulids, and echinoids included many anascans, of which, Herpetopora spp. and "Membranipora" spp. were most common, as were the rectangulatan Disporella irregularis, and the tubuloporinan Stomatopora spp.

Most bryozoans were forms that anchored either directly into the sediment using a club or root-like base, or to hard substrates. Included in this group were most of the very abundant anascans, notably, "Biflustra" argus, Latereschara galeata, Onychocella inelegans, O. matrona, O. nysti, O. rowei, Quadricellaria grania, and Woodipora disparilis, the ascophorans Porina goldfussi and P. spp., the cancellatans Petalopora spp., Sparsicavea spp., and Sulcocava spp., the salpinginans Meliceritites gothica and M. spp., and the tubuloporinan Pustulopora spp.

Only two free-living forms were recognised, the stratigraphically restricted Volviflustrellaria taverensis and the more widespread, disc-like Lunulites spp. which is particularly common above omission surfaces (P.S. Whittlesea personal communication, April 1989).

Although almost never found during field collecting, the abundance and diversity of bryozoans, both epifaunally and in bulk samples shows that they were a very important constituent of the original fauna.

5.5.1.6 Miscellaneous Fossil Groups

Other fossil groups represented included serpulids, sponges, corals, cirripedes, and foraminifera. Of the serpulids most were epifaunal forms, although several were also found unattached in bulk samples presumably having been parted from their original substrates due to erosion, dissolution etc. Common free-living forms were Glomerula gordialis and G. g. var ilium. Collected sponges included the epifaunal Porosphaera sessilis, the independent, spherical, P. globularis, and P. sp. (fusiform) which apparently grew around the stems of sea grasses etc. Iron-stained outlines of siliceous sponges were common in many sections and may well have been important substrates for epifaunal species (Surlyk, 1972, Figure 12, p. 28). Basal attachments of the corals Coelosmilia spp. and Moltkia spp. were very widespread on exposed macrofauna. Other faunal elements included occasional cirripede plates, ostracod carapaces, and some of the larger foraminifera, in particular, the epifaunal Bullopora sp.

The other faunal elements, not preserved under normal circumstances, included the aragonitic gastropods and ammonites. The latter must have been important sites for epifaunal colonisation as indicated by the frequent utilisation of baculitids as substrates by pycnodontids.

5.5.2 SEA-FLOOR ECOLOGY

5.5.2.1 Gonioteuthis Zone

The paucity of exposure makes it difficult to assess the ecological conditions in the Gonioteuthis Zone, and only general comments can be made. Macrofauna was very rare, although bulk samples and material from the Wymondham boreholes contained fragments of brachiopods, bivalves, echinoderms, bryozoans etc. Due to the absence of boring or epifaunal data no ideas of the relative abundance of firm substrate or the variety and amount of epifauna are available. The scant evidence suggests that the sea-bed was probably firm enough to support an independent fauna most of the time. All major fossil groups were represented although they were never abundant at any level. Presumably bioturbation was also important although no evidence of it was found.

5.5.2.2 Belemnitella mucronata Zone

In contrast to the underlying Gonioteuthis Zone, large parts of the Belemnitella mucronata Zone are well exposed in and around Norwich and on the north Norfolk coast. The 2700 macrofossils from zonal sections and the mesofauna from bulk sample and borehole residues have yielded much ecological information.

For most of the time a well structured community existed on the sea-floor (Figure 5.33). Large organisms including brachiopods, bivalves, echinoids, siliceous sponges, and many bryozoans lay freely on the sediment, or were anchored to it by pedicles etc. Other mostly small forms, particularly serpulids and bryozoans, and juveniles of free living adults were confined to hard substrates provided by the remains of belemnites, echinoids, ammonites, and sponges.

The sediment surface was mostly soft, but probably not ooze at least for the top few cm, being of ?fine-medium sand grade and composed mainly of faecal pellets etc. of the myriad organisms that preyed on the coccoliths that floated in near surface waters. The remains of animals, especially nektonic belemnites and ammonites that fell on to the sea-bed were rarely buried immediately, and with other exposed remains were bored, chiefly by sponges, and colonised by the large epifaunal community. Overall densities of macrofauna were usually low with animals scattered over the sea-bed.

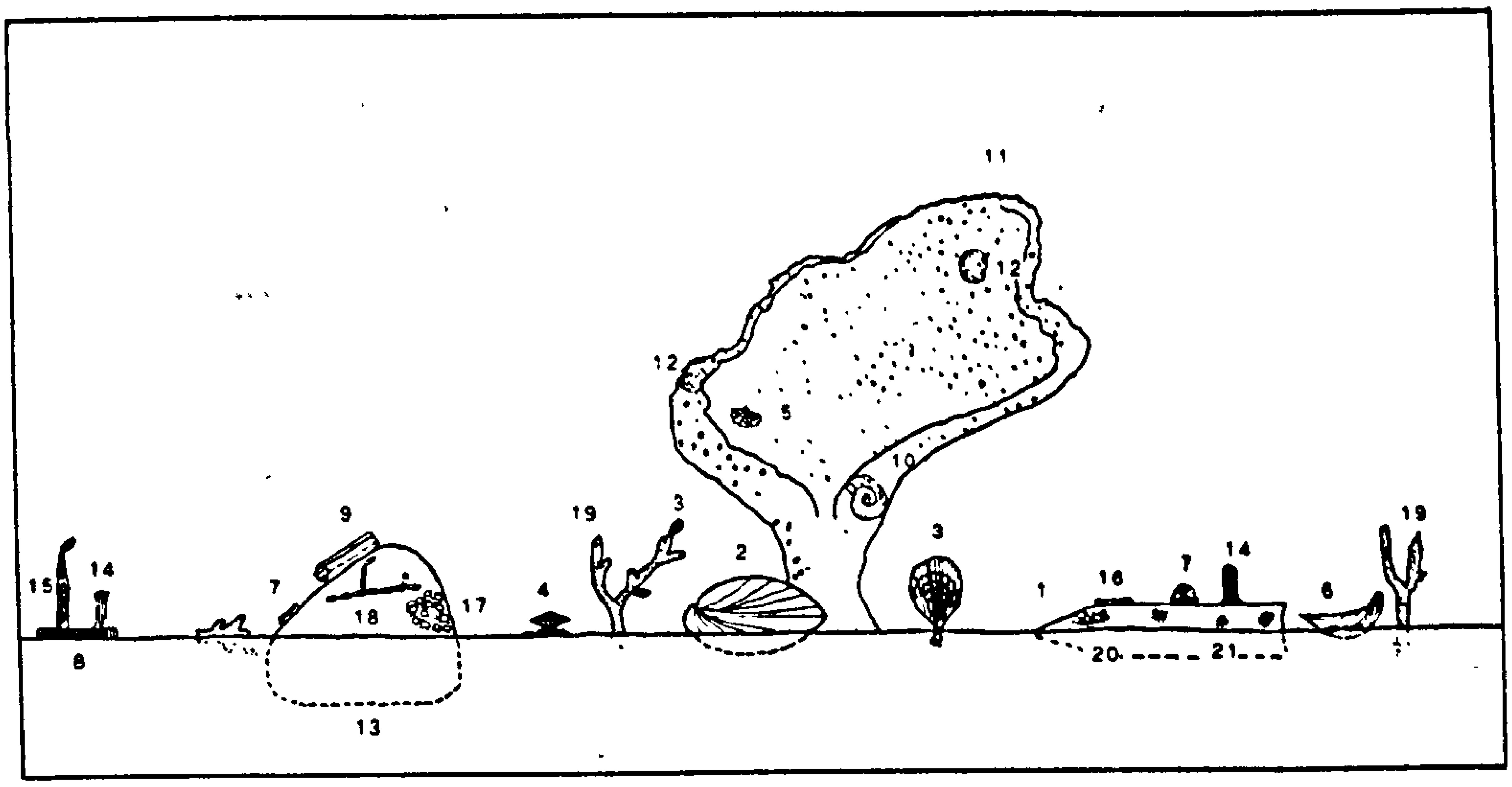


FIGURE 5.33 "Typical" Belemnitella mucronata Zone sea-floor assemblage. Belemnite: 1=Belemnitella mucronata; brachiopods: 2=Carneithyris carnea, 3=Terebratulina spp., 4=Isocrania costata, 5=Argyrotheca sp.; bivalves: 6=Pycnodonte vesiculare, 7=Atreta nilssoni, 8=Inoceramus sp.; serpulids: 9=Pentaditrupa subtorquata, 10=Neomicrorbis crenatostriatus; sponges: 11=siliceous sponge, 12=Porosphaera sessilis; echinoderm: 13=Echinocorys sp.; coral: 14=Coelosmilia sp.; bryozoans: 15=Onychocella matrona, 16="Membranipora" sp., 17=Dionella sp., 18=Herpetopora sp., 19=Pustulopora sp; borings: 20=Calcideletrix sp., 21=Dendrina belemniticola.

Below the sediment surface intense bioturbation, by soft bodied worms etc., broke down the pelleted chalk to a clay grade ooze. Current activity was intermittent and weak, of insufficient strength to realign exposed biota and faunal remains, but strong enough to disturb the top 1-2 cm of sediment. Rare higher energy currents caused greater disturbance with nests of Echinocorys spp. tests, which were probably relatively buoyant for a time after death due to gas trapped within the tests, and other remains being collected and dumped in hollows on the sea-bed etc.

Rarely, as in the middle of the Weybourne Chalk, at Weybourne and Harford Bridges, and the lower Beeston Chalk, at Caistor, oysters, notably Pycnodonte vesiculare, became very abundant. The chalk at both horizons is blockier and firmer than that encountered at other levels and the oysters seem to have been able to exploit this and spread over the sediment, although they were still attached, as juveniles, to baculitid ammonites etc.

5.5.3 FAUNAL TURNOVERS

The only major faunal turnover occurred at the top of the Weybourne Chalk of the during the formation of the, currently unexposed, Catton Sponge Beds, with many species appearing for the first time or becoming extinct (Wood, 1988, pp. 61-66). The Catton Sponge Beds are known to exist from the north Norfolk coast near Sheringham to south of Norwich and appear to represent a widespread development of hardgrounds, with their specialised fauna, at this level.

Other, minor, turnovers were noted at the top of the Gonioteuthis Zone and at about the level of the base of the Weybourne Chalk, although in both cases, only a few species were involved.

CHAPTER SIX

CONCLUSIONS AND REFERENCES

6.1 CONCLUSIONS

The Norfolk Campanian Chalk was deposited on a tectonically stable shelf at depths between 150 and 200 m in water at a temperature of about twenty degrees Celcius. Occasionally, deposition occurred at lesser depths leading to the formation of hardgrounds, as in the middle of the Weybourne Chalk. Current activity at the sea-floor was very weak, of insufficient strength to reorientate living or dead fauna on the sea-bed and only rarely strong enough to redistribute relatively buoyant (gas filled) irregular echinoid tests.

The actions of bioturbating organisms were largely responsible for disturbing the many fossils, particularly belemnite guards, that were rolled about at, or close to, the sediment surface.

A varied macrofauna, dominated by belemnites, brachiopods, bivalves, echinoids, and siliceous sponges characterised the chalk. The mesofauna, in addition to fragments of larger taxa, contained many small brachiopods, serpulids, echinoderm remains (most commonly cidarid spines, crinoid columnals, asteroid ossicles, and ophiuroid plates), and bryozoans.

At most levels, however, the overall abundance of large fauna was low, averaging only a few specimens for every ten square metres of sea-bed per decade.

The sediment surface was firm enough to support large faunal remains, especially belemnite guards, ammonite shells, and echinoid tests, which were readily colonised by epifaunal brachiopods, bivalves, serpulids, corals, and bryozoans if they remained exposed for any length of time. Much of the epifauna, including juveniles of forms that lived freely on the sediment as adults, could exist only on the hard substrates provided by large faunal remains.

Rarely, as in the hardground complex in the middle of the Weybourne Chalk, the sea-floor was much firmer, and oysters, in particular, were able to spread out over the sea-bed in considerable numbers.

6.2 REFERENCES

ASGAARD, A., 1975. A revision of Sahni's types of the brachiopod subfamily Carneithyridinae. Bulletin of the British Museum (Natural History) Geology, 25, pp. 319-365, 8 pls.

BASSLER, R.S., 1953. Treatise on invertebrate paleontology, part G, Bryozoa, G1-253. University of Kansas Press, Lawrence, Kansas.

BROMLEY, R.G., SCHULZ, M.G., and PEAKE, N.B., 1975. Paramoudras: giant flints, long burrows and the early diagenesis of chalks. Det Kongelige Danske Videnskabernes Selskab Biologiske Skrifter, 20. 31pp.

BRYDONE, R.M., 1930. The "Norwich Chalk". Transactions of the Norfolk and Norwich Naturalists Society, 13, pp. 47-49.

BRYDONE, R.M., 1932. The course of Marsupites and Uintacrinus across Norfolk (with a note on the basal Norwich Chalk). Transactions of the Norfolk and Norwich Naturalists Society, 13, pp. 115-118.

BRYDONE, R.M., 1938. On Correlation of some of the Norfolk Exposures of Chalk with Belemnitella mucronata. Dulau, London.

DAVIDSON, T., 1854. A monograph of British Cretaceous Brachiopoda, 1. Palaeontographical Society (Monograph), London. pp. 1-117, 12 pls.

DAVIDSON, T., 1874. A monograph of British Cretaceous Brachiopoda, 4(1), supplement to the Recent, Tertiary and Cretaceous species. Palaeontographical Society (Monograph), London. pp. 1-72, 8 pls.

GREGORY, J.W., 1899. Catalogue of the fossil Bryozoa in the Department of Geology, British Museum (Natural History). The Cretaceous Bryozoa, 1. xiv + 457 pp., 17 pls. London.

GREGORY, J.W., 1909. Catalogue of the fossil Bryozoa in the Department of Geology, British Museum (Natural History). The Cretaceous Bryozoa, 2. xlviii + 346 pp., 9 pls. London.

HÅKANSSON, E., BROMLEY, R.G. and PERCH-NEILSEN, K., 1974. Maastrichtian chalk of north-west Europe - a pelagic shelf sediment. In: K.J. Hsü and H.C. Jenkyns eds., Pelagic Sediments: on land and under the Sea. Special Publications of the international Association of Sedimentologists, 1, pp. 211-233.

HAYES, J.D. and PITMAN, W.C. III., 1973. Lithospheric plate motions, sea level changes and climatic and ecological consequences. Nature, 246, pp. 18-22.

HORNBY, R.J., GOLDSMITH, J.G. and GOFF, J.C., 1973. Eaton Chalk Pit - Site of Special Scientific Interest. Bulletin of the geological Society of Norfolk, 24, pp. 3-14.

JÄGER, M., 1983. Serpulidae (Polychaeta Sedentaria) aus der norddeutschen höhren Oberkreide-Systematik, Stratigraphie, Ökologie. Geologishes Jahrbuch Reihe A, Heft. 68, pp. 3-219, 16 pls.

KENNEDY, W.J. and GARRISON, R.E., 1975. Morphology and genesis of nodular chalks and hardgrounds in the Upper Cretaceous of southern England. Sedimentology, 22, pp. 311-386.

LANG, W.D., 1921. Catalogue of the fossil Bryozoa (Polyzoa) in the Department of Geology, British Museum (Natural History). The Cretaceous Bryozoa (Polyzoa), 3. cx + 269 pp., 8 pls. London.

LANG, W.D., 1922. Catalogue of the fossil Bryozoa (Polyzoa) in the Department of Geology, British Museum (Natural History). The Cretaceous Bryozoa (Polyzoa), 4. xii + 404 pp., 8 pls. London.

LARWOOD, G.P., 1962. The morphology and systematics of some Cretaceous cribimorph Polyzoa (Pelmatoporinae). Bulletin of the British Museum (Natural History) Geology, 6, pp. 1-285, pls 1-23.

LOWENSTAM, H.A. and EPSTEIN, S., 1954. Palaeotemperatures of the post-Aptian Cretaceous as determined by the oxygen isotope method. Journal of Geology, 62, pp. 207-248.

MÄGDEFRAU, K., 1937. Lebensfurren fossiler "Bohr"-organismen. Beiträge naturkundlichen Forshung Südwestdeutschland, 2, pp. 54-67, 3 pls.

McKINNEY, M.L., 1986. Estimating volumetric fossil abundance from cross - sections : A stereological approach. Palaios, 1, pp. 79-84.

MOORE, R.C., (ed.) 1962. Treatise on invertebrate paleontology, part W, Miscellanea, W1-259. University of Kansas Press, Lawrence, Kansas.

PEAKE, N.B. and HANCOCK, J.M., 1961. The Upper Cretaceous of Norfolk. Transactions of the Norfolk and Norwich Naturalists Society, 19, pp. 293-339.

PEAKE, N.B. and HANCOCK, J.M. 1970. The Upper Cretaceous of Norfolk. In: G.P Larwood and B.M. Funnell, eds. The Geology of Norfolk. Headly Bros., London.

RAWSON, P.F., CURRY, D., DILLEY, F.C., HANCOCK, J.M., KENNEDY, W.J., NEALE, J.W., WOOD, C.J. and WORSSAM, B.C., 1978. A correlation of the Cretaceous rocks in the British Isles. Geological Society of London, Special Report, 9, 70 pp.

SCHLANGER, S.O. and DOUGLAS, R.G., 1974. The pelagic ooze-chalk-limestone transition and its implications for marine stratigraphy. In: K.J. Hsü and H.C. Jenkyns, eds. Pelagic Sediments: on land and under the Sea. Special Publications of the international Association of Sedimentologists, 1, pp. 211-233.

SURLYK, F., 1972. Morphological adaptations and population structures of the Danish Chalk brachiopods (Maastrichtian, Upper Cretaceous). Det Kongelige Danske Videnskabernes Selskab Biologiske Skrifter, 19, 2, pp. 1-57, 5 pls.

SURLYK, F., 1973. Autecology and taxonomy of two Upper Cretaceous brachiopods. Bulletin of the geological Society of Denmark, 22, pp. 219-243, 6 pls.

WITHERS, T.H., 1935. Catalogue of fossil Cirripedia in the Department of Geology, British Museum (Natural History). Volume II Cretaceous. 534 pp., 50 pls. London.

WOOD, C.J., 1988. The stratigraphy of the Chalk of Norwich. Bulletin of the geological Society of Norfolk, 38, pp. 3-120.

WOODS, H., 1903. A monograph of the Cretaceous Lamellibranchia of England. Palaeontographical Society (Monograph), 1. xliii + 232pp., 42 pls.

WOODS, H., 1913. A monograph of the Cretaceous Lamellibranchia of England. Palaeontographical Society (Monograph), 2. 473pp., 62 pls.

PLATES

PLATE 1

1. Belemnitella mucronata (x1) [1425]. Caistor quarry.
2. Cretirhynchia arcuata (x1) [1441-2, 1463]. Caistor quarry.
3. Carneithyris carnea (x0.5) [195]. Caistor Quarry.
4. Cretirhynchia ?norvicensis (juv) (x1) [1857, 1870-1]. Weybourne cliff section.
5. Pycnodonte vesiculare (x0.5) [1872]. Weybourne cliff section.
6. Acutostrea cf. incurva (x1) [827-9]. Caistor quarry.
7. Atreta nilssoni (x1) on belemnite guard. Keswick quarry. (P.S. Whittlesea collection.)
8. Micraster sp. (x0.5) [2479]. Weybourne cliff section.
9. Echinocorys sp. (x0.5) [2675]. Wells quarry.

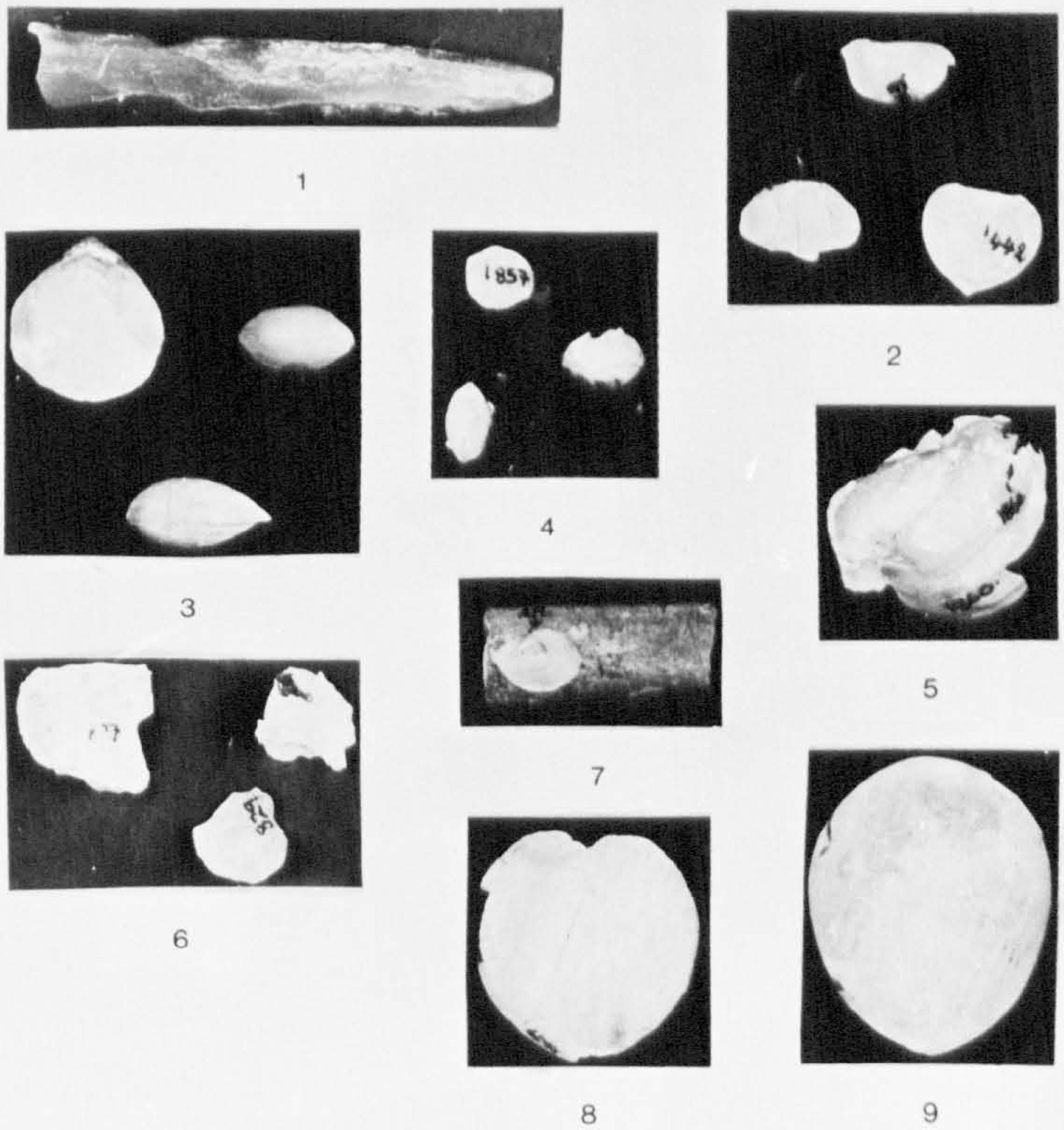


PLATE 1

PLATE 2

(All fossils photographed using a scanning electron microscope.)

1, 2. _Terebratulina_ sp. (x5) Frettenham (JSS. Aggregates). Bulk sample 39.
3, 4. _Isocrania costata_ (x3) Whitlingham. Bulk sample 238.
5. _Neomicrorbis crenatostriatus_ (x8) Newfound Farm, Cringleford. Bulk sample 32.
6. _Neomicrorbis subrugosus_ (x8) Newfound Farm, Cringleford. Bulk sample 33.
7. _Hamulus sexangularis_ (x5) Newfound Farm, Cringleford. Bulk sample 33.
8. _Glomerula gordialis_ (x5) Newfound Farm, Cringleford. Bulk sample 32.
9. "_Serpula_" _accumulata_ (x15) on echinoid test. Weybourne cliff section.
10. _Porosphaera globularis_ (x5) Newfound Farm, Cringleford. Bulk sample 33.
11. _Porosphaera sessilis_ (x5) Stiffkey. Bulk sample 248.
12, 13. _Bourgueticrinus_ sp. (x6) [1694]. Weybourne cliff section.

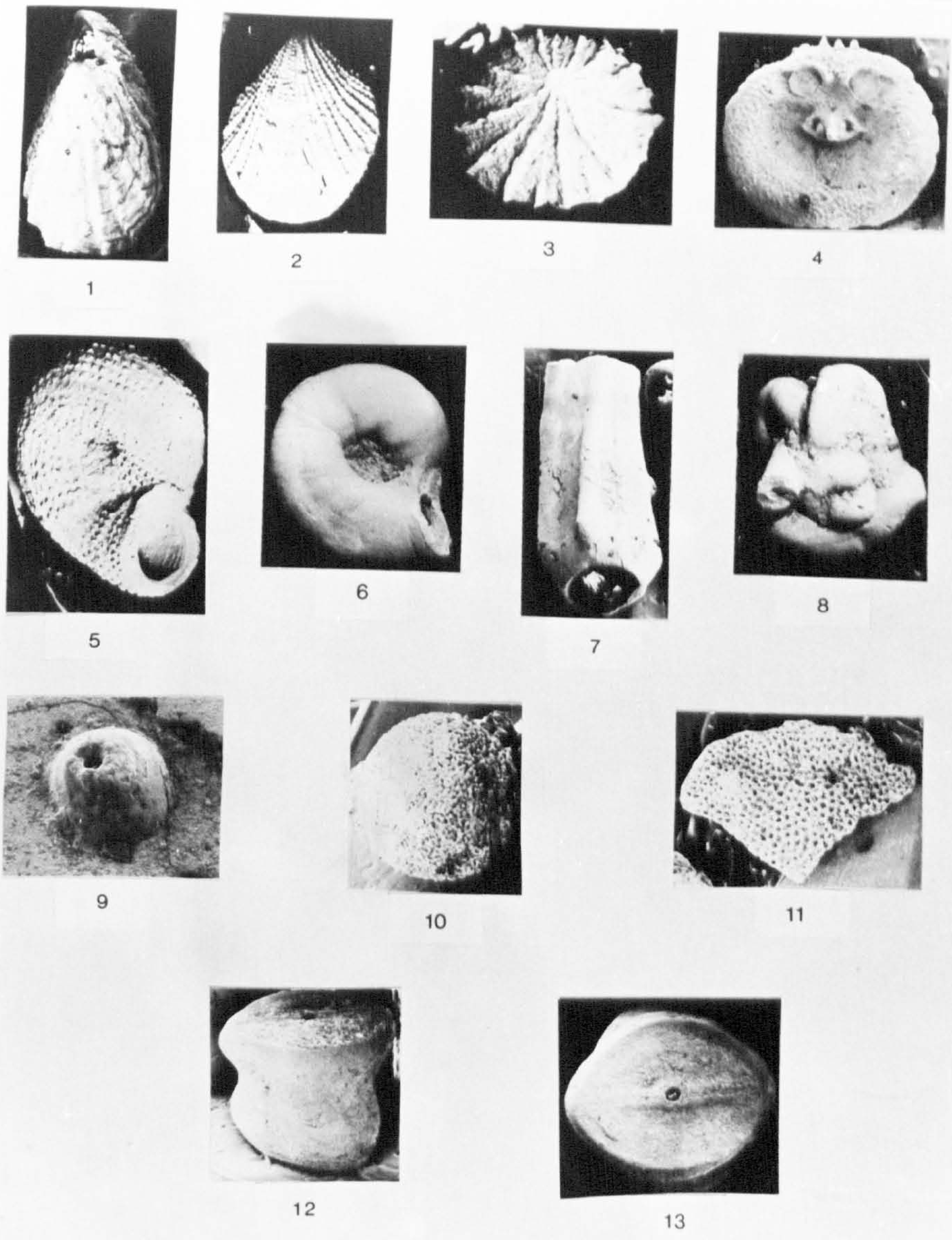


PLATE 2

PLATE 3

(All fossils photographed using a scanning electron microscope.)

1. Onychocella inelegans (x5) Caistor quarry. Bulk sample 2.
2. Onychocella matrona (x5) Frettenham (JSS. Aggregates). Bulk sample 39.
3. Onychocella rowei (x5) Newfound Farm, Cringleford. Bulk sample 32.
4. Onychocella nysti (x5) Newfound Farm, Cringleford. Bulk sample 32.
5. "Biflustra" argus (x5) Weybourne cliff section. Bulk sample 14.
6. Woodipora disparilis (x9) Weybourne cliff section. Bulk sample 14.
7. Vincularia supercilium (x6) Stiffkey. Bulk sample 249.
8. "Membranipora" flabelliformis (x15) Newfound Farm, Cringleford. Bulk sample 35.
9. Volviflustrellaria taverensis (x5) UEA 1. Bulk sample 36.
10. Lunulites sp. (x5) Frettenham (WM. Howes). Bulk sample 26.
11. Petalopora sp. (x7) Keswick quarry. Bulk sample 8.
12. Eohornera langethali (x6) Weybourne cliff section. Bulk sample 11.
13. Sulcocava sp. (x5) Keswick quarry. (P.S. Whittlesea collection.)
14. Disporella irregularis (x5) Weybourne cliff section. Bulk sample 12.
15. Meliceritites sp. (x5) Caistor quarry. Bulk sample 4.
16. Clypeina rosula (x20) Eaton quarry. Bulk sample 31.
17. Pustulopora sp. (x6) Harford Bridges quarry. Bulk sample 24.

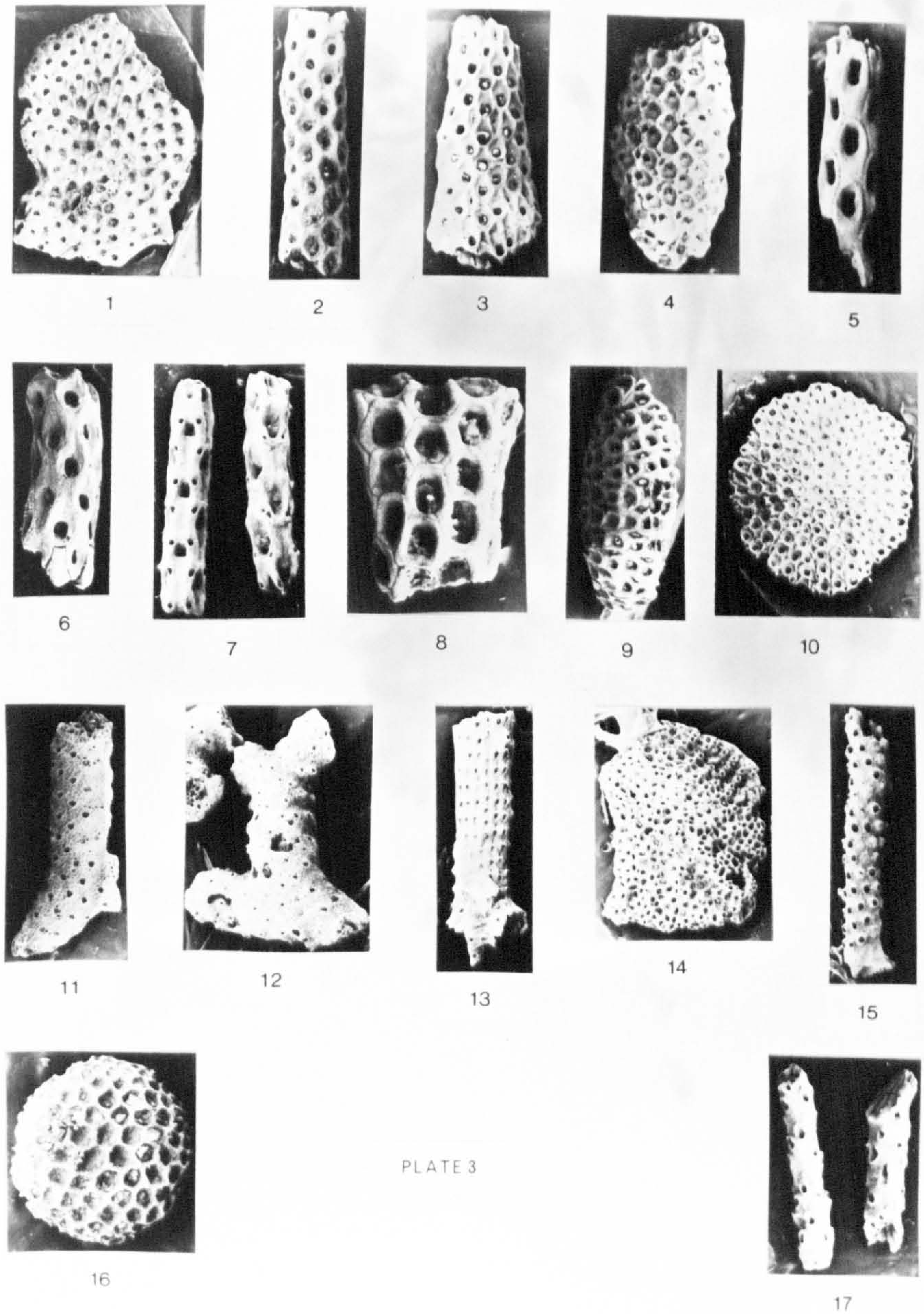


PLATE 3

APPENDICES

APPENDIX ONE

a) ALPHABETICAL INDEX OF CURRENT CHALK EXPOSURES IN THE GONIOTEUTHIS AND BELEMNITELLA MUCRONATA ZONES IN NORFOLK.

Abbreviations: GZ = *Gonioteuthis* Zone; PWC = Pre-Weybourne Chalk; WC = Weybourne Chalk; CSB = Catton Sponge Beds; BC = Beeston Chalk; PC = Paramoudra Chalk. (All grid references are in 100 km square TG except where otherwise indicated.)

ATTLEBRIDGE (Spring Farm)	(1550 1600) [PWC]
BRACONDALE (Colmans)	(2390 0740) [BC]
CAISTOR (Frettenham Lime Company Ltd.)	(2390 0466) [BC]
CLEY-NEXT-THE-SEA	(0540 4400) [PWC]
CRINGLEFORD (Newfound Farm)	(1892 0692) [PWC]
CRINGLEFORD (UEA 1)	(1870 0840) [PWC]
EATON TUNNELS	(2090 0640) [WC]
FRETTENHAM (JSS Aggregates Ltd.)	(2370 1670) [BC]
FRETTENHAM (W.M. Howes Ltd.)	(2460 1730) [BC]
GUIST	(0000 2570) [GZ]
HARFORD BRIDGES	(2188 0576) [WC]
HELLESDON (Whiffler Road)	(2120 1070) [WC]
KESWICK (W. M. Howes Ltd.)	(2120 0485) [WC]
MARLINGFORD	(1370 0930) [GZ]
SPARHAM 1	(0580 1890) [GZ]
SPARHAM 2	(0650 1900) [GZ]
STIFFKEY	(TF 9780 4310) [GZ]
ST. JAMES'S HOLLOW	(2420 0950) [BC]
THARSTON (Furze Hill)	(TM 1940 9560) [PWC]
WELLS	(TF 9280 4290) [GZ]
WEYBOURNE HOPE -	(1115 4369) [WC] -
OLD BUTTS GAP	(1236 4362) [WC]
WEYBOURNE HOPE EAST	(1290 4360) [WC] -
	(1390 4350) [WC]
WHITLINGHAM	(1681 0770) [PC]

b) ALPHABETICAL INDEX OF KNOWN, BUT UNEXPOSED / OBLITERATED SECTIONS IN THE <u>GONIOTEUTHIS</u> AND <u>BELEMNITELLA</u> <u>MUCRONATA</u> ZONES IN NORFOLK (AS AT 1.10. 1988). Abbreviations as in appendix 1a.

ALDBOROUGH	(1740 3580) [WC]
ALDERFORD	(1180 1840) [GZ]
ALDERFORD COMMON	(1290 1840) [GZ/PWC]
ATTLEBRIDGE	(1490 1560) [GZ]
ATTLEBRIDGE	(1340 1650) [GZ]
ATTLEBRIDGE	(1418 1570) [GZ]
BAWBURGH	(1610 0906) [GZ]
BAWBURGH	(1470 0960) [GZ]
BAWBURGH	(1450 0890) [GZ]
BINHAM	(TF 9900 4020) [GZ]
BLAKENEY	(0330 4360) [PWC]
BLAKENEY	(0230 4320) [PWC]
BLAKENEY	(0190 4260) [GZ]
BURGH-NEXT-AYLSHAM	(2240 2540) [WC]
CATTON GROVE (Camplings Pit)	(2289 1094) [WC/CSB/BC]
CLEY GREEN	(0480 4330) [PWC]
COCKTHORPE COMMON	(TF 9850 4300) [GZ]
COLNEY	(1802 0903) [PWC]
COLNEY	(1755 0790) [PWC]
COLNEY	(1700 0927) [PWC]
COLNEY	(1630 0890) [PWC]
COSTESSEY	(1690 1140) [PWC]
COSTESSEY	(1732 1162) [PWC]
CRINGLEFORD	(1940 0618) [PWC]
CRINGLEFORD	(1960 0530) [PWC]
CRINGLEFORD (Cantley Pit)	(1810 0810) [PWC]
CROSTWICK	(2650 1640) [BC]
FIDDLERS HILL	(TF 9630 4100) [GZ]
FLORDON	(1900 9720) [PWC]
GREAT HAUTBOIS	(2670 2040) [BC]
GREAT WALSINGHAM	(2670 2040) [BC]
HELLESDON	(1950 0980) [PWC]
HEMPSTEAD	(1090 3670) [PWC]
HEYDON	(1200 2890) [PWC]
HORSTEAD (Little Switzerland)	(2570 1730) [PC]
HORSTEAD	(2560 2000) [BC]
LANGHAM	(0090 4170) [GZ]
LENWADE	(0860 1720) [GZ]
LENWADE	(0940 2000) [GZ]
LETHERINGSETT	(0560 3980) [PWC]
LETHERINGSETT	(0540 3880) [PWC]
LYNG	(0780 1710) [GZ]

MATLASK	(1500 3330) [PWC/WC]
MORSTON	(TF 9980 4390) [GZ]
MORSTON	(0040 4390) [GZ/PWC]
MORSTON DOWNS	(0170 4370) [GZ/PWC]
NEWTON FLOTMAN	(TM 2106 9830) [WC]
NORWICH	(2220 0870) [WC]
NORWICH ("Baculite" Pit)	(2280 0860) [WC]
NORWICH	(2230 0860) [WC]
NORWICH	(2380 0780) [WC]
NORWICH (Stonehills Pit)	(2100 0920) [PWC/WC]
NORWICH (Earlham Limeworks)	(2010 0930) [PWC/WC]
OLD CATTON (Attoes Pit)	(2390 1180) [WC/CSB/BC]
RACKHEATH	(2710 1550) [BC]
RINGLAND	(1250 1320) [GZ]
RINGLAND	(1360 1440) [GZ]
RINGLAND	(1300 1460) [GZ]
RINGLAND	(1380 1270) [GZ]
SHERINGHAM	(1690 4320) [BC]
STIFFKEY	(TF 9680 4330) [GZ]
STIFFKEY	(TF 9770 4320) [GZ]
STOKE HOLY CROSS	(2330 0260)[WC/CSB]
STOKE HOLY CROSS	(2536 0140) [WC/CSB/BC]
SWANTON MORLEY	(0190 1780) [GZ]
TASBURGH	(TM 2030 9550) [PWC]
TAVERHAM	(1474 1386) [PWC]
TAVERHAM	(1490 1350) [PWC]
TAVERHAM	(1620 1410) [PWC]
THORPE ST. ANDREW (Lollards Pit)	(2410 0890) [BC]
THORPE ST. ANDREW	(2866 0801) [PC]
THORPE ST. ANDREW	(2755 0900) [PC]
THURSFORD	(TF 9920 3420) [GZ]
TROWSE NEWTON (Crown Point Pit)	(2500 0690) [BC]
UPPER SHERINGHAM	(1410 4130) [WC]
UPPER SHERINGHAM	(1480 4170) [WC]
WELLS	(TF 9280 4270) [GZ]
WELLS	(TF 9080 4380) [GZ]
WEYBOURNE	(1120 4310) [WC]
WRAMPLINGHAM	(1150 0610) [GZ]

APPENDIX TWO

List of all bulk samples collected from sections and boreholes. Abbreviations: P/D (M) = position or depth in metres; BH NO = borehole number; CD (M rel to OD) = absolute depth in metres relative to ordnance datum. Localities: CS = Caistor St. Edmund; KS = Keswick; WH = Weybourne Hope; MW = Mayton Wood boreholes; HBR = Harford Bridges; FR2 = Frettenham (W. M. Howes); FR1 = Frettenham (J.S.S. Aggregates); ET = Eaton; NFF = Newfound Farm, Cringleford; UEA1 = University of East Anglia; CBR = Colmans, Bracondale; WYM = Wymondham boreholes; WIT = Whitlingham boreholes; NCH = Norwich boreholes; SP2, SP1 = Sparham; CL = Cley-next-the-sea; WHE = Weybourne Hope East; SPF = Spring Farm, Attlebridge; SJH = St. James's Hollow; GU = Guist; MF = Marlingford; TH = Tharston; WHR = Whiffler Road, Hellesdon; WLS = Wells; STF = Stiffkey.

NO.	LOC	GRID REF	P/D (M)	BH NO	CD (M rel to OD)	NOTES
1	CS	TG2390004660	B1-B2	-	2.00-3.00	not accurately positioned
2	CS	TG2390004660	-80--100B3	-	5.50	-
3	CS	TG2390004660	B5-B6	-	9.50	as 1
4	CS	TG2390004660	B5-B6	-	9.50	as 1
5	CS	TG2390004660	B7-B8	-	11.50	as 1
6	KS	TG2120004850	-	-	-	pos. unknown
7	KS	TG2120004850	-270BI	-	1.00	-
8	KS	TG2120004850	BC-BD	-	8.50	as 1
9	KS	TG2120004850	BC-BD	-	8.50	as 1
10	WH	TG1105043690	BELOW B1	-	5.00	as 1
11	WH	TG1135043660	B2-B3	-	5.00	as 1
12	WH	TG1150043650	B4-B5	-	5.00	as 1
13	WH	TG1185043640	B9-B10	-	5.00	as 1
14	WH	TG1220043630	B11-B12	-	5.00	as 1
15	MW	TG2465020980	8.4	1A	8.6	-
16	MW	TG2465020980	14.6	1A	2.4	-
17	MW	TG2465020980	8.4	1A	8.6	-
19	MW	TG2465020980	1	1	16	-
20	MW	TG2465020980	0.65	2	16.35	-
21	MW	TG2465020980	1.45	4	15.55	-
22	MW	TG2465020980	1.3	6	15.70	-
23	MW	TG2465020980	2.85	3	14.15	-
24	HBR	TG2188005760	70-90B1	-	14.00	-
25	FR2	TG2460017300	-25--35B2	-	13.25	-
26	FR1	TG2370016700	-105--120B1	-	13.75	-
27	ET	TG2087006350	-30--45B8	-	6.50	-
28	ET	TG2087006350	-20--40B1	-	15.50	-
29	ET	TG2087006350	-15--25B6	-	7.75	-
30	ET	TG2087006350	-55--75B4	-	10.50	-
31	ET	TG2087006350	-65--75B2	-	13.50	-
32	NFF	TG1892006920	-10--20B2	-	10.75	-
33	NFF	TG1892006920	B3--20B3	-	8.75	-
34	NFF	TG1892006920	-25--35B1	-	11.75	-
35	NFF	TG1892006920	-120--130B2	-	9.75	-
36	UEA1	TG1870008400	-20--30B1	-	11.25	-
37	UEA1	TG1870008400	50-60B2	-	13.25	SHWC
38	FR1	TG2370016700	-20--35B2	-	13.25	SHWC
39	FR1	TG2370016700	-45--55B1	-	11.25	SHWC
40	CBR	TG2390007400	65-75B2	-	8.50	-
41	CBR	TG2390007400	-35--45B2	-	7.00	-
42	CBR	TG2390007400	B1--10B1	-	9.00	-
55	MW	TG2465020980	1.95	5	15.05	-
56	MW	TG2465020980	17.7	1A	-0.7	-10%flint
64	ET	TG2087006350	-25--35B5	-	9.00	UHG
65	WYM	TM1010098580	20.20	27	21.79	-
66	WYM	TM1010098580	25.60	27	16.39	-
67	WYM	TM1010098580	27.55	27	14.44	-
68	WYM	TM1010098580	28.40	27	13.59	-
69	WYM	TM1010098580	29.55	27	12.44	-
70	WYM	TM1015498758	25.70	29	15.00	-
71	WYM	TM1015498758	29.00	29	11.70	-
72	WYM	TM0938098260	28.50	33	14.00	-
73	WYM	TM0938098260	29.90	33	12.60	-
74	WYM	TM1107699432	18-18.50	46	29.30-28.80	-
75	WYM	TM1107699432	19.00	46	28.30	-
76	WYM	TM1107699432	21-21.50	46	26.30-25.80	-
77	WYM	TM1107699432	24-24.50	46	23.30-22.80	-
78	WYM	TM1107699432	25.50-26	46	21.80-21.30	-
79	WYM	TM1107699432	27-27.50	46	20.30-19.80	-
80	WYM	TM1107699432	28.50-29	46	18.80-18.30	-
81	WYM	TM1107699432	29.50-30	46	17.80-17.30	-
82	WYM	TG1242500706	12.45	68	22.95	-
83	WYM	TG1242500706	13.50	68	21.90	-
84	WYM	TG1242500706	15.45	68	19.95	-
85	WYM	TG1253300320	13.00	71	25.40	-
86	WYM	TG1253300320	14.80	71	23.60	-
87	WYM	TG1253300320	16.80	71	21.60	+BH73 21.50
88	WYM	TG1253300320	17.70	71	20.70	-
89	WYM	TG1253300320	19.20	71	19.20	-
90	WYM	TG1253300320	21.00	71	17.40	-
-	WYM	TG1253300320	24.00	71	14.40	no sample
91	WYM	TG1253300320	25.00	71	13.40	-

NO.	LOC	GRID REF	P/D (M)	BH NO	CD (M rel to OD)	NOTES
92	WYM	TG1253300320	27.00	71	11.40	-
93	WYM	TG1253300320	28.00	71	10.40	-
94	WYM	TG1253300320	30.00	71	8.40	-
95	WYM	TG1254200342	13.80	73	24.50	-
96	WYM	TG1257400333	10.00	74	28.10	-
97	WYM	TG1257400333	10.90-11.35	74	27.20-26.75	-
98	WYM	TG1257400333	12.90	74	25.20	-
99	WYM	TG1257400333	14.00-14.45	74	24.10-23.65	-
100	WYM	TG1255300318	15.50	75	22.60	-
101	WYM	TG1255300318	18.50	75	19.60	-
-	WYM	TG1255300318	19.20	75	18.90	no sample processed
102	WYM	TG1255300318	21.70	75	16.40	-
103	WYM	TG1255300318	23.00	75	15.10	-
104	WYM	TG1255300318	25.00	75	13.10	-
105	WYM	TG1255300318	26.00	75	12.10	-
106	WYM	TG1255300318	28.00	75	10.10	-
107	WYM	TG1255300318	28.85	75	9.25	-
108	WYM	TG1255300318	30.90	75	7.20	-
109	WYM	TG1255300318	32.00	75	6.10	-
110	WYM	TG1255300318	34.00	75	4.10	-
111	WYM	TG1270200861	16.45	81	28.95	-
112	WYM	TG1270200861	17.95	81	27.45	-
113	WYM	TG1270200861	21.45	81	23.95	-
114	WYM	TG1270200861	23.45	81	21.95	-
115	WYM	TG1276600906	24.95	85	20.45	-
116	WYM	TG1276600906	26.50	85	18.90	-
117	WYM	TG1276600906	27.95	85	17.45	-
118	WYM	TG1276600906	29.00	85	16.40	-
119	WYM	TG1276600906	32.00	85	13.40	-
120	WYM	TG1276600906	33.95	85	11.45	-
121	WYM	TG1276600906	34.50	85	10.90	-
122	WHIT	TG2770007070	14.15-35	1	10.05-9.85	CYNC
123	WHIT	TG2770007070	15.15-35	1	9.05-8.85	-
124	WHIT	TG2770007070	16.15-35	1	8.05-7.85	-
125	WHIT	TG2770007070	17.15-35	1	7.05-6.85	-
126	WHIT	TG2770007070	18.15-35	1	6.05-5.85	-
127	WHIT	TG2770007070	19.15-35	1	5.05-4.85	SWNC
128	WHIT	TG2770007070	20.15-35	1	4.05-3.85	-
129	WHIT	TG2770007070	21.15-35	1	3.05-2.85	-
130	WHIT	TG2770007070	22.15-35	1	2.05-1.85	-
131	WHIT	TG2770007070	23.15-35	1	1.05-0.85	-
132	WHIT	TG2770007070	24.15-35	1	0.05--0.15	-
133	WHIT	TG2770007070	25.15-35	1	-0.95--1.15	-
134	WHIT	TG2770007070	26.15-35	1	-1.95--2.15	-
135	WHIT	TG2770007070	27.15-35	1	-2.95--3.15	-
136	WHIT	TG2770007070	28.65-85	1	-4.45--4.65	-
137	WHIT	TG2770007070	29.65-85	1	-5.45--5.65	1LFIS
138	WHIT	TG2770007070	31.15-35	1	-6.95--7.15	-
139	WHIT	TG2770007070	32.15-35	1	-7.95--8.15	-
140	NCH	TG2459008040	7-7.50	6	0--0.50	LFIS
141	NCH	TG2459008040	8-8.50	6	-1--1.50	LFIS
142	NCH	TG2459008040	9-9.50	6	-2--2.50	SHWNC
143	NCH	TG2459008040	11-11.50	6	-4--4.50	SHYNC
144	NCH	TG2459008040	12-12.50	6	-5--5.50	SHY/WNC
145	NCH	TG2459008040	13-13.50	6	-6--6.50	1LFIS MHW/YNC
146	NCH	TG2459008040	14-14.50	6	-7--7.50	MHW/YNC
147	NCH	TG2459008040	15-15.50	6	-8--8.50	-
148	NCH	TG2459008040	15-16.50	6	-9--9.50	LFIS CHYNC
149	NCH	TG2459008040	17-17.50	6	-10--10.50	RHWNC
150	NCH	TG2459008040	18-18.50	6	-11--11.50	SHWNC
151	NCH	TG2459008040	19-19.50	6	-12--12.50	LFIS
152	NCH	TG2459008040	20-20.50	6	-13--13.50	SHWNC
153	NCH	TG2459008040	21-21.50	6	-14--14.50	SHWNC
154	NCH	TG2459008040	22-22.50	6	-15--15.50	LFIS
155	NCH	TG2459008040	23-23.50	6	-16--16.50	-
156	NCH	TG2459008040	24-24.50	6	-17--17.50	LFIS RHWNC
157	NCH	TG2459008040	26-26.50	6	-19--19.50	LFIS RHWNC
158	NCH	TG2459008040	27-27.50	6	-20--20.50	SHWNC
159	NCH	TG2459008040	28-28.50	6	-21--21.50	SHW/YNC
160	NCH	TG2459008040	29-29.50	6	-22--22.50	SHWNC
161	NCH	TG2459008040	30-30.50	6	-23--23.50	LFIS CHWNC
162	NCH	TG2459008040	31-31.50	6	-24--24.50	LFIS

NO.	LOC	GRID REF	P/D (M)	BH NO	CD (M rel to OD)	NOTES
163	NCH	TG2459008040	32-32.50	6	-25--25.50	LFIS SHYNC
164	NCH	TG2459008040	33-33.50	6	-26--26.50	LFIS
165	NCH	TG2459008040	34-34.50	6	-27--27.50	CHNYC
166	NCH	TG2459008040	36-36.50	6	-29--29.50	LFIS SHNW/YC
167	NCH	TG2459008040	37-37.50	6	-30--30.50	SHNWC
168	NCH	TG2459008040	38-38.50	6	-31--31.50	-
169	NCH	TG2459008040	39-39.50	6	-32--32.50	LFIS
170	NCH	TG2459008040	40-40.50	6	-33--33.50	LFIS
171	NCH	TG2459008040	41-41.50	6	-34--34.50	RHWNC
172	NCH	TG2459008040	42-42.50	6	-35--35.50	RHWNC
173	NCH	TG2459008040	43-43.50	6	-36--36.50	-
174	NCH	TG2459008040	44-44.50	6	-37--37.50	-
175	NCH	TG2459008040	46-46.50	6	-39--39.50	LFIS
176	NCH	TG2459008040	47-47.50	6	-40--40.50	-
177	NCH	TG2459008040	48-48.50	6	-41--41.50	LFIS
178	NCH	TG2459008040	49-49.50	6	-42--42.50	-
179	WHIT	TG2757007710	2.50-3	2	3.70-3.20	-
180	WHIT	TG2757007710	3.50-4	2	2.70-2.20	-
181	WHIT	TG2757007710	4.50-5	2	1.70-1.20	ILFIS
182	WHIT	TG2757007710	5.50-6	2	0.70-0.20	-
183	WHIT	TG2757007710	6.50-7	2	-0.30--0.80	small sample
184	WHIT	TG2757007710	8-8.50	2	-1.80--2.30	-
185	WHIT	TG2757007710	11.50-12	2	-5.30--5.80	-
186	WHIT	TG2757007710	13.50-14	2	-7.30--7.80	-
187	WHIT	TG2757007710	14.50-15	2	-8.30--8.80	small sample
188	WHIT	TG2757007710	15.50-16	2	-9.30--9.80	small sample
189	WHIT	TG2757007710	17.50-18	2	-11.30--11.80	-
190	WHIT	TG2757007710	19-19.50	2	-12.80--13.30	-
191	NCH	TG2425007920	9-9.50	5	-7--7.50	LFsIS SFWNC
192	NCH	TG2425007920	10-10.50	5	-8--8.50	FIS SFWNC
193	NCH	TG2425007920	11-11.50	5	-9--9.50	FIS SFWNC
194	NCH	TG2425007920	12-12.50	5	-10--10.50	RFWNC
195	NCH	TG2425007920	13-13.50	5	-11--11.50	LFIS
196	NCH	TG2425007920	14-14.50	5	-12--12.50	1VLFIS CFWNC
197	NCH	TG2425007920	15-15.50	5	-13--13.50	LFsIS SFWNC
198	NCH	TG2425007920	16-16.50	5	-14--14.50	LFsIS CHWNC
199	NCH	TG2425007920	17-17.50	5	-15--15.50	1VLFIS SFWNC
200	NCH	TG2425007920	18-18.50	5	-16--16.50	SFWNC
201	NCH	TG2425007920	20-20.50	5	-18--18.50	LFIS
202	NCH	TG2425007920	21-21.50	5	-19--19.50	RFWNC
203	NCH	TG2425007920	22-22.50	5	-20--20.50	SHWNC
204	NCH	TG2425007920	23-23.50	5	-21--21.50	FsIS VCVHW/YNC
205	NCH	TG2425007920	24-24.50	5	-22--22.50	FsIS SFWNC
206	NCH	TG2425007920	25-25.50	5	-23--23.50	SFWNC
207	NCH	TG2425007920	26-26.50	5	-24--24.50	LFIS
208	NCH	TG2425007920	27-27.50	5	-25--25.50	LFIS
209	NCH	TG2425007920	28-28.50	5	-26--26.50	-
210	NCH	TG2425007920	32-32.50	5	-30--30.50	-
211	NCH	TG2425007920	33-33.50	5	-31--31.50	-
212	NCH	TG2425007920	34-34.50	5	-32--32.50	-
213	NCH	TG2425007920	35-35.50	5	-33--33.50	FsIS
214	NCH	TG2425007920	36-36.50	5	-34--34.50	-
215	NCH	TG2425007920	37-37.50	5	-35--35.50	1LFIS SHWNC
216	NCH	TG2425007920	38-38.50	5	-36--36.50	SHWNC
217	NCH	TG2425007920	39-39.50	5	-37--37.50	-
218	NCH	TG2425007920	40-40.50	5	-38--38.50	FsIS
219	NCH	TG2425007920	41-41.50	5	-39--39.50	FsIS RFWNC
220	NCH	TG2425007920	42-42.50	5	-40--40.50	-
221	NCH	TG2425007920	43-43.50	5	-41--41.50	RFW/YNC
222	NCH	TG2425007920	44-44.50	5	-42--42.50	-
223	NCH	TG2425007920	45-45.50	5	-43--43.50	-
224	NCH	TG2425007920	46-46.50	5	-44--44.50	RFWNC
225	NCH	TG2425007920	47-47.50	5	-45--45.50	SHW/YNC
226	NCH	TG2425007920	48-48.50	5	-46--46.50	FsIS SFWNC
227	NCH	TG2425007920	50-50.50	5	-48--48.50	RFWNC
228	SP1	TG0580018900	-20--40B1	-	20.50	-
229	SP2	TG0650019000	-75--90B1	-	26.50	-
230	CL	TG0540044000	-	-	9.25	MHYNC car park
231	WHE	TG1370043520	-45--55B4	-	5.00	-
232	WHE	TG1395042950	-5--15B6	-	5.00	MHYNC
233	SPF	TG1550016000	-	-	18.50	-
234	SJH	TG2420009500	-50--70TOP	-	14.00	-

NO.	LOC	GRID REF	P/D (M)	BH NO	CD (M rel to OD)	NOTES
235	GU	TG0000025700	-	-	43.50	-
236	MF	TG1370009300	-	-	20.50	-
237	TH	TG1940095600	-	-	41.25	-
238	WHIT	TG2681007700	-25--35B2	-	11.50	-
239	WHIT	TG2681007700	-160--170B1	-	9.50	-
240	WHR	TG2120010700	-30--40B1	-	11.25	-
241	WHR	TG2120010700	-55--70B2	-	13.25	-
242	WLS	TF9280042900	-5--15B12	-	11.25	GS
243	WLS	TF9280042900	-15--35MB	-	5.25	GS
244	WLS	TF9280042900	B4	-	3.25	GS
245	WLS	TF9280042900	MB	-	5.75	GS
246	WLS	TF9280042900	-50--65B8	-	7.25	GS
247	WLS	TF9280042900	-10--20B1	-	1.25	GS
248	STF	TF9780043100	-35--45B2	-	7.25	GS
249	STF	TF9780043100	-85--100B6	-	10.25	GS

APPENDIX THREE

a) List of epifaunal and boring abbreviations used in appendices 3b-7, inclusive.

NAME	ABBREV.
ANCISTOCRANIA PARISIENS (Defrance)	AP
DIOMYODON Spp	DY
ATRETA NILSSONI (Von Hagenow)	AN
GYROPLEURA INEQUIROSTRATA (S.Woodward)	GI
OSTREA Spp	OT
PYCNODONTE VESICULARE (Lamarck)	PV
SPONDYLUS DUTEMPLEANUS (d'Orbigny)	SD
CEMENTULA SPIRASERPULA (Regenhardt)	CS
CEMENTULA Spp	CE
CONORCA TROCHIFORMIS (Hagenow)	CN
FILOGRANULA CINCTA (Goldfuss)	FC
GLOMERULA GORDIALIS (Schlotheim)	GG
NEOMICRORBIS CRENATOSTRIATUS (Münster)	NC
NEOMICRORBIS Spp	NE
NEOMICRORBIS SUBRUGOSUS (Münster)	NS
PENTADITRUPA SUBTORQUATA (Münster)	PS
SCLEROSTYLA MACROPUS (Sowerby)	SM
SCLEROSTYLA Spp	SS
"SERPULA" ACCUMULATA S. Woodward	SA
VEPRECULINA FIMBRIATA Regenhardt	VF
VEPRECULINA Spp	VP
VEPRECULINA TUBERCULIFERA (Nielsen)	VT
VERMILIOPSIS FLUCTUATA (Sowerby)	VL
unidentified worm tube remains	uw
hexactinellid sponge (mould)	hx
POROSPHAERA SESSILIS Brydone	PO
POROSPHAERA Spp	PH
BULLOPORA Sp	BU
COELOSMILIA Spp	CO
foraminiferal remains	fr
MOLTKIA Spp	MO
AECHMELLA ANGLICA (Brydone)	AA
AECHMELLA NITESCENS (Brydone)	AE
ANDRIOPORA MAJOR Larwood	AM
APLOUSINA FULGORA (Brydone)	AF
APLOUSINA Spp	AL
"BIFLUSTRA" Spp	BF
CASTANOPORA CASTANEA Lang	CC
CASTANOPORA DIBLEYI (Brydone)	CD
CASTANOPORA MAGNIFICA (d'Orbigny)	CM
CASTANOPORA Spp	CT
DIONELLA Spp	DL
DIONELLA TRIFARIA (Von Hagenow)	DT
DIONELLA TRIGONOPORA (Marsson)	DG
ELLISINA RINGENS (Von Hagenow)	ER
HERPETOPORA LAXATA (d'Orbigny)	HL
HERPETOPORA Spp	HE
HOMALOSTEGA CLATHRATA Beissel	HC
HOMALOSTEGA Spp	HO
LEPTOCHEILOPORA MAGNA Lang	LM
LEPTOCHEILOPORA Spp	LE
"MEMBRANIPORA" EXHAURENSIS Brydone	ME
"MEMBRANIPORA" FURINA (Brydone)	MF
"MEMBRANIPORA" LANGEI Brydone group	ML
"MEMBRANIPORA" PALPEBRA var. NUNTIANS Brydone	MP
"MEMBRANIPORA" Spp	MS
"MEMBRANIPORA" TENEBROSA Brydone group	MT
"MEMBRANIPORA" WITHERSI (Brydone)	MW
"MEMBRANIPORELLA" MONASTICA Brydone	MM

NAME	ABBREV.
MICROPORA BEDENENSIS (Brydone)	MB
ONYCHOCELLA GIBBOSUM (Marsson)	OG
ONYCHOCELLA INELEGANS Lonsdale	OI
ONYCHOCELLA NORFOLCIA Brydone	ON
ONYCHOCELLA NYSTI (Von Hagenow)	OY
ONYCHOCELLA Spp	OS
PLIOPHLOEA cf SUBVITREA (Brydone)	PL
TRICEPHALOPORA Spp	TR
UBAGHSIA CRASSA (Lang)	UC
UBAGHSIA Spp	US
CRYPTOSTOMELLA COMPACTA (Brydone)	CP
BICAVEA Spp	BI
CRISINA Spp	CR
HOMOEOSOLEN Spp	HM
SULCOCAVA Spp	SU
CLAUSA GLOBULOSA (d'Orbigny)	CG
DISPORELLA IRREGULARIS (d'Orbigny)	DS
DISPORELLA Spp	DP
ACTINOPORA Spp	AC
DIASTOPORA Spp	DA
IDMONEA Spp	ID
PROBOSCINA Spp	PR
STOMATOPORA GRACILIS (Edwards)	SG
STOMATOPORA PEDICELLATA (Marsson)	SP
STOMATOPORA Spp	ST
bryozoan attachment remains	by
cheilostome bryozoan attachments	cb
unidentified bryozoan remains	uy
CALCIDELETRIX Spp	CA
DENDRINA BELEMNITICOLA Mägdefrau	DB
DICTYOPORUS NODOSUS Mägdefrau	DN
DICTYOPORUS Spp	DI
echinoid 'bite' marks	eb
ENTOBIA Spp	EN
?NYGMITES Spp	?N
PODICHNUS Sp	PD
RAMOSULCICHNUS BIFRONS group	RB
ROGERELLA Spp	RO
SIMONIZAPFES Spp	SI
TALPINA Spp	TA
unidentified borings	ub

b) List of all fossils found in the quarry at Caistor St. Edmund (TG 23900 04660). Column heading abbreviations: TAX = taxonomic description; DES = description; POS = level below next numbered flint band above, in cm; FB = flint band; DIM = dimensions in cm; ORI = angular orientation; BOR/EPI = number of borings/epifaunal remains in each quadrant (NE/SE/SW/NW) for belemnites, per specimen for other taxa; B(D)/E(D) = identified borings/epifaunal remains (abbreviations as in appendix 3a). Within column abbreviations: G = belemnite guard; A = belemnite alveolus; (XE) = tip end of belemnite guard absent; NC = not collected; MC = mostly complete; (CR/CRU) = crushed; MC = mostly complete; PV = pedicle valve.

NO	TAX	DES	POS	FB	DIM	ORI	BOR	EPI	B(O)	E(O)
2652	GLAUCONITE	PEBBLES	BEL	1	-	-	-	-	-	-
683	BELEMNITELLA	G	-5	1	32.4 10.3	1330760	0110 2	0100 1	CA	?NO
584	C NORVICENSIS Pettitt	CS	-20	1	16.4 16.4 11.5	PVB	-	-	-	-
2545	ORBIRHYNCHIA Sp	CS	-20	1	11.2 12.9 7.2	PVT	-	-	-	-
615	S DUTEMPLEANUS d'Orbigny	FRAGS	-20	1	-	-	-	-	-	-
737	?GLOMERULA Sp	tube	-25	1	-	-	-	-	-	-
705	BELEMNITELLA	A	-25	1	28.2 11.8	160001U	NNNN N	0	DB TA	-
738	C CARNEA (J. Sowerby)	PS	-25	1	-	-	-	-	-	-
583	BELEMNITELLA	G+A(XE)	-30	1	19.5 5.3	800091U	NNNN N ALL	0	CA DB	-
601	BELEMNITELLA	G+A	-30	1	75.0 12.2	90U	0	1110 3	-	AN MO
676	C CARNEA (J. Sowerby)	FRAGS	-30	1	-	-	-	-	-	-
684	ECHINOCORYS	FRAGS	-40	1	-	-	-	-	-	DS ST
609	BELEMNITELLA	G+A(XE)	-55	1	40.3 14.5	1532520	NNNN N ALL	0334 10	CA DB	AN NC NL MS
621	BELEMNITELLA	A	-55	1	26.8 15.5	433160U	N00N N NEINW	0	CA DB	-
594	BELEMNITELLA	G+A	-60	1	51.9 13.5	1531300	00NN N SWINW	0308 3	CA DB ?N	AN; BU ?4r
612	ECHINOCORYS	-	-60	1	-	0IS	-	-	-	-
614	C CARNEA (J. Sowerby)	FRAGS	-65	1	-	-	-	-	-	-
589	BELEMNITELLA	G	-70	1	32.4 12.9	221050	NOON N NEINW	0022 4	CA RO	AN CO 4r MS ST
630	BELEMNITELLA	G+A	-70	1	38.8 6.5	850070U	NNNN N ALL	0	?TA	-
634	BELEMNITELLA	G+A(XE)	-70	1	51.5 10.8	90U	NOON N NEINW	0001 1	CA DB TA	AN; BU
600	BELEMNITELLA	G+A(XE)	-	1	38.4 12.6	2131540	1100 2	0011 2	CA DB	AN; MO
618	BELEMNITELLA	G+A(XE)	-	1	51.0 10.2	931440D	00NN N SWINW	0031 4	?	AN MO MS
623	BELEMNITELLA	G+A	-	1	66.1 11.4	5023220	NNNN N ALL	4204 10	CA DB ?N RO	AN CO 10 MS ST UC
628	BELEMNITELLA	G+A(XE)	-	1	63.3 12.4	1021300	NNNN N ALL	5002 7	CA DB ?N RO	4r ?CO MS
890	BELEMNITELLA	in fl NC	-	1	-	692079U	-	-	-	-
753	BOURGUETICRINUS Sp	COLUMNAL	-	1	-	-	-	-	-	-
754	C CARNEA (J. Sowerby)	NC	-	1	-	-	-	-	-	-
892	C CARNEA (J. Sowerby)	FRAG NC	-	1	-	-	-	-	-	-
885	SPONGE	NC	-	1	-	-	-	-	-	-
886	C CARNEA (J. Sowerby)	FRAG NC	-5	2	-	-	-	-	-	-
136	C NORVICENSIS Pettitt	MC(CRU)	-5	2	12.4 15.6 10.1	PVB	-	-	-	-
102	C CARNEA (J. Sowerby)	FRAG	-7	2	13.2 12.8 7.5	-	-	-	-	-
696	BELEMNITELLA	A	-10	2	57.5 9.4	33024U	464N N NW	0010 1	CA DB TA	?NE
887	BELEMNITELLA	smashed NC	-10	2	-	58220U	-	-	-	-
761	C CARNEA (J. Sowerby)	FRAGS	-10	2	-	-	-	-	-	-
114	C NORVICENSIS Pettitt	CS(CRU)	-10	2	21.6 22.3 12.6	PVB	-	-	-	-
160	ECHINOCORYS	FRAGS	-10	2	-	-	-	-	-	AA AC DA HL
17	BELEMNITELLA	G+A(SM WN)	-14	2	47.6 7.8	7532040	00NN N SW	0300 3	CA DB	BU GI
145	BELEMNITELLA	G	-15	2	45.9 10.5	5333540	0	-	-	-
592	BELEMNITELLA	G+A(4)	-15	2	70.6 10.2	3833070	0	0110 2	-	CO SA
685	BELEMNITELLA	G+A(3)	-15	2	64.9 14.7	630500	NNNN N ALL	3102 6	CA DB EN	AP BU ?4r ST uv
751	BELEMNITELLA	G	-15	2	21.2 5.8	03104	NNNN N ALL	0	CA DB	-
622	C CARNEA (J. Sowerby)	PV	-15	2	18.9 18.6 7.5	-	-	-	-	-
1208	CRET Sp	NC	-15	2	-	-	-	-	-	-
101	ECHINOCORYS	FRAG	-15	2	15.6 7.2	-	-	-	-	-
161	ECHINOCORYS	MC	-15	2	57.4 53.8 55.8	-	-	-	-	-
162	ECHINOCORYS	FRAGS	-15	2	-	-	-	-	-	BU DS ?PR
1137	SPONGE	NC	-15	2	-	-	-	-	-	-
1140	SPONGE	NC	-15	2	-	-	-	-	-	-
1145	SPONGE	NC	-15	2	-	-	-	-	-	-
113	ECHINOCORYS	FRAG	-17	2	13.3 6.4	-	-	-	-	-
675	BELEMNITELLA	G+A(XE)(2)	-20	2	62.4 15.5	931160	1121 5	0300 3	CA TA	AA CO GI
706	C CARNEA (J. Sowerby)	PV(PART)	-20	2	19.1 20.8 6.8	0IS	-	-	-	-
888	C CARNEA (J. Sowerby)	FRAG NC	-20	2	-	-	-	-	-	-
655	ECHINOCORYS	FRAGS (65)	-20	2	-	RWU	-	-	-	-
656	ECHINOCORYS	MC (65)	-20	2	63.3 48.8 46.5	0IS	-	-	wb	AA uv
657	ECHINOCORYS	FRAGS (65)	-20	2	-	RWU	-	-	-	AA AC AN; DA EP GI LM MO MS NE SA
658	ECHINOCORYS	MC (65)	-20	2	64.2 57.6 40.9	RWU	-	-	-	AA AN; ?GI DA DS NEc4 ST
659	ECHINOCORYS	PS (65)	-20	2	41.6 29.1 45.0	-	-	-	-	DT GI
699	N OBESA Sahni	CS	-20	2	45.5 37.3 29.8	0IS	-	-	-	BU
2545a	P GLOBULARIS (Phillips)	PS	-20	2	-	-	-	-	-	-
627	S DUTEMPLEANUS d'Orbigny	FRAGS	-20	2	-	-	-	-	-	-
104	BELEMNITELLA	G?JUV	-22	2	24.0 11.9	03012	0022 4	0	CA DB	-
674	BELEMNITELLA	G+A(XE)	-25	2	32.1 12.8	303310U	NNNN N NEINW	0010 1	CA DB RO	4r
762	BELEMNITELLA	G(XE)	-25	2	20.5 12.2	260140U	0	0	-	-
677	C CARNEA (J. Sowerby)	FRAGS	-25	2	-	PVT	-	-	-	-
891	C CARNEA (J. Sowerby)	FRAG NC	-25	2	-	-	-	-	-	-
680	ECHINOCORYS	FRAGS	-25	2	-	RWU	-	-	-	MS
681	N SEXCOSTATA (S. Woodward)	FRAGS	-25	2	-	-	-	-	-	-
1135	SPONGE	NC	-25	2	-	-	-	-	-	-
1141	SPONGE	NC	-25	2	-	-	-	-	-	-
1143	SPONGE	NC	-25	2	-	-	-	-	-	-
1144	SPONGE	NC	-25	2	-	-	-	-	-	-
1147	SPONGE	NC	-25	2	-	-	-	-	-	-
616	BELEMNITELLA	A(2)	-30	2	27.4 10.6	33120U	0	0011 2	-	4r CO
596	C CARNEA (J. Sowerby)	PS	-30	2	15.8 17.4 11.5	0IS	-	-	EN	-
1139	SPONGE	NC	-30	2	-	-	-	-	-	-
1142	SPONGE	NC	-30	2	-	-	-	-	-	-
686	BELEMNITELLA	A(WN)	-35	2	33.3 9.6	360060U	NNNN N NEINW	1001 2	CA DB ?N TA	AN PV;
736	BELEMNITELLA	G(XE)	-35	2	11.4 4.7	03331	0	0	-	-
671	C CARNEA (J. Sowerby)	MC	-35	2	23.5 20.3 10.3	PVT	-	-	-	-
694	ECHINOCORYS	FRAGS	-35	2	-	RWU	-	-	EN RO	DA DS PP ww
603	N OBESA Sahni	CS	-35	2	29.5 25.5 10.5	PVT	-	-	-	-
593	BELEMNITELLA	A	-40	2	18.6 10.9	220160	1000 1	1000 1	CA	SA
582	C CARNEA (J. Sowerby)	FRAGS	-40	2	19.5 18.7 16.7	PVT	-	-	-	-
620	C CARNEA (J. Sowerby)	FRAG	-40	2	16.1 13.5 16.8	PVT	-	-	-	-
889	C CARNEA (J. Sowerby)	FRAG NC	-40	2	-	-	-	-	-	-
1138	SPONGE	NC	-40	2	-	-	-	-	-	-
1146	SPONGE	NC	-40	2	-	-	-	-	-	-
2359	TEREBRATULINA Sp	NC	-40	2	-	PVT	-	-	-	-
110	BELEMNITELLA	G+A(XE)	-44	2	74.3 14.4	1330400	NNN0 N NEISEISW	0	DB RO TA	-
144	BELEMNITELLA	G+A(XE)	-45	2	73.5 15.7	2533500	0	0	-	-
750	C ARCUATA Pettitt	PV	-45	2	11.7 13.8 5.6	-	-	-	wb	-
672	C CARNEA (J. Sowerby)	MC	-45	2	20 15	PVT	-	-	-	-
752	C NORVICENSIS Pettitt	PS	-45	2	15 15	-	-	-	-	-
586	ECHINOCORYS	PS	-45	2	60.8 48.3 35.5	USD	-	-	-	-
660	ECHINOCORYS	FRAGS	-45	2	-	-	-	-	-	-
606	BELEMNITELLA	G+A	-50	2	55.3 8.5	330600	1000 1	2302 7	RO	AN BU GI ST
638	BELEMNITELLA	G(XE)	-55	2	19.3 9.9	140250U	0010 1	0	DB	-
695	BELEMNITELLA	G+A(2)	-55	2	15.4 10.2	20102U	0	1001 2	-	DS MO
765	C CARNEA (J. Sowerby)	FRAG	-55	2	-	-	-	-	-	-
1136	SPONGE	NC	-55	2	-	-	-	-	-	-
121	BELEMNITELLA	G+A(XE)	-57	2	87.1 14.3	800290U	NNNN ALL	3123 9	CA DB TA	AF AN BU MO MS
766	BELEMNITELLA	G+A(XE)	-65	2	31.8 7.4	2700970	NNNN N NEINW	1001 2	CA DB TA	4r MO
684	BELEMNITELLA	G+A(XE)	-70	2	28.4 7.6	130205U	NNNN N ALL	0	DB EN	-
595	BELEMNITELLA	G+A(2)	-	2	41.2 7.3	280032U	NNNN N ALL	0	CA DB TA	-
893	BELEMNITELLA	in fl NC	-	2	-	1002000	-	-	-	-
112	C CARNEA (J. Sowerby)	FRAG	-	2	15.7 15.6 11.0	PVT	-	-	-	AN
632	C CARNEA (J. Sowerby)	FRAGS	-	2	-	PVT	-	-	-	-
134	K PENTANGULATA S. Woodward	CS(CRU)	-	2	9.1 9.2 4.0	-	-	-	-	-
731	T STRIATA d'Orbigny	in flint	-	2	-	-	-	-	-	-
1036	C CARNEA (J. Sowerby)	MC	-5	2A	24.0 23.7 15.2	PVB	-	-	CA	-
1068	GLOMERULA SP	2	-5	2A	-	-	-	-	-	-
1061	K PENTANGULATA S. Woodward	MC	-5	2A	9.6 9.7 4.0	-,	-	-	-	-
21	S DUTEMPLEANUS d'Orbigny	CS	-5	2A	21 21	-	-	-	-	-
103	BELEMNITELLA	G+A	-10	2A	56.3 11.0	1031000	1111 4	0100 1	?	?CO
585	BELEMNITELLA	G	-15	2A	42.5 9.4	90U	NNNN N SEISW	1111 4	CA DB ?N TA	BU MO
1009	BELEMNITELLA	G+A(2)	-15	2A	69.0 10.0	533143U	FFFF N ALL	2100 3	CA DB TA	CO MO MS
116	C CARNEA (J. Sowerby)	PV(PART)	-15	2A	12.9 7.6	-	-	-	-	-
105a	G INEQUIROSTRATA (S. Woodward)	INSIDE PYC	-15	2A	-	-	-	-	-	-
105b	P VESICULARE (Lamarck)	FRAGS	-15	2A	27.2 21.1	-	-	-	-	-
129	BELEMNITELLA	G+A(XE)	-20	2A	63.9 12.3	1520610	1211 5	0001 1	CA DB ?N RO	AN;
1031	BELEMNITELLA	G+A	-20	2A	57.4 8.8	03342	FFFF N	0005 5	CA DB ?N	BU MO ST
1134	C CARNEA (J. Sowerby)	NC	-20	2A	-	-	-	-	-	-
130	C CARNEA (J. Sowerby)	FRAG	-25	2A	12.1 12.4	-	-	-	-	-
1006	C CARNEA (J. Sowerby)	CS	-25	2A	16.5 14.6 6.6	PVT	-	-	-	-
669	ECHINOCORYS	MC(CR)(2spjnd)	-25	2A	94.1 53.5 30.0	1RWU1USD	-	-	EN	by DA DS HE MS OG PO PR VTc4
995	P VESICULARE (Lamarck)	FRAG	-25	2A	-	-	-	-	-	-
1049	C CARNEA (J. Sowerby)	MC	-30	2A	21.0 14.1 10.1	PVT	-	-	-	-
117	P VESICULARE (Lamarck)	FRAG	-30	2A	31.1 24.5 12.5	-	-	-	-	-
107	BELEMNITELLA	G+A(XE)	-35	2A	40.0 14.5	720390U	4101 6	1000 1	CA DB	AN
619	BELEMNITELLA	G+A(XE)	-35	2A	75.5 17.0	03105	NNNN N SEISW	0110 2	CA DB EN ?N RO	BU ST
581	C CARNEA (J. Sowerby)	FRAG	-35	2A	9.0 9.6	-	-	-	-	-
1118	C CARNEA (J. Sowerby)	MC	-35	2A	-	-	-	-	-	-
118	N OBESA Sahni	PS	-37	2A	15.5 17.9 14.0	0IS	-	-	-	-
599	BELEMNITELLA	G+A(XE)(WN)	-40	2A	20.2 9.2	122241U	NNNN N SEISW	0	CA DB ?N RO	-
2360	P VESICULARE (Lamarck)	MC	-40	2A	-	-	-	-	-	-
590	BELEMNITELLA	G+A(XE)	-45	2A	19.0 5.9	283308U	NNNN N ALL	0100 1	CA DB ?N	CO
633	C CARNEA (J. Sowerby)	FRAGS	-45	2A	-	-	-	-	-	-
729	A cfINCURVA Nilsson	PS	-50	2A	29.5 30.1 19.4	-	-	-	-	?OL PV
120	BELEMNITELLA	G+A(XE)	-50	2A	71.3 9.9	9022120	0	0	-	-
602	BELEMNITELLA	G+A	-50	2A	75.3 13.9	1720240	NNNN N NEISE	0	CA DB EN	-
735	BELEMNITELLA	A	-50	2A	24.4 11.7	532910	4003 7	0	DB ?N	-
19	C CARNEA (J. Sowerby)	PS	-50	2A	18.2 20.5 9.3	-	-	-	-	-
9	BELEMNITELLA	G+A(V TN)	-55	2A	39.2 5.7	102220U	N11N N NEVNW	1001 2	DB	AN; AP
99	BELEMNITELLA	FRAG	-55	2A	9.6 4.3	830280	NNNN N ALL	0	CA DB	-
153	BELEMNITELLA	G+A(SM)	-55	2A	56.0 7.8	900	0	0	-	-
745	BELEMNITELLA	G+A	-55	2A	64.0 9.4	8533100U	NNNN N ALL	0	CA DB ?N	-
1035	BELEMNITELLA	G+A(WN)	-55	2A	66.0 10.0	8020680	FNNF N SEISW	1000 1	CA DB TA	AN;
738	OSTREA Sp	FRAGS	-55	2A	-	-	-	-	-	-

NO	TAX	DES	POS	FB	DIM	OPI	BOR	EPI	B(D)	E(D)
636	P VESICULARE (Lamarck)	FRAGS	-55	2A	-	-	-	-	-	-
146	P VESICULARE (Lamarck)	FRAGS	-57	2A	19.6 17 8 10.0	OIS	-	-	-	-
2361	C CARNEA (J. Sowerby)	NC	-60	2A	-	-	-	-	-	-
697	BELEMNITELLA	6	-65	2A	56.4 14.4	753310D	F00F F	0	?N	-
747	BELEMNITELLA	6+A(2)(WN)	-65	2A	46.5 8.3	273350U	NNNN N ALL	0100 1	CA DB ?N	fr
2	C CARNEA (J. Sowerby)	PS	-65	2A	30.3 23.0 12.0	PVB	-	-	-	-
611	C CARNEA (J. Sowerby)	PS	-65	2A	12.6 10.1 7.5	-	-	-	-	-
654	ECHINOCORYS	FRAGS	-65	2A	-	RAU	-	-	RO	AP DA MS PR
596	BELEMNITELLA	6+A(XE)	-70	2A	43.2 9.4	213005D	0	0	-	-
698	BELEMNITELLA	6	-70	2A	32.9 8.2	330320	2410 7	0	CA DB	-
690	C CARNEA (J. Sowerby)	PS	-70	2A	-	PVB	-	-	-	-
637	S DUTEMPLEANUS d'Orbigny	FRAGS	-70	2A	-	-	-	-	-	-
147	C CARNEA (J. Sowerby)	FRAGS	-74	2A	13.9 12.3 11.6	PVT	-	-	-	-
639	C CARNEA (J. Sowerby)	PU	-75	2A	13 17	-	-	-	EN	-
635	CRET Sp	FRAGS	-75	2A	-	-	-	-	-	-
631	?	FRAG	-80	2A	-	-	-	-	-	-
691	C CARNEA (J. Sowerby)	FRAG	-80	2A	-	-	-	-	-	-
624	C CARNEA (J. Sowerby)	C?JUV	-85	2A	17.0 17.2 9.2	OIS	-	-	-	-
716	C CARNEA (J. Sowerby)	FRAG	-85	2A	-	PVT	-	-	CA	-
746	C CARNEA (J. Sowerby)	CS	-90	2A	19.3 16.1 10.0	OIS	-	-	-	-
2362-77	ECHINOCORYS	FRAGS NC(616)	-25--10	2A	-	R5U105426	-	-	-	-
661-8	ECHINOCORYS	FRAGS	-50--30	2A	-	R2U20S2?2	-	-	EN	DA
152	BELEMNITELLA	6	-	2A	34.4 12.0	08015	6 21 9 3 39	1000 1	CA DB TA	ANJ
673	BELEMNITELLA	6+A	-	2A	55.0 8.7	08270U	1231 7	0200 2	CA ??N	AN BU
605	C CARNEA (J. Sowerby)	PS	-	2A	20 17	OIS	-	-	-	-
670	ECHINOCORYS	3 in flint	-	2A	-	-	-	-	-	-
728	A cfINCURVA Nilsson	FRAG	-5	3	-	-	-	-	-	-
760	A cfINCURVA Nilsson	FRAGS	-5	3	24.7 15.7	-	-	-	-	-
139	BELEMNITELLA	6+A(XE)	-5	3	43.9 11.2	3?01520	0NN0 N SE|SW	0	CA DB	-
724	BELEMNITELLA	A	-5	3	20.5 11.3	200080U	1112 5	0	CA TA	-
727	BELEMNITELLA	6(XE)	-5	3	18.4 9.5	260130D	N35N N SE|SW	0100 1	CA DB ?N TA	VL
757	BELEMNITELLA	6	-5	3	31.3 10.6	4031000	3112 7	0001 1	CA DB	BU
798	BELEMNITELLA	6(XE)	-5	3	9.3 4.4	03210	NNNN N SW	0	CA DB	-
770	CIDARID Sp	SPINE	-5	3	20 4	-	-	-	-	AN
682	ECHINOCORYS	FRAGS	-5	3	-	-	-	-	RO	AP DL PV
744	INOCERAMID	HINGE	-5	3	-	-	-	-	-	-
714	P VESICULARE (Lamarck)	FRAG	-5	3	12.5 20.6 3.1	-	-	-	-	MD
978	P VESICULARE (Lamarck)	FRAG	-5	3	-	-	-	-	-	-
826	?BURROW FILL	hard chalk	-10	3	-	-	-	-	-	-
777	A cfINCURVA Nilsson	FRAGS	-10	3	-	-	-	-	-	-
169	BELEMNITELLA	6+A(WN)	-10	3	31.5 8.3	173350D	NNNN N ALL	0100 1	CA DB EN TA	fr
703	BELEMNITELLA	6	-10	3	31.1 8.8	5301430	NNNN N NW|SW	0010 1	CA DB ?N	VL
725	BELEMNITELLA	6+A(2)	-10	3	67.6 9.0	460510D	NNNN N SE|SW	0010 1	CA DB ?TA	FC
687	INOCERAMID	FRAGS	-10	3	-	-	-	-	-	DS ST
931	INOCERAMID	NC	-10	3	20cm+	-	-	-	-	-
843	P VESICULARE (Lamarck)	FRAG	-10	3	-	-	-	-	-	-
921	P VESICULARE (Lamarck)	NC	-10	3	-	-	-	-	-	-
923	P VESICULARE (Lamarck)	FRAGS NC	-10	3	-	-	-	-	-	-
7	BELEMNITELLA	6+A(SL)	-15	3	86.4 11.5	703225U	NNNN N ALL	0110 2	CA DB EN RO	AP
22	BELEMNITELLA	6+A	-15	3	72.3 10.1	580158U	FNF N SE|SW	0	CA DB	-
31	BELEMNITELLA	6+A?JUV	-15	3	36.5 6.9	220062D	1322 0	0	CA DB	-
171	BELEMNITELLA	6+A(XE)	-15	3	50.8 9.1	52340D	NNNN N ALL	1122 6	CA TA	AN AP CO MD
617	BELEMNITELLA	6+A(3)	-15	3	64.9 12.0	2002080	NNNN N NE|SE	-	CA DB TA	-
707	BELEMNITELLA	6+A(SM)	-15	3	39.0 6.3	731430	0	2100 3	-	BU CO SA
708	BELEMNITELLA	6(XE)	-15	3	20.4 10.5	930440U	11 415 21	0	CA DB TA	-
778	BELEMNITELLA	A	-15	3	30.3 8.0	12034U	N00N N NE|NW	0010 1	CA DB	?OY
949	BELEMNITELLA	6	-15	3	15.7 3.5	702620	FFFF N NE|NW	0010 1	DB ?N	ww
742	K PENTANGULATA S. Woodward	CS	-15	3	10.6 9.3 4.2	-	-	-	-	-
764	P VESICULARE (Lamarck)	FRAGS	-15	3	-	-	-	-	-	OT
808	P VESICULARE (Lamarck)	FRAG	-15	3	-	-	-	-	-	-
815	P VESICULARE (Lamarck)	FRAG	-15	3	-	-	-	-	-	-
908	P VESICULARE (Lamarck)	NC	-15	3	80 60	-	-	-	-	-
963	P VESICULARE (Lamarck)	FRAG	-15	3	-	-	-	-	-	-
979	P VESICULARE (Lamarck)	NC	-15	3	-	OIS	-	-	-	-
1017	P VESICULARE (Lamarck)	FRAGS	-15	3	-	-	-	-	-	-
847	??P VESICULARE (Lamarck)	FRAG	-20	3	-	-	-	-	-	-
827	A cfINCURVA Nilsson	PS	-20	3	14.4 21.5 24.2	-	-	-	-	-
828	A cfINCURVA Nilsson	FRAGS	-20	3	-	-	-	-	-	-
829	A cfINCURVA Nilsson	FRAG	-20	3	-	-	-	-	-	-
830	A cfINCURVA Nilsson	FRAG	-20	3	-	-	-	-	-	-
181	BELEMNITELLA	6(?JUV)	-20	3	11.6 4.3	100600U	NNNN N ALL	0010 1	CA	BU
186	BELEMNITELLA	6+A(XE)	-20	3	57.7 10.0	6032670	6002 0	2000 2	CA DB	MD ?SS
702	BELEMNITELLA	6+A	-20	3	94.0 13.5	772?710	NNNN N SW	1221 6	CA ?N	BU AP
723	BELEMNITELLA	A	-20	3	26.7 10.0	52070U	NNNN N ALL	FFFF F	CA DB	AN BU DS MD VL
758	BELEMNITELLA	A	-20	3	20.0 13.0	100126U	NN2I N NE|SE	1101 3	CA DB TA	BU fr MD
784	BELEMNITELLA	6+A	-20	3	63.4 11.6	1500210	NNNN N NW	0001 1	CA DB EN TA	PU
787	BELEMNITELLA	6+A	-20	3	51.9 10.4	52053U	1002 3	1000 1	CA DB	BU
788	BELEMNITELLA	A	-20	3	25.0 8.6	1102460	1131 6	0001 1	DB DI	AP
822	BELEMNITELLA	6	-20	3	41.2 7.7	3730280	0	0	-	-
846	BELEMNITELLA	6+A(2)	-20	3	77.6 10.2	4032000	NN00 N NE|SE	0001 1	CA DB ?N	DA
802	CRET Sp	broke up	-20	3	NC	OIS	-	-	-	-
900	ECHINOCORYS	FRAG NC	-20	3	-	-	-	-	-	-
1131	ECHINOCORYS	NC	-20	3	-	-	-	-	-	-
771	INOCERAMID	HINGE	-20	3	-	-	-	-	-	-
814	INOCERAMID	HINGE	-20	3	-	-	-	-	-	MS
786	P VESICULARE (Lamarck)	FRAGS	-20	3	-	-	-	-	-	-
819	P VESICULARE (Lamarck)	FRAG	-20	3	-	-	-	-	-	-
899	P VESICULARE (Lamarck)	smashed NC	-20	3	-	-	-	-	-	-
959	P VESICULARE (Lamarck)	FRAG	-20	3	-	-	-	-	-	-
919	SPONGE	NC	-20	3	-	-	-	-	-	-
168	?M SEMIPLANA (J. de C. Sowerby)	FRAG	-25	3	17.5 10.3	-	-	-	-	-
167	BELEMNITELLA	6+A	-25	3	75.1 10.6	900	0011 2	2314 10	CA DB	ANJ BU CS fr ST
183	BELEMNITELLA	6+A(XE)	-25	3	20.0 9.0	1032700	0	1112 5	-	AP MD MS
776	BELEMNITELLA	6+A(XE)	-25	3	51.6 9.7	3031540U	0110 2	0100 1	DB	AN
768	ECHINOCORYS	FRAG	-25	3	20 20	-	-	-	-	-
720	G CANALICULATA (J. Sowerby)	FRAGS	-25	3	-	-	-	-	-	PVJ
976	P VESICULARE (Lamarck)	NC	-25	3	-	-	-	-	-	-
2304	P VESICULARE (Lamarck)	NC	-25	3	-	-	-	-	-	-
807	S MAX v SULCATUM (J.de C. Sowerby)	CARINA	-25	3	-	-	-	-	-	-
903	?	FRAG	-30	3	-	-	-	-	-	-
780	BELEMNITELLA	A	-30	3	17.0 10.6	3230160	5004 9	1000 1	CA DB TA	AP
715	BELEMNITELLA	6+A(XE)	-30	3	37.3 10.5	331240U	N21N N NE|NW	0002 2	CA DB	fr MD
721	BELEMNITELLA	6(TIP)	-30	3	13.4 4.6	3031200U	N12N N NE|NW	0001 1	DB	fr
779	BELEMNITELLA	6+A	-30	3	77.1 10.9	4030200	NNNN N ALL	2320 7	CA DB TA	AP BU MD VL
806	BELEMNITELLA	6+A(XE)	-30	3	31.1 12.3	33059U	3255 15	3101 5	CA DB EN TA	BU ST
832	BELEMNITELLA	6(XE)(2)	-30	3	20.2 8.3	7023000	NNNN N ALL	0	CA DB	-
734	INOCERAMID	HINGE	-30	3	-	-	-	-	-	-
733	P VESICULARE (Lamarck)	FRAGS	-30	3	-	-	-	-	-	-
763	P VESICULARE (Lamarck)	FRAGS	-30	3	-	-	-	-	-	-
980	P VESICULARE (Lamarck)	NC	-30	3	-	RAU	-	-	-	-
897	SPONGE	NC	-30	3	-	-	-	-	-	-
177	BELEMNITELLA	6+A(XE)(WN)	-35	3	47.5 16.9	1332580	N03N N NE|NW	0011 2	CA DB ?N RO	AN BU
953	BELEMNITELLA	6+A	-35	3	46.4 11.7	431710	4195 19	0001 1	CA DB RO	VL
796	C NORVICENSIS Pettitt	C(CR)	-35	3	10.9 20.3 8.4	PVB	-	-	-	-
951	ECHINOCORYS	FRAG	-35	3	-	RAU	-	-	-	-
2370	G CANALICULATA (J. Sowerby)	NC	-35	3	-	-	-	-	-	-
1110	P VESICULARE (Lamarck)	NC	-35	3	-	-	-	-	-	-
950	?TEREBRATULINA	NC	-40	3	-	-	-	-	-	-
142	BELEMNITELLA	6+A(XE)(WN)	-40	3	38.7 7.3	202040U	NNNN N ALL	1000 1	CA DB ?N TA	CO
810	BELEMNITELLA	6(XE)(2)	-40	3	32.4 11.3	531020	NNNN N ALL	0	CA DB TA	-
823	BELEMNITELLA	6+A(XE)(3)	-40	3	32.3 8.8	1531030	NFFN N NE|NW	0	CA DB ?N	-
834	BELEMNITELLA	6(XE)	-40	3	36.0 8.4	503350	0010 1	0002 2	TA	ww
795	CIDARID Sp	SPINE	-40	3	-	-	-	-	-	-
853	ECHINOCORYS	FRAGS	-40	3	-	OIS	-	-	RO	BU DA ?LE HF MD PR ST
2383	G CANALICULATA (J. Sowerby)	NC	-40	3	-	-	-	-	-	-
835	G INEQUIROSTRATA (S. Woodward)	PS	-40	3	15 10	-	-	-	-	SD
165	K PENTANGULATA S. Woodward	FRAG	-40	3	4 4	-	-	-	-	-
920	SPONGE	NC	-40	3	-	-	-	-	-	-
185	BELEMNITELLA	6+A(SM)	-45	3	59.5 9.1	1332280	2002 4	0102 3	DB ?N	ANJ CO MD
818	BELEMNITELLA	6	-45	3	15.0 3.0	03100	0	0	-	-
898	C CARNEA (J. Sowerby)	NC	-45	3	-	-	-	-	-	-
809a	ECHINOCORYS	PS	-45	3	14.1 23.7 13.0	RAU	-	-	-	-
854	ECHINOCORYS	FRAGS	-45	3	-	OIS	-	-	-	-
911	ECHINOCORYS	NC(63)	-45	3	-	RAU	-	-	-	-
912	ECHINOCORYS	NC(63)	-45	3	-	USD	-	-	-	-
913	ECHINOCORYS	NC(63)	-45	3	-	RAU	-	-	-	-
824	N SEXCOSTATA (S. Woodward)	CAST	-45	3	-	-	-	-	-	-
910	P VESICULARE (Lamarck)	NC	-45	3	-	-	-	-	-	-
809b	S DUTEMPLEANUS d'Orbigny	inside ech test	-45	3	-	-	-	-	-	-
1100	C CARNEA (J. Sowerby)	NC	-50	3	31.1 29.9 20.9	PVT	-	-	-	-
717	ECHINOCORYS	FRAGS	-50	3	-	OIS	-	-	EN	AP
812	M CHITONIFORMIS (Schlotheim)	CS	-50	3	8.7 8.3 4.3	PVT	-	-	-	DS MD
803	N SEXCOSTATA (S. Woodward)	FRAGS	-50	3	-	-	-	-	-	-
962	P HOPERI Mantell	NC	-50	3	40 40	-	-	-	?N TA	AN DA
748	?C Sp	FRAG	-55	3	-	-	-	-	-	-
749	BELEMNITELLA	A	-55	3	18 2 8.1	43148U	0	0021 3	RO	AN BU
163	BELEMNITELLA	6+A(XE)	-60	3	47.3 7.4	402256U	5101 7	1011 3	CA DB	ANJ BU FC
825	BELEMNITELLA	6	-60	3	55.2 13.1	303300U	NNNN N ALL	0	CA DB TA	-
833	BELEMNITELLA	6(XE)(WN)	-60	3	40.1 12.7	212162U	NNNN N ALL	0	CA DB ?N TA	-
743	BELEMNITELLA	A	-65	3	30.2 9.0	1931870U	0	0	-	-

NO	TAX	DES	POS	FB	DIM	ORI	BOR	EPI	B(D)	E(D)
961	BELEMNITELLA	G+A(WN)	-65	3	59.6 10.0	230341D	NNNN N SE SW	0	CA DB ?N TA	-
811	CRET Sp	NC	-65	3	-	-	-	-	-	-
816	A cf INCURVA Nilsson	FRAG	-70	3	-	-	-	-	-	-
197	BELEMNITELLA	G(WN)	-70	3	53.3 10.4	303205U	0100 1	0	TA	-
119	C CARNEA (J. Sowerby)	FRAG	-70	3	12 10	OIS	-	-	-	-
767	C cf ARCUATA Pettitt	CS	-70	3	8.3 8.2 4.2	PVB	-	-	-	-
932	SPONGE	NC	-70	3	-	-	-	-	-	-
126	BELEMNITELLA	G(PART)	-75	3	17.2 17.7	572020D	1111 4	1000 1	CA MO	MO
143	BELEMNITELLA	G	-75	3	48.9 13.2	120250D	NNNN N ALL	2001 3	CA DB TA	AP CO MO
2379	C NORVICENSIS Pettitt	NC	-85	3	-	-	-	-	-	-
94	ECHINOCORYS	FRAGS	-85	3	-	-	-	-	-	-
1122	P VESICULARE (Lamarck)	NC	-85	3	-	-	-	-	-	-
150	ECHINOCORYS	FRAGS(4SPEC)	-90	3	-	-	-	-	-	-
1130	ECHINOCORYS	NC	-90	3	-	-	-	-	-	-
1127	BELEMNITELLA	in 41 NC	-95	3	-	03060	-	-	-	-
1129	BELEMNITELLA	in 41 NC	-95	3	-	520930	-	-	-	-
1088	ECHINOCORYS	PS(64)	-95	3	60 50 50	RWU	-	-	-	-
85a-61	ECHINOCORYS	FRAGS	-95	3	-	P2U2052	-	-	-	AA AP DA DS
851	INOCERAMID	FRAGS	-95	3	-	-	-	-	-	PVj
1103	INOCERAMID	NC	-95	3	-	-	-	-	-	-
180	BELEMNITELLA	G(V BORED)	-97	3	23 0 0.8	172067D	4001 5	0002 2	EN	MO
1004	BELEMNITELLA	A(WN)	-100	3	54.2 14.9	133253D	NNNN N NEISE	0110 2	CA DB ?EN ?N	?fr MO
1086	BELEMNITELLA	G+A(2)(64)	-100	3	70.2 10.6	203300U	NNNN N ALL	0110 2	CA DB ?N	AP MO
193	ECHINOCORYS	PS(DIS)	-100	3	-	-	-	-	?EN	DA MO DS ?SS
977	ECHINOCORYS	NC	-100	3	-	USD	-	-	-	-
1005	ECHINOCORYS	FRAGS	-100	3	-	-	-	-	-	-
1095	ECHINOCORYS	PS(64)	-100	3	70 55 50	USD	-	-	-	wy
1087	ECHINOCORYS	FRAG(64)	-100	3	50 35	-	-	-	-	-
817	P VESICULARE (Lamarck)	FRAG	-100	3	-	-	-	-	-	-
732	S DUTEMPLEANUS d'Orbigny	NC	-100	3	-	-	-	-	-	-
138	BELEMNITELLA	G	-105	3	37.0 9.1	453207D	3610 10	0	DB	-
188	BELEMNITELLA	G	-105	3	43.0 13.1	433093D	F00F F	0	CA DB TA	-
813	BELEMNITELLA	G+A(2)	-105	3	33.9 5.3	220230U	F000 F	0	CA	-
831	BELEMNITELLA	G+A(3)	-105	3	67.4 10.4	203116D	FFFF N	1000 1	?N TA	ANj
159	ECHINOCORYS	FRAGS	-105	3	-	-	-	-	-	AA DA DS ID MO NE
1076	ECHINOCORYS	FRAGS	-105	3	-	OIS	-	-	EN	DA MO
1106	P VESICULARE (Lamarck)	NC	-105	3	-	-	-	-	-	-
997	G CANALICULATA (J. Sowerby)	FRAG	-110	3	-	-	-	-	-	-
172	BELEMNITELLA	G+A(XE)	-115	3	19.9 10.2	123010D	1100 2	1001 2	DB	fr MO
1054	BELEMNITELLA	G+A(XE)	-115	3	36.9 9.2	303310D	NNNN N NWISW	0	CA DB TA	-
1068	C CARNEA (J. Sowerby)	PS	-115	3	29.6 30.5 16.2	OIS	-	-	-	-
1070	S DUTEMPLEANUS d'Orbigny	FRAGS	-115	3	-	-	-	-	-	-
1071	SPONDYLUS Sp	FRAGS	-115	3	-	-	-	-	-	-
124	N OBESA Sahni	PS	-118	3	40 30	-	-	-	-	-
123	C CARNEA (J. Sowerby)	FRAG	-120	3	25 19	-	-	-	-	-
588	S DUTEMPLEANUS d'Orbigny	PS	-120	3	7 7	-	-	-	-	-
190	BELEMNITELLA	G+A(XE)	-125	3	18.3 7.5	393346D	0	0	-	-
83	ECHINOCORYS	FRAGS	-125	3	-	-	-	-	-	-
954	ECHINOCORYS	FRAGS	-125	3	-	OIS	-	-	-	AA MP PO
1113	ECHINOCORYS	NC	-125	3	-	-	-	-	-	-
1114	ECHINOCORYS	NC	-125	3	-	-	-	-	-	-
1121	ECHINOCORYS	NC	-125	3	-	-	-	-	-	-
1125	ECHINOCORYS	NC	-125	3	-	-	-	-	-	-
128	BELEMNITELLA	G(XE)	-130	3	35.2 15.3	213342U	74 13 0 32 SW	0010 1	CA DB	AP
1037	C ARCUATA Pettitt	NC	-130	3	8.2 6.5 3.8	PVT	-	-	-	-
135	ECHINOCORYS	FRAGS	-130	3	-	-	-	-	-	-
137	ECHINOCORYS	PS	-130	3	-	-	-	-	-	-
155	ECHINOCORYS	FRAGS	-135	3	-	-	-	-	-	DA DS PF
157	ECHINOCORYS	PS (PART FL)	-135	3	-	-	-	-	-	-
127	BELEMNITELLA	G+A(XE)(SM)	-140	3	17.4 6.5	202074D	1002 3	0	CA DB	-
141	BELEMNITELLA	G	-140	3	27.9 7.9	154204U	0101 2	1000 1	?N	CO
1042	BELEMNITELLA	G	-140	3	34.9 10.0	103011D	NFFN N NEINW	0001 1	CA DB TA	AN
687	PLICATULA Sp	FRAG	-140	3	6.2 6.9 3.3	-	-	-	-	-
1032	BELEMNITELLA	G(2)	-145	3	56.5 10.6	403214D	FFFF F	0001 1	DB TA	AN
1133	BELEMNITELLA	in 41 NC	-145	3	-	472278U	-	-	-	-
1034	C ARCUATA Pettitt	NC	-145	3	8.0 8.9 5.4	-	-	-	-	-
1051	C CARNEA (J. Sowerby)	FRAG	-145	3	-	-	-	-	-	-
1069	CRET Sp	PS	-145	3	7.0 8.3 3.3	OIS	-	-	-	-
1132	ECHINOCORYS	FRAG NC	-145	3	-	-	-	-	-	-
1108	P VESICULARE (Lamarck)	NC	-145	3	-	-	-	-	-	-
1123	P VESICULARE (Lamarck)	NC	-145	3	-	-	-	-	-	-
148	BELEMNITELLA	G	-150	3	55.2 14.9	203350D	0203 5	0	DG	-
149	BELEMNITELLA	G+A(XE)	-150	3	65.0 9.9	753296D	NNNN N ALL	0100 1	CA DB TA	AN
1077	C ARCUATA Pettitt	CS?JUV	-150	3	8.9 8.6 4.0	PVB	-	-	-	-
13	BELEMNITELLA	G+A	-160	3	25.7 8.5	03240	3023 0	1200 3	CA DB	DA MS
1045	C ARCUATA Pettitt	CS	-160	3	9.0 9.1 5.2	PVB	-	-	-	-
1115	ECHINOCORYS	NC	-160	3	-	-	-	-	-	-
626	INOCERAMID	FRAG	-160	3	42.4 32.3	-	-	-	-	AA AF DA MO PV
1104	INOCERAMID	NC	-160	3	-	-	-	-	-	-
1105	INOCERAMID	NC	-160	3	-	-	-	-	-	-
1107	INOCERAMID	NC	-160	3	-	-	-	-	-	-
1112	INOCERAMID	NC	-160	3	-	-	-	-	-	-
1120	INOCERAMID	NC	-160	3	-	-	-	-	-	-
98	BELEMNITELLA	G+A(XE)	-165	3	74.0 10.6	403335U	320N N NW	0	CA DB	-
106	BELEMNITELLA	G+A(XE)	-165	3	45.1 11.3	413359U	NIIN N NEVWW	1000 1	CA DB	ANj
104	BELEMNITELLA	G+A(XE)	-165	3	89.6 15.3	152029D	00NN N SWINW	0	CA DB	-
1011	BELEMNITELLA	G	-165	3	41.0 9.3	242067D	FFFF N ALL	1000 1	CA DB	AN
1014	BELEMNITELLA	A	-165	3	27.3 11.9	222310U	F00F F ALL	0100 1	CA DB EN	AN
1047	BELEMNITELLA	G+A(XE)(2)	-165	3	73.0 16.0	142358D	NNNN N ALL	1001 2	CA DB DI ?N	BU ww
1046	P VESICULARE (Lamarck)	FRAG	-165	3	-	-	-	-	-	-
1053	BELEMNITELLA	G+A	-170	3	40.7 8.1	403133U	NNNN N ALL	0	CA DB TA	-
1116	INOCERAMID	NC	-170	3	-	-	-	-	-	-
133	BELEMNITELLA	G(XE)	-175	3	40.9 13.9	142069U	0	0	-	-
1040	BELEMNITELLA	G	-180	3	10.2 5.0	233350	F00F F	0	CA DB	-
1050	BELEMNITELLA	G+A(XE)	-180	3	36.9 0.0	172270D	0	0	-	-
625	BRACH	broke up	-180	3	-	-	-	-	-	-
156	ECHINOCORYS	FRAGS	-180	3	-	-	-	-	RO	VL
650	ECHINOCORYS	FRAGS(614)	-180	3	-	RWU	-	-	-	-
1012	INOCERAMID	HINGE	-180	3	-	-	-	-	-	-
999	M ALAEFORMIS (S. Woodward)	PS	-180	3	29.5 12.7	-	-	-	-	?MS
587	BELEMNITELLA	G+A(3)	-185	3	40.4 14.2	392030U	NNNN N SWINW	1000 1	CA DB TA	ANj
600	BELEMNITELLA	A(w echs)	-185	3	14.2 3.7	103352D	0	0	-	-
640	ECHINOCORYS	FRAGS(614)	-185	3	-	-	-	-	-	DA DT
644	ECHINOCORYS	FRAGS(614)	-185	3	-	-	-	-	-	DA ?OS
647	ECHINOCORYS	FRAGS(614)	-185	3	-	RWU	-	-	EN	AN DA
649	ECHINOCORYS	FRAGS(614)	-185	3	-	OIS	-	-	EN	AE
651	ECHINOCORYS	FRAGS(614)	-185	3	-	-	-	-	-	ANj CE DA MS ST ?VF
652	ECHINOCORYS	FRAGS(614)	-185	3	-	-	-	-	-	CH ??CR ?MS
653	ECHINOCORYS	FRAGS(614)	-185	3	-	-	-	-	-	DA DT
1128	INOCERAMID	NC	-185	3	-	-	-	-	-	-
629	S DUTEMPLEANUS d'Orbigny	FRAG(w echs) NC	-185	3	-	-	-	-	-	-
591	BELEMNITELLA	G+A(XE 2) w echs	-190	3	77.0 11.4	172012U	NNNN N SEISW	1111 4	CA DB ?N	ANj MO ST wy
1003	BELEMNITELLA	G	-190	3	55.6 10.4	103075D	F00F F	0	CA DB	-
1008	BELEMNITELLA	G+A	-190	3	31.5 5.0	273323U	NNNN N ALL	0	CA DB	-
1052	BELEMNITELLA	A	-190	3	24.0 9.0	333203U	FFFF N NEINW	1000 1	CA DB	ST
641	ECHINOCORYS	FRAGS(614)	-190	3	-	USD	-	-	-	AA CR DA DG DT MO PR ST
642	ECHINOCORYS	FRAGS(614)	-190	3	-	OIS	-	-	-	AN DT ?VP
643	ECHINOCORYS	NC(614)	-190	3	-	RWU	-	-	-	AA AN DA DS DT BG BI MO OS OY ST·
645	ECHINOCORYS	FRAGS(614)	-190	3	-	OIS	-	-	EN	DA DS
648	ECHINOCORYS	FRAGS(614)	-190	3	-	-	-	-	-	DA DT ww VP
1117	INOCERAMID	NC	-190	3	-	-	-	-	-	-
998	BELEMNITELLA	G+A(2)	-195	3	20.0 5.7	520080U	0	0	-	-
1033	BELEMNITELLA	G+A(2)	-195	3	55.1 0.3	801350	FFFF N ALL	0	CA DB ?N TA	-
610	CIDARID Sp	SPINE	-195	3	-	-	-	-	-	-
646	ECHINOCORYS	FRAGS(614)	-195	3	-	-	-	-	-	DA MS VP
1111	ECHINOCORYS	NC	-195	3	-	-	-	-	-	-
109	BELEMNITELLA	G+A(XE)	-200	3	33.6 8.2	100021U	09NI N SEISW	0	CA DB ?N	-
154	BELEMNITELLA	G+A(XE)	-200	3	53.5 13.5	163345U	0210 3	0001 1	CA DB TA	ANj
613	C CARNEA (J. Sowerby)	NC	-200	3	-	-	-	-	-	-
1126	INOCERAMID	NC	-200	3	-	-	-	-	-	-
122	BELEMNITELLA	G(XE)(WN)	-205	3	54.4 10.2	50135D	1221 6	2001 3	DB TA	AN CO fr
140	BELEMNITELLA	G+A(XE)	-205	3	40.0 15.7	213152U	NNNN N ALL	0	CA DB TA	-
1109	INOCERAMID	NC	-205	3	-	-	-	-	-	-
16	BELEMNITELLA	G+A	-210	3	17.0 6.9	163326U	N94N N NEVWW	0	EN	-
115	BELEMNITELLA	G+A	-210	3	37.0 11.0	83084D	3114 0	0	CA DB TA	-
132	BELEMNITELLA	G(XE)	-213	3	37.4 8.0	03102	NNNN N ALL	0010 1	CA DB TA	AF
108	BELEMNITELLA	G(WN)	-215	3	29.0 10.0	203041D	NNNN N ALL	0	CA	-
111	BELEMNITELLA	G+A(WN)	-215	3	73.6 11.2	453066D	NNNN N ALL	1000 1	CA DB ?N	AN
151	BELEMNITELLA	G+A(V WN)	-215	3	82.4 13.9	303290D	NNNN N NEINW	0	CA DB ?EN ?N	-
1041	BELEMNITELLA	A	-215	3	23.0 11.6	403190D	NN00 N NEISE	0	DG	-
1010	METOPASTER Sp	OSSCICLE	-215	3	-	-	-	-	-	-
150	P SUBTORQUATA (Munster)	FRAG	-215	3	25.6 2.0	-	-	-	-	-
1013	BELEMNITELLA	A	-220	3	35.5 9.9	200233D	1000 1	0001 1	CA	AN
1124	P VESICULARE (Lamarck)	NC	-220	3	-	-	-	-	-	-
131	BELEMNITELLA	G+A(XE)	-222	3	77.7 12.3	403138U	NNNN N ALL	0200 2	CA DB TA	MO SA
996	BELEMNITELLA	G+A(XE)	-225	3	24.3 6.4	203263D	0014 5	0200 2	CA DB	wy
1119	S DUTEMPLEANUS d Orbigny	NC	-225	3	-	-	-	-	-	-
1040	BELEMNITELLA	G+A(2)	-230	3	43.6 8.4	272039D	NFFN N NEINW	0001 1	CA DB	SA
14	BELEMNITELLA	NC	-234	3	-	103306U	-	-	-	-
125	?N SEMIPLANA (J. de C. Sowerby)	PS	-235	3	22.6 16.9 14.0	OIS	-	-	-	-

NO	TAX	DES	POS	FB	DIM	ORI	BOR	EFI	B·D·	E·D·
100	BELEMNITELLA	G+A(XE	-235	3	43.2 11.1	120400	30 12 7 20	3000 3	CA DB ?N	AN,
1039	BELEMNITELLA	A	-235	3	20.4 8.3	1002200	FFFF N	0	CA DB TA	-
28	BELEMNITELLA	G+A(XE)	-240	3	30.5 8.7	402760	5000 5 NE	2000 2	EN	AN
1007	BELEMNITELLA	A	-240	3	17.4 5.7	5303160	0010 1	0	CA DB	-
1038	BELEMNITELLA	G+A(2)	-240	3	70 3 10.9	520470	NNNN N ALL	1001 2	CA DB PO TA	MO PU
12	P VESICULARE (Lamarck)	PS	-240	3	32 21	-	-	-	-	-
701	A cfINCURVA Nilsson	PS	-	3	29.3 16.8 7.0	-	-	-	-	-
709	A cfINCURVA Nilsson	FRAG	-	3	28.3 10.3	-	-	-	-	-
1027	A cfINCURVA Nilsson	PS	-	3	25 15	-	-	-	-	-
174	BELEMNITELLA	G+A(WN)	-	3	33.7 19.1	2002180	0249 21	0	CA DB	-
710	BELEMNITELLA	G	-	3	19.3 8.1	1420560	4233 12	0	CA DB	-
772	BELEMNITELLA	G+A(3)	-	3	40.1 11.9	1001210	0300 3	0	?N	-
901	BELEMNITELLA	in fl NC	-	3	-	4101020	-	-	-	-
902	BELEMNITELLA	in fl NC	-	3	-	2020970	-	-	-	-
928	BELEMNITELLA	in fl NC	-	3	-	900	-	-	-	-
769	COELOSMILIA Sp	NC	-	3	15 10	-	-	-	-	-
785	P VESICULARE (Lamarck)	FRAGS	-	3	-	-	-	-	-	-
689	SPONGE	in flint	-	3	-	-	-	-	-	-
1059	TEREBRATULID	NC	-5	4	-	-	-	-	-	-
1184	BELEMNITELLA	A	-10	4	51.4 15.1	1120190	NFFN N NEINW	3001 4	CA DB ?N	AN BU CO
1235	M CHITONIFORMIS (Schlotheim)	FRAGS	-10	4	-	-	-	-	-	-
1236	O GRANULOSUM (Roemer)	OSSCICLE	-10	4	-	-	-	-	-	-
994	ECHINOCORYS	NC	-15	4	-	OIS	-	-	-	-
1099	ECHINOCORYS	FRAGS NC	-15	4	-	-	-	-	-	-
1044	M CHITONIFORMIS (Schlotheim)	CS	-15	4	9.2 9.7 4.6	PVT	-	-	-	-
170	BELEMNITELLA	G+A(XE)	-20	4	86.3 12.5	803250	0010 1	0231 6	CA DB PO	AN AP BU GI MO
1196	BELEMNITELLA	G(XE)	-20	4	18.3 6.7	5032090	F000 F	0	DB	-
1149	P VESICULARE (Lamarck)	FRAGS NC	-20	4	-	-	-	-	-	-
944	C ARCUATA Pettitt	CS(?JUV)	-25	4	0 0	-	-	-	-	-
988	ECHINOCORYS	NC	-25	4	-	RWU	-	-	-	-
1234	N SEXCOSTATA (S. Woodward)	FRAG	-25	4	-	-	-	-	-	-
1190	T STRIATA d'Orbigny	BV	-25	4	6.2 5.0	-	-	-	-	-
109	BELEMNITELLA	G	-27	4	37.4 13.0	1523070	4112 0	2002 4	CA DB ?N	BU
939	BELEMNITELLA	G+A(2)	-30	4	58.1 9.7	1721600	NFFN N NEINW	0	CA DB TA	-
957	BELEMNITELLA	G	-30	4	15.4 6.0	2321630	0	0010 1	-	AN
1182	BELEMNITELLA	A	-30	4	46.3 15.4	2602110	NFFN N NEINW	0003 3	CA DB ?N	BU
1191	BELEMNITELLA	G+A	-30	4	46.4 8.9	2421790	NFFN N NEINW	0001 1	CA DB ?N	BU
982	CRET Sp	IMPRESSION NC	-30	4	-	-	-	-	-	-
970	ECHINOCORYS	FRAGS	-30	4	-	OIS	-	-	-	BU DA
1153	S OUTEMPLEANUS d Orbigny	NC	-30	4	-	-	-	-	-	-
937	BELEMNITELLA	G	-35	4	51.0 11.7	3200200	FFFF N	0003 3	CA DB RO	AN, CO
1600	BELEMNITELLA	G+A	-35	4	72.3 12.9	1523000	FNFF N SE	0003 3	CA DB ?N	AN
1055	C ARCUATA Pettitt	CS	-35	4	7.0 7.1 3.2	PVT	-	-	-	-
1079	ECHINOCORYS	FRAGS	-35	4	-	OIS	-	-	-	DA VT
943	BELEMNITELLA	A	-40	4	47.4 14.7	820640	NOON N NEINW	0	CA DB ?N	-
952	BELEMNITELLA	A	-40	4	10.1 9.9	522200	NFFN N NEINW	0020 2	CA DB	AP PO
1072	BRACH	NC	-40	4	-	OIS	-	-	-	-
1082	ECHINOCORYS	FRAGS	-40	4	-	OIS	-	-	-	-
1102	ECHINOCORYS	NC	-40	4	-	-	-	-	-	-
992	P VESICULARE (Lamarck)	NC	-40	4	-	-	-	-	-	-
1198	T GRACILIS Schlotheim	FRAGS	-40	4	-	-	-	-	-	-
956	BELEMNITELLA	G(XE)(2)(WN)	-45	4	29.6 9.5	4021650	NNNN N ALL	0100 1	CA DB	?AN
1063	BELEMNITELLA	G(2)	-45	4	21.5 5.0	1331310	F00F F	0	DB	
1020	C ARCUATA Pettitt	CS	-45	4	10.0 9.0 3.9	PVB	-	-	-	-
255	ECHINOCORYS	FRAGS	-45	4	-	-	-	-	-	AA AN OT UL VT
256	ECHINOCORYS	FRAGS	-45	4	-	-	-	-	EN PO	-
1242	ECHINOCORYS	FRAGS	-45	4	-	OIS	-	-	-	AA DS ?OY MS ww
1092	P VESICULARE (Lamarck)	FRAGS NC	-45	4	-	-	-	-	-	-
250	BELEMNITELLA	G+A	-50	4	57.2 9.0	120680	3001 4	1000 1	CA DB ?N	SA
1050	C ARCUATA Pettitt	NC	-50	4	7.0 8.1 4.0	PVT	-	-	-	-
1004	ECHINOCORYS	FRAGS	-50	4	-	USD	-	-	-	AN DA ?OY PO ww
1165	P VESICULARE (Lamarck)	NC	-50	4	-	-	-	-	-	-
983	SPONGE	NC	-50	4	-	-	-	-	-	-
967	BELEMNITELLA	G+A(XE)	-55	4	55.1 11.4	4630200	FFFF N	2200 4	CA DB DI	AN BU ?OY
1016	BELEMNITELLA	A(V WN)	-55	4	21.1 9.1	93230	NNNN N ALL	0	CA DB ?EN TA	-
1010	BELEMNITELLA	G+A(XE)(WN)	-55	4	35.4 9.2	1123040	NNNN N ALL	2001 3	CA DB EN TA	BU CO MO
1023	BELEMNITELLA	G(2)	-55	4	20.0 6.0	920350	N001 N NE	0	CA DB	-
1220	BELEMNITELLA	A(V WN)	-55	4	20.6 5.5	1721600	FFNN N NWISW	0010 1	CA DB EN ?N	AN
1223	ECHINOCORYS	FRAGS	-55	4	-	-	-	-	-	AN DA ?OY HM, MO UL
1089-90	ECHINOCORYS	FRAGS	-55	4	-	USDRWU	-	-	-	AL AN, DA ?OY MO PO PR ST VT
1062	ORBIRHYNCHIA Sp	NC	-55	4	9.5 10.7 6.9	-	-	-	-	
713	BELEMNITELLA	A(WN)	-60	4	27.0 9.5	5020330	NNNN N NEINW	1010 2	CA DB TA	AN ?OY
1197	BELEMNITELLA	G	-60	4	65.2 15.1	1822300	FFNN N SWINW	0030 3	CA DB ?EN DI ?N	MO
1210	BELEMNITELLA	G+A(2)	-60	4	35.3 5.4	1721060	0	0	-	-
991	CRET Sp	NC	-60	4	-	-	-	-	-	-
1075	ECHINOCORYS	FRAGS	-60	4	-	RWU	-	-	-	ww
1070	ECHINOCORYS	FRAGS	-60	4	-	USD	-	-	-	MO
1148	ECHINOCORYS	FRAGS NC	-60	4	-	-	-	-	-	-
1022	?ECHINOCORYS	FRAGS	-65	4	-	-	-	-	-	AP
238	BELEMNITELLA	G(WN)	-65	4	37.0 12.0	1203080	NNNN N ALL	2101 4	TA	CO
1043	BELEMNITELLA	G+A(2)	-65	4	97.3 16.6	03160	0	0	-	-
1103	BELEMNITELLA	A	-65	4	19.4 6.3	2320630	0	0	-	-
1105	BELEMNITELLA	G(XE)	-65	4	14.5 6.4	920200	FFFF F	0	?TA	-
1219	BELEMNITELLA	G+A(2)	-65	4	85.3 10.4	5031200	NNNN N ALL	2003 5	CA DB TA	AN ?OY MO
1232	BELEMNITELLA	A	-65	4	19.1 11.2	4031200	N00N N NEINW	0001 1	CA DB ?EN	MO
1464	C NORVICENSIS Pettitt	CR	-65	4	13.7 15.1 4.1	PVB	-	-	-	-
894	ECHINOCORYS	NC	-65	4	-	RWU	-	-	-	-
989	P VESICULARE (Lamarck)	NC	-65	4	-	-	-	-	-	-
1097	SPONGE	NC	-65	4	-	-	-	-	-	-
969	?ECHINOCORYS	FRAGS	-70	4	-	RWU	-	-	-	-
239	BELEMNITELLA	G+A(WN)	-70	4	67.9 10.0	2422020	NNNN N ALL	1002 3	CA DB TA	AN, AP CO
848	ECHINOCORYS	FRAGS	-70	4	-	RWU	-	-	-	-
1074	ECHINOCORYS	FRAGS	-70	4	-	-	-	-	-	ww
974-5	INOCERAMID	FRAGS	-70	4	30cm²	-	-	-	-	UL
800	BELEMNITELLA	G+A(2)	-75	4	85.2 17.5	1520840	N1IN N NEINW	0	CA DB ?N	-
1081	BELEMNITELLA	A	-75	4	36.9 10.1	1221830	FFFF N	0212 5	CA DB TA	AN DS ?OY ww
1186	BELEMNITELLA	G	-75	4	43.4 0.0	4522950	FFFF N ALL	0011 2	CA DB ?N	AN ww
1083	ECHINOCORYS	FRAGS	-75	4	-	RWU	-	-	-	AN ME MS
1096	S OUTEMPLEANUS d'Orbigny	NC	-75	4	-	-	-	-	-	-
473	BELEMNITELLA	G+A	-80	4	66.0 9.0	4320900	N1IN N NEINW	2000 2	CA DB TA	GI ST
796	BELEMNITELLA	G	-80	4	24.1 7.0	2321600	NNNN N ALL	0100 1	CA DB ?N	BU
1024	BELEMNITELLA	G+A(XE)	-80	4	72.6 13.5	2032140	NFFN N NEINW	0011 2	CA DB	AN BU
1030	BELEMNITELLA	G+A(2)	-80	4	67.3 13.0	1121830	F00F F	1001 2	CA DB ?N	BU PV,
799	CIDARID Sp	SPINE	-80	4	-	-	-	-	-	-
989	ECHINOCORYS	smashed NC	-80	4	-	-	-	-	-	-
1094	ECHINOCORYS	FRAG NC	-80	4	-	-	-	-	-	-
1151	ECHINOCORYS	FRAGS NC	-80	4	-	-	-	-	-	-
1248	ECHINOCORYS	FRAGS	-80	4	-	OIS	-	-	-	CR DA MS
842	PETALOPORA Sp	-	-80	4	-	-	-	-	-	-
1019	?H cfSEMIPLANA (J. de C. Sowerby)	FRAG	-85	4	-	-	-	-	-	-
946	BELEMNITELLA	G+A	-85	4	21.6 9.0	2632520	0	0	DB	-
955	BELEMNITELLA	A(WN)	-85	4	12.3 5.9	03162	NNNN N ALL	0	CA DB	-
1233	BELEMNITELLA	A	-85	4	25.7 16.4	131560	NNNN N NEINW	0100 1	CA DB	MO
852	ECHINOCORYS	FRAGS	-85	4	-	OIS	-	-	-	DA
917	ECHINOCORYS	FRAG NC	-85	4	-	-	-	-	-	-
924	ECHINOCORYS	NC	-85	4	-	OIS	-	-	-	-
987	ECHINOCORYS	NC	-85	4	-	RWU	-	-	-	-
1091	ECHINOCORYS	FRAGS NC	-85	4	-	-	-	-	-	-
948	S OUTEMPLEANUS d'Orbigny	FRAG	-85	4	-	-	-	-	-	-
904	ECHINOCORYS	NC(64)	-90	4	-	-	-	-	-	-
938	ECHINOCORYS	FRAGS	-90	4	-	RWU	-	-	-	-
1002	ECHINOCORYS	FRAG	-90	4	-	-	-	-	-	-
719	INOCERAMID	FRAGS	-90	4	-	OIS	-	-	-	-
1100	P VESICULARE (Lamarck)	NC	-90	4	-	-	-	-	ob	-
1150	P VESICULARE (Lamarck)	FRAGS NC	-90	4	-	-	-	-	-	-
164	BELEMNITELLA	G+A(9H)	-95	4	49.0 10.0	6732650	0100 1	0010 1	TA	?OS
718	BELEMNITELLA	G+A(2)	-95	4	43.1 11.0	3232120	N1IN N NEINW	2002 4	CA DB TA	AP CO MS
1021	BELEMNITELLA	G+A(4)	-95	4	col 9.6	1123100	FNNF N SEISW	1001 2	CA DB ?N	AP SA
1181	BELEMNITELLA	A	-95	4	24.3 9.1	932060	0110 2	0	DB	-
1249	BELEMNITELLA	G	-95	4	13.9 7.4	1200110	NNNN N ALL	0	CA DB	-
1025	BRACH	NC	-95	4	-	-	-	-	-	-
679	ECHINOCORYS	FRAG	-95	4	47.3 32.1	RWU	-	-	-	-
1000	ECHINOCORYS	FRAGS	-95	4	-	OIS	-	-	RO	-
1243	ECHINOCORYS	FRAGS	-95	4	-	USD	-	-	-	OHcf SA
950	M CHITONIFORMIS (Schlotheim)	CS	-95	4	8.4 9.2 3.6	-	-	-	-	-
1101	P VESICULARE (Lamarck)	NC	-95	4	-	-	-	-	-	-
804	A cfINCURVA Nilsson	FRAGS	-100	4	-	-	-	-	-	-
941	BELEMNITELLA	G+A(XE)	-100	4	20.9 5.6	?22060	NN00 N NEISE	0	CA DB	CO
1028	BELEMNITELLA	G+A(5)	-100	4	85.7 14.0	?840900	0	0001 1	-	AN
1029	BELEMNITELLA	G	-100	4	26.3 11.4	25?1?60	N00N N	0	CA DB	-
1222	BELEMNITELLA	G(2)	-100	4	26.0 7.3	?2480	N00N N NEINW	0300 3	CA DB	AN
1067	C ARCUATA Pettitt	CS?JUV	-100	4	7.0 0.0 4.3	PVT	-	-	-	-
905	ECHINOCORYS	NC(64)	-100	4	-	-	-	-	-	-
933	ECHINOCORYS	FRAG	-100	4	-	-	-	-	-	-
984	ECHINOCORYS	NC	-100	4	-	RWU	-	-	-	-
990	ECHINOCORYS	NC	-100	4	-	RWU	-	-	-	-
1015	ECHINOCORYS	FRAGS	-100	4	-	-	-	-	-	-
971-3	ECHINOCORYS	FRAGS(03)	-100	4	-	-	-	-	-	-
930	INOCERAMID	NC	-100	4	55cm²	USD2RWU	-	-	-	OHcf OS ST ww
1095	P VESICULARE (Lamarck)	NC	-100	4	-	-	-	-	-	-

NO	TAX	DES	POS	FB	DIM	?PI	BOF	EPI	B(D)	E(D)
711	A cfINCURVA Nilsson	FRAGS	-105	4	-	-	-	-	-	-
722	A cfINCURVA Nilsson	FRAG	-105	4	27.3 20.2	-	-	-	-	-
794	BELEMNITELLA	G+A	-105	4	67.5 9.6	1982?40	NNNN N SW	1221 6	CA DB	AN, DS
756	BELEMNITELLA	G(SM)	-105	4	28.9 6.2	04160	0	0	-	-
839	BELEMNITELLA	G(2)	-105	4	29.0 8.9	308225U	0	0	-	-
1056	BELEMNITELLA	G(2)	-105	4	31.9 10.9	7?334U	FFFF N ALL	0021 3	CA DB EN TA	AN MO SA
1241	BELEMNITELLA	G(XE)(3)	-105	4	35.9 9.8	242043D	NN08 N NEISE	0	CA DE TA	-
934	BRACH	NC	-105	4	-	-	-	-	-	-
964	C ARCUATA Pettitt	CS	-105	4	8.7 9.5 4.5	-	-	-	-	-
1065	C ARCUATA Pettitt	FRAG	-105	4	-	-	-	-	-	-
965	CIDARID Sp	SPINE	-105	4	-	-	-	-	-	-
257	ECHINOCORYS	FRAGS	-105	4	-	-	-	-	-	-
692	ECHINOCORYS	FRAG	-105	4	-	-	-	-	-	-
906	ECHINOCORYS	NC(64)	-105	4	-	-	-	-	-	GI
981	ECHINOCORYS	NC	-105	4	-	01S	-	-	-	-
914	INOCERAMID	NC	-105	4	25 15	-	-	-	-	-
918	INOCERAMID	smashed NC	-105	4	10 10	-	-	-	-	-
1066	N SEXCOSTATA (S. Woodward)	FRAGS	-105	4	-	-	-	-	-	-
820	P VESICULARE (Lamarck)	FRAG	-105	4	-	-	-	-	-	-
755	S DUTEMPLEANUS d Orbigny	PS	-105	4	20 20	-	-	-	-	-
1093	SPONGE	NC	-105	4	-	-	-	-	-	-
1109	T STRIATA d'Orbigny	CS	-105	4	7.4 6.0 3.4	PVT	-	-	-	-
789	A cfINCURVA Nilsson	FRAG	-110	4	-	-	-	-	-	-
775	BELEMNITELLA	G+A(XE)	-110	4	33.4 7.5	3030700	4112 0	0500 5	CA DB TA	?CE DA VL
793	BELEMNITELLA	G+A	-110	4	60.6 10.0	1330650	NNNN N ALL	0	CA DB	-
881	BELEMNITELLA	G	-110	4	14.4 5.9	030860	1001 2	1000 1	CA DB	BU
836	BELEMNITELLA	A	-110	4	16.4 6.0	6020040	4234 13	4012 7	CA DB	CO MO SA
840	BELEMNITELLA	G+A(XE)(3)	-110	4	50.0 11.0	1131110	0300 3	0	CA DB	-
644	BELEMNITELLA	G	-110	4	26.0 8.1	?730200	NONN N NEINWISW	0	CA DB ?N	-
895	ECHINOCORYS	NC	-110	4	-	01S	-	-	-	-
907	ECHINOCORYS	NC(64)	-110	4	-	-	-	-	-	-
942	INOCERAMID	FRAG	-110	4	61.9 47.1	-	-	-	-	MS fr
896	Pectinid	FRAGS NC	-110	4	-	-	-	-	-	-
220	BELEMNITELLA	G+A(SM)	-115	4	57.9 9.0	1603520	NNNN N ALL	1020 3	CA DB TA	ww
741	BELEMNITELLA	G	-115	4	50.6 11.0	1603170	NNNN N NEISE	1000 1	CA DB ?N TA	BU
759	BELEMNITELLA	G(XE)	-115	4	20.0 9.0	2030700	NN11 N NEISE	0010 1	DB TA	BU
1057	BELEMNITELLA	G	-115	4	34.1 5.3	931590	NFFN N NEINW	1000 1	CA DB ?N	ww
1221	BELEMNITELLA	G+A(3)	-115	4	76.1 13.4	3742370	NN00 NNEISE	0100 1	CA DB TA	CO
850	INOCERAMID	FRAGS	-115	4	-	-	-	-	-	by DS SA
783	S DUTEMPLEANUS d Orbigny	FRAG	-115	4	-	-	-	-	-	-
179	BELEMNITELLA	G(XE)	-120	4	38.9 8.5	3032320	4112 0	2002 4	CA DB	?
746	BELEMNITELLA	G+A(XE)(MN)	-120	4	38.0 9.9	3432500	NNNN N ALL	1201 4	CA DB	BU CO MO
786	BELEMNITELLA	G(XE)(V MN)	-120	4	49.6 10.5	5730500	NFFN N NEINW	2001 3	CA DB ?N	CO ST UC
782	BELEMNITELLA	G	-120	4	17.7 5.2	3031800	2213 0	-	CA ?N	-
791	BELEMNITELLA	A(MN)	-120	4	22.3 10.1	1131000	NNNN SEISW	0111 3	CA DB EN	BU
792	BELEMNITELLA	G(2)	-120	4	23.2 5.1	3031640	0	-	-	-
849	BELEMNITELLA	G+A(2)	-120	4	39.0 8.7	1032500	F00F F	1000 1	DB	BU
968	BELEMNITELLA	G(XE)(2)	-120	4	35.6 9.1	1931620	N2NN N NEISWINW	1001 2	CA DB ?N	?MS
925	ECHINOCORYS	NC	-120	4	-	RWU	-	-	-	-
993	ECHINOCORYS	NC	-120	4	-	USD	-	-	-	-
945	P VESICULARE (Lamarck)	FRAG	-120	4	-	-	-	-	-	-
1098	P VESICULARE (Lamarck)	NC	-120	4	-	-	-	-	-	-
929	SPONGE	NC	-120	4	-	-	-	-	-	-
182	BELEMNITELLA	G(XE)	-125	4	30.1 12.9	3030760	5012 0	1100 2	DB	AN MO
781	BELEMNITELLA	G	-125	4	17.0 5.6	2130500	0	0	-	-
830	BELEMNITELLA	A	-125	4	8.9 3.4	1503450	0	0	-	-
1026	BELEMNITELLA	G(XE)(3)	-125	4	32.3 8.4	931600	FFFF N	0	CA DB ?N	-
680	ECHINOCORYS	FRAG	-125	4	-	-	-	-	-	-
922	ECHINOCORYS	FRAGS NC	-125	4	-	01S	-	-	-	-
926	ECHINOCORYS	NC	-125	4	-	01S	-	-	-	-
805	BELEMNITELLA	G	-130	4	49.2 10.4	3731200	2000 2	0025 7	DB ?N	BU CO MO
935	BELEMNITELLA	G+A	-130	4	57.7 8.6	?130900	NNNN N ALL	0	CA DB EN	-
936	BELEMNITELLA	G+A(2)	-130	4	69.6 11.5	2031910	FFNN N SWINW	2111 5	CA EN ?N	CO MO SA
1073	BELEMNITELLA	G	-130	4	49.9 11.9	2033440	FFFF N ALL	0020 2	CA DB	AP ?HE
855	ECHINOCORYS	FRAGS	-130	4	-	-	-	-	-	DA DL DS OS PR SA
915	ECHINOCORYS	FRAG NC	-130	4	-	01S	-	-	-	-
916	ECHINOCORYS	FRAG NC	-130	4	-	01S	-	-	-	-
927	ECHINOCORYS	NC	-130	4	-	RWU	-	-	-	-
194	INOCERAMID	FRAGS	-130	4	-	-	-	-	-	DA
985	P VESICULARE (Lamarck)	NC	-130	4	-	-	-	-	-	-
986	P VESICULARE (Lamarck)	NC	-130	4	-	-	-	-	-	-
774	A cfINCURVA Nilsson	FRAGS	-135	4	-	-	-	-	-	-
773	BELEMNITELLA	A	-135	4	33.3 8.7	430320	NNNS N NEISEISW	2200 4	CA DB TA	BU MO ST
797	BELEMNITELLA	A	-135	4	25.6 14.7	1931630	NNNN N ALL	NNNN N	CA DB EN ?N	BU DS MS ST
821	BELEMNITELLA	G	-135	4	17.4 5.6	1230970	N00N N NEINW	1000 1	CA DB ?N	BU
837	BELEMNITELLA	G	-135	4	0.9 4.0	6731000	3100 4	0	DB	-
678	ECHINOCORYS	FRAGS	-135	4	20 25	USD	-	-	-	ON cf ?OS FC ?HS ?PR SA
944	ECHINOCORYS	FRAG	-135	4	-	01S	-	-	-	-
712	INOCERAMID	FRAGS	-135	4	43.0 33.1	-	-	-	-	DS
173	BELEMNITELLA	G+A	-137	4	58.4 9.3	7032800	0201 3	5200 7	DB	AN by CO MO VL
798	BELEMNITELLA	G	-140	4	18.6 6.0	2403370	6435 10	0001 1	CA DB	AP
841	BELEMNITELLA	G	-140	4	24.0 8.0	6730400	1210 4	1023 6	DB ?N	AP BU CO
1001	BELEMNITELLA	G+A(2)	-140	4	56.0 9.6	520350	NFFN N NEINW	0001 1	CA DB ?N	AN
739	C NORVICENSIS Pettitt	CS	-140	4	13.3 12.1 10.3	PVT	-	-	-	-
947	ECHINOCORYS	FRAG	-140	4	-	-	-	-	-	-
726	OSTREA Sp	FRAG	-140	4	-	-	-	-	-	AN GI PR ST
966	P VESICULARE (Lamarck)	FRAGS	-140	4	-	-	-	-	-	BU
845	BELEMNITELLA	G(2)	-145	4	53.1 9.1	1432520	FFFF N	1120 4	CA DB	BU ww
960	CRET Sp	NC	-145	4	-	-	-	-	-	-
076-04	ECHINOCORYS	FRAGS	-65--55	4	-	03U40S2	-	-	RO	DA ?DY MS SD
867-75	ECHINOCORYS	FRAGS	-95--80	4	-	R2U205372	-	-	-	BU CR DA GI MO PR PV SA TR VF
862-6	ECHINOCORYS	FRAGS	-110--90	4	-	R372	-	-	EN	DA DS DT MM MO
597	BELEMNITELLA	NC	-	4	-	430620D	-	-	-	-
1163	BELEMNITELLA	NC	-5	5	-	1631180	-	-	-	-
1202	BELEMNITELLA	G(XE)	-5	5	33.0 0.0	790510	NNFN N NEISEINW	0200 2	CA DB	BU MO
1195	C CARNEA (J. Sowerby)	PV	-5	5	-	-	-	-	-	-
1162	CRET Sp	broke NC	-5	5	-	-	-	-	-	-
1230	RECURVASTER Sp	OSSCICLE	-5	5	-	-	-	-	-	-
24	BELEMNITELLA	G+A	-10	5	69.1 11.4	3420620	200N N NW	0022 4	CA DB TA	BU
192	ECHINOCORYS	PS(DIS)	-15	5	-	-	-	-	-	-
1239	ECHINOCORYS	FRAGS	-15	5	-	RWU	-	-	EN RO	-
1157	INOCERAMID	NC	-25	5	30cm+	-	-	-	-	-
1240	P SUBTORQUATA (Munster)	FRAG	-25	5	10.6 2.4	-	-	-	-	-
1169	SPONGE	NC	-25	5	-	-	-	-	-	-
1231	T STRIATA d'Orbigny	CS	-25	5	6.7 5.4 2.1	-	-	-	-	BU
1170	SPONGE	NC	-30	5	-	-	-	-	-	-
1225	P GLOBULARIS (Phillips)	SPHERE	-35	5	11 10 9	-	-	-	-	-
1152	S DUTEMPLEANUS d'Orbigny	PS NC	-35	5	-	-	-	-	-	-
1206	BELEMNITELLA	A(2)	-40	5	41.7 16.6	1023200	NNNN N ALL	0	CA DB ?DI	-
1168	INOCERAMID	NC	-40	5	-	-	-	-	-	-
1193	C CARNEA (J. Sowerby)	FRAGS	-45	5	-	-	-	-	-	-
1164	ECHINOCORYS	FRAGS NC	-45	5	-	-	-	-	-	-
1194	BELEMNITELLA	G	-50	5	20.4 11.7	2522310	FNNF N SEISW	1000 1	CA DB	BU
1332	K PENTANGULATA S. Woodward	CS	-50	5	9.0 0.5 4.6	PVT	-	-	-	-
1156	S DUTEMPLEANUS d'Orbigny	NC	-50	5	-	-	-	-	-	-
1192	BELEMNITELLA	G(3)	-55	5	49.5 12.6	2031340	NNNN N ALL	0010 1	CA DB ?N	AN
176	C CARNEA (J. Sowerby)	PS	-55	5	15.0 11.0 9.9	PVT	-	-	-	-
20	BELEMNITELLA	G+A(XE)	-65	5	45.7 9.6	2023120	N2?N N NEWNW	0002 2	CA DB EN TA	MO
1189	BELEMNITELLA	G+A	-70	5	72.4 13.7	721390	NNNN N ALL	0001 1	CA DB ?N TA	BU
1205	C ARCUATA Pettitt	NC	-70	5	0.0 0.0	PVB	-	-	-	-
166	C ARCUATA Pettitt	CS (CRU)	-	5	13.6 15.2 6.6	PVB	-	-	-	-
1238	K PENTANGULATA S. Woodward	FRAGS	-	5	-	-	-	-	-	-
1212	BELEMNITELLA	G	-5	6	37.7 8.3	5031300	0	0	-	-
1429	BELEMNITELLA	G+A(2)	-5	6	04.7 15.6	2530500	FONN N SWINW	0	CA DB ?N TA	-
1470	BELEMNITELLA	G+A(XE)	-5	6	20.5 7.6	2031200	N0FN N NEINW	0100 1	CA DB ?N TA	AN
1173	ECHINOCORYS	NC	-5	6	-	-	-	-	-	-
245	C ARCUATA Pettitt	NC(CRU)	-10	6	10 12	-	-	-	-	-
1155	ECHINOCORYS	NC	-10	6	-	01S	-	-	-	-
1160	INOCERAMID	NC	-10	6	15cm+	-	-	-	-	-
1178	SPONGE	NC	-10	6	-	-	-	-	-	-
1290	BELEMNITELLA	LOST	-15	6	-	5400800	-	-	-	-
1176	ECHINOCORYS	in fl NC	-15	6	-	-	-	-	-	-
1340	ECHINOCORYS	NC	-15	6	-	-	-	-	-	-
1245-7	ECHINOCORYS	FRAGS	-15	6	-	-	-	-	-	-
1215	G CANALICULATA (J. Sowerby)	PS	-15	6	22 22	-	-	-	-	-
1166	CRET Sp	NC	-20	6	-	-	-	-	-	-
229	S DUTEMPLEANUS d'Orbigny	FRAG	-20	6	9.0 10 5	-	-	-	-	-
1177	SPONGE	NC	-20	6	-	-	-	-	-	-
1355	SPONGE	NC	-20	6	-	-	-	-	-	-
1354	SPONGES	sev sp NC	-20	6	-	-	-	-	-	-
175	BELEMNITELLA	G+A(XE)	-25	6	27.6 8.5	1030600	NNNN N ALL	0	CA DB TA	-
1211	C ?ARCUATA Pettitt	CS	-25	6	14.0 15.5 7.0	PVB	-	-	CA	-
1200	C CARNEA (J. Sowerby)	FRAG	-25	6	-	-	-	-	-	-
1224	INOCERAMID	FRAG	-25	6	45 35	-	-	-	-	?MO
1174	S DUTEMPLEANUS d Orbigny	NC	-25	6	-	-	-	-	?EN	-
1281	SPONGE	NC	-25	6	-	-	-	-	-	-
1471	-	BURROW FL	-30	6	-	-	-	-	-	-
1244	INOCERAMID	FRAGS	-30	6	-	-	-	-	-	-
1290	SPONGE	NC	-30	6	-	-	-	-	-	DA
1204	BELEMNITELLA	G	-35	6	40.9 11.2	2221000	F0IF F NEINW	0	CA DB	-

NO	TAX	DES	POS	FB	DIM	ORI	BOF	EPI	B·D·	E·D·
1227	BELEMNITELLA	5	-35	6	45.3 10.2	620250	001N N NW	0002 2	CA DB	AN
1439	CRET Sp	FRAGS	-35	6	-	-	-	-	-	-
1154	INOCERAMID	NC	-35	6	10cm+	-	-	-	-	-
1171	INOCERAMID	NC	-35	6	30cm+	-	-	-	-	-
1175	INOCERAMID	NC	-35	6	30cm+	-	-	-	-	-
1179	INOCERAMID	NC	-35	6	30cm+	-	-	-	-	-
1282	SPONGE	NC	-35	6	-	-	-	-	-	-
1229	?CARNEITHYRIS	FRAG	-40	6	-	-	-	-	-	-
1228	BELEMNITELLA	6	-40	6	38.5 9.5	2602120	NNNN N ALL	0	CA DB	-
1161	CRET Sp	NC	-40	6	-	-	-	-	-	-
1150-4	ECHINOCORYS	NC	-40	6	-	USDRMU	-	-	-	-
1213	BELEMNITELLA	6+A(XE)	-45	6	54.1 10.3	1500550	NOON N NEINW	0	CA DB ?N PO	-
1167	CRET Sp	NC	-45	6	-	-	-	-	-	-
1201	T STRIATA d'Orbigny	CS	-45	6	12.9 9.6 4.1	PVB	-	-	-	-
1199	BELEMNITELLA	A	-50	6	27.0 10.5	420850	3300 6	0	DB	-
1216	BELEMNITELLA	6	-50	6	14.1 3.7	3700900	NNNN N ALL	0	CA DB TA	-
1214	BELEMNITELLA	6	-55	6	17.7 5.0	300630	0	0	-	-
1237	C CARNEA (J. Sowerby)	FRAGS NC	-55	6	-	-	-	-	-	-
1203	-	flint	-60	6	-	-	-	-	-	-
0	BELEMNITELLA	6+A(XE)	-60	6	65.6 11.4	2403040	NNNN N ALL	0	CA DB TA	-
1357	SPONGES	sev sp NC	-60	6	-	-	-	-	-	-
1217	BRACH	NC	-65	6	-	-	-	-	-	-
1172	C CARNEA (J. Sowerby)	NC	-65	6	-	-	-	-	-	-
1210	BELEMNITELLA	6	-70	6	36.0 10.4	2000500	NFFN N NEINW	0	CA DB ?N TA	-
1209	C ARCUATA Pettitt	CS?JUV	-70	6	8.7 9.6 5.6	-	-	-	-	-
1207	BELEMNITELLA	6+A	-75	6	36.6 6.5	1002370	FFFF N ALL	0200 2	CA D6 ?N	BU
1180	BRACH	NC(broke)	-75	6	-	-	-	-	-	-
1226	LIMA Sp	FRAGS	-75	6	-	-	-	-	-	-
1370	SPONGES	sev sp NC	-10--20	6	-	-	-	-	-	-
178	BELEMNITELLA	6(XE)	-	6	51.4 14.3	0003070	4114 10	0	CA DB ?N	-
234	BELEMNITELLA	6+A(SM)	-	6	65.5 9.8	?531?50	NNNN N ALL	0	CA DB EN	-
1318	C CARNEA (J. Sowerby)	FRAG	-	6	-	-	-	-	-	-
1275	SPONGE	NC	-	6	-	-	-	-	-	-
1277	SPONGE	NC	-	6	-	-	-	-	-	-
1278	SPONGE	NC	-	6	-	-	-	-	-	-
1359	SPONGE	NC	-	6	-	-	-	-	-	-
1361	SPONGES	sev sp NC	-	6	-	-	-	-	-	-
1350-1	SPONGES	?? sp NC	-	6--15 6	-	-	-	-	-	-
1432	C CARNEA (J. Sowerby)	NC	-5	7	16.1 16.2 10.2	PVB	-	-	-	-
1256	ECHINOCORYS	NC	-5	7	-	-	-	-	-	-
251	INOCERAMID	FRAGS	-5	7	30cm+	-	-	-	EN	CS
253	INOCERAMID	FRAGS	-5	7	35cm+	-	-	-	EN	-
1307	K PENTANGULATA S. Woodward	PS	-5	7	10.2 8.4 4.4	-	-	-	-	-
1410	BELEMNITELLA	6	-10	7	70.9 16.3	103136U	PNF N SEISW	0111 3	CA DB ?N	BU CO
1451	BELEMNITELLA	6	-10	7	30.2 10.2	13090U	NOON N NEINW	2000 2	CA DB TA	BU MS
241	C CARNEA (J. Sowerby)	NC	-10	7	14.9 14.9 7.7	PVT	-	-	-	-
1503	C CARNEA (J. Sowerby)	PS	-10	7	-	OIS	-	-	-	-
1317	K PENTANGULATA S. Woodward	NC	-10	7	13.9 14.0 7.1	PVB	-	-	-	-
1291	BELEMNITELLA	6	-15	7	24.9 6.5	3131630	0	0	-	-
1273	C CARNEA (J. Sowerby)	NC	-15	7	-	-	-	-	-	-
1309	CRET Sp	FRAGS	-15	7	-	-	-	-	-	-
1474	S DUTEMPLEANUS d'Orbigny	FRAGS NC	-15	7	-	-	-	-	-	-
1326	BRACH	broke NC	-20	7	-	-	-	-	-	-
1352	BRACH	NC	-20	7	-	-	-	-	-	-
1322	C ARCUATA Pettitt	PS	-20	7	8.2 9.4 4.1	PVT	-	-	-	-
1279	CRET Sp	NC	-20	7	-	-	-	-	-	-
1450	M CHITONIFORMIS (Schlotheim)	CS	-20	7	8.0 7.6 3.9	PVT	-	-	-	-
1405	T STRIATA d Orbigny	PS	-20	7	7.1 5.0	-	-	-	-	-
1288	C ARCUATA Pettitt	FRAGS	-25	7	-	-	-	-	-	-
1441	C ARCUATA Pettitt	CS	-25	7	12.7 14.9 9.4	PVT	-	-	-	-
1269	C CARNEA (J. Sowerby)	NC	-25	7	-	-	-	-	-	-
1530	CRET Sp	lost NC	-25	7	-	-	-	-	-	-
191	INOCERAMID	FRAGS	-25	7	-	-	-	-	EN	AN, DS fr GI MS ?PR ?US
1420	M CHITONIFORMIS (Schlotheim)	NC	-25	7	11.7 10.1 5.3	PVT	-	-	-	-
1443	S DUTEMPLEANUS d'Orbigny	FRAGS	-25	7	-	-	-	-	-	-
1274	SPONGE	NC	-25	7	-	-	-	-	-	-
1363	SPONGE	NC	-25	7	-	-	-	-	-	-
1463	C ARCUATA Pettitt	CS	-30	7	12.9 15.5 8.3	-	-	-	-	-
1448	C CARNEA (J. Sowerby)	FRAG	-30	7	-	-	-	-	-	-
1334	CIDARID Sp	SPINE	-30	7	-	-	-	-	-	-
1335	M CRETOSA (Defrance)	FRAG	-30	7	-	-	-	-	-	-
1369	BRACH	NC	-35	7	-	-	-	-	-	-
1555	C ?ARCUATA Pettitt	PS	-35	7	9.9 11.0 7.2	PVB	-	-	-	-
25	C ARCUATA Pettitt	CS	-35	7	10.4 10.9 6.4	-	-	-	-	-
1368	CIDARID Sp	SPINE NC	-35	7	-	-	-	-	-	-
1365	CRET Sp	broke NC	-35	7	-	-	-	-	-	-
1286	S DUTEMPLEANUS d'Orbigny	NC	-35	7	-	-	-	-	-	-
1364	SPONGES	sev sp NC	-35	7	-	-	-	-	-	-
218	?ORBIRHYNCHIA Sp	NC	-40	7	7.1 8.1 6.0	-	-	-	-	-
1422	BELEMNITELLA	A	-40	7	32.9 8.9	503070U	FOFN N NW	1000 1	CA DB ?N	ww
1428	C CARNEA (J. Sowerby)	PV	-40	7	15 15	PVT	-	-	-	-
1344	CRET Sp	NC	-40	7	-	-	-	-	-	-
1308	K PENTANGULATA S. Woodward	PS	-40	7	10 10	-	-	-	-	-
1271	S DUTEMPLEANUS d'Orbigny	NC	-40	7	-	-	-	-	-	-
1431	S DUTEMPLEANUS d'Orbigny	FRAG	-40	7	-	-	-	-	-	-
1287	SPONGE	NC	-40	7	-	-	-	-	-	-
1328	?	?	-45	7	-	-	-	-	-	-
219	?OSTREA Sp	FRAG	-45	7	17 7	-	-	-	-	-
232	BELEMNITELLA	6(?JUV)	-45	7	21.1 4.9	102182U	0	0	-	-
1413	BELEMNITELLA	6+A(2)	-45	7	118.7 19.6	3732050	NOOF N NE	2200 4	CA DB EN	AN, BU CO GI
228	C ARCUATA Pettitt	CS(CRU)	-45	7	12.3 12.0 6.1	PVT	-	-	-	-
1442	C ARCUATA Pettitt	CS	-45	7	13.6 15.3 8.7	PVT	-	-	-	-
1460	C ARCUATA Pettitt	NC	-45	7	11.5 13.1 7.4	-	-	-	EN	-
1461	CIDARID Sp	SPINE	-45	7	-	-	-	-	-	-
2300	ECHINOCORYS	NC	-45	7	-	USD	-	-	-	-
1333	K PENTANGULATA S. Woodward	FRAG	-45	7	-	-	-	-	-	-
1319	P SUBTORQUATA (Munster)	FRAG	-45	7	-	-	-	-	-	-
1356	S DUTEMPLEANUS d'Orbigny	FRAGS NC	-45	7	-	-	-	-	-	-
1268	SPONGE	NC	-45	7	-	-	-	-	-	-
1421	BRACH	NC	-50	7	-	-	-	-	-	-
224	C CARNEA (J. Sowerby)	FRAG	-50	7	10 10	-	-	-	-	-
1343	SPONGE	NC	-50	7	-	-	-	-	-	-
43	BELEMNITELLA	WN	-55	7	-	1021340	V BORED	-	CA DB	MO
1311	C ARCUATA Pettitt	CS(CR)	-55	7	11.2 11.5 4.9	PVB	-	-	-	-
1270	C CARNEA (J. Sowerby)	NC	-55	7	-	-	-	-	-	-
1444	C CARNEA (J. Sowerby)	NC	-55	7	17.2 10.3 10.4	OIS	-	-	-	-
1346	INOCERAMID	NC	-55	7	15cm+	-	-	-	-	-
1477	INOCERAMID	NC	-55	7	30cm+	-	-	-	-	-
1283	SPONGE	NC	-55	7	-	-	-	-	-	-
242	BELEMNITELLA	6+A	-60	7	79.4 12.2	1532400	NIIN N NEINW	0	CA DB EN ?N	-
244	BELEMNITELLA	6+A	-60	7	41.4 9.0	900	NIIN N NEINW	5005 10	CA DB TA	ANss AP SA
1468	BELEMNITELLA	6+A(XE)	-60	7	37.1 8.0	2730350	NNNN N NE	0100 1	CA DB	BU
1414	C ?NORVICENSIS Pettitt	PV?JUV	-60	7	9.1 10.4	-	-	-	-	-
222	C ARCUATA Pettitt	NC(CRU)	-60	7	13.2 13.2 7.4	PVB	-	-	-	-
1272	INOCERAMID	NC	-60	7	20cm+	-	-	-	-	-
1340	INOCERAMID	FRAGS	-60	7	-	-	-	-	-	-
1347	INOCERAMID	NC	-60	7	10cm+	-	-	-	-	-
1467	INOCERAMID	FRAGS	-60	7	15cm+	-	-	-	-	DA ?PR
1284	SPONGE	NC	-60	7	-	-	-	-	-	-
1285	SPONGE	NC	-60	7	-	-	-	-	-	-
1371	SPONGES	sev sp NC	-60	7	-	-	-	-	-	-
1289	BELEMNITELLA	6	-65	7	43.7 8.3	332100	NOON N NEINW	0002 2	CA DB ?N	GI
1449	BELEMNITELLA	6+A	-65	7	42.5 6.7	03000	0	0010 1	-	ANU
1469	BELEMNITELLA	6	-65	7	26.2 8.8	903500	0	0	-	-
1336	M OBESA Sahni	FRAG	-65	7	8.8 20.6 15.6	-	-	-	CA	-
1349	SPONGES	3 sp NC	-65	7	-	-	-	-	-	-
1323	C ARCUATA Pettitt	CS	-70	7	11.2 12.5 7.4	PVB	-	-	-	-
1447	C CARNEA (J. Sowerby)	FRAG	-70	7	-	-	-	-	-	-
4	C NORVICENSIS Pettitt	PV	-70	7	10.2 20.2 10.4	-	-	-	-	-
1345	SPONGES	sev sp NC	-70	7	-	-	-	-	-	-
1310	BELEMNITELLA	6	-75	7	30.2 6.6	1332050	NNNN N	1000 1	CA DB ?N	BU
1445	C ARCUATA Pettitt	CS(?JUV)	-75	7	9.6 10.3 5.0	PVB	-	-	-	-
1433	C CARNEA (J. Sowerby)	NC	-75	7	23.1 22.2 10.5	PVT	-	-	-	-
215	M CHITONIFORMIS (Schlotheim)	FRAG	-75	7	5 3	-	-	-	-	-
1423	N SEXCOSTATA (S. Woodward)	FRAGS	-75	7	15 15	-	-	-	wb	-
1444	C ARCUATA Pettitt	NC	-80	7	8.0 10.0 4.5	PVB	-	-	-	-
1338	C CARNEA (J. Sowerby)	PS	-80	7	14.2 13.9 9.3	PVT	-	-	-	-
1353	CRET Sp	NC	-80	7	-	-	-	-	-	-
1419	BELEMNITELLA	6+A	-85	7	46.6 8.7	5200110	PNF N SEISW	0	CA DB ?EN ?N	-
1464	BELEMNITELLA	6	-85	7	13.1 2.9	3060830	FFFF F	0	DB	-
3	C CARNEA (J. Sowerby)	PS	-85	7	15.9 13.9 7.5	PVB	-	-	-	-
1465	ECHINOCORYS	FRAGS	-85	7	-	-	-	-	-	-
1276	SPONGE	NC	-85	7	-	-	-	-	-	-
1342	SPONGE	NC	-85	7	-	-	-	-	-	-
1358	SPONGES	sev sp NC	-85	7	-	-	-	-	-	-
1339	BELEMNITELLA	6	-90	7	26.0 7.0	6030000	NNNN N ALL	0	CA DB TA	-
252	INOCERAMID	FRAGS	-90	7	40cm+	-	-	-	EN	-
1316	BELEMNITELLA	6(XE)	-95	7	17.6 5.6	1131360	NNNN N ALL	0010 1	CA DB ?N TA	MO
1430	BELEMNITELLA	A	-95	7	22.7 12.2	1300390	NOON N NEINW	0	CA DB	-
241	C CARNEA (J. Sowerby)	FRAGS	-95	7	8 7	-	-	-	-	-

NO	TAX	DES	POS	FB	DIM	ORI	BOR	EPI	B(D)	E(D)
254	ECHINOCORYS	FRAGS	-95	?	-	-	-	-	-	AP BU CS DA DS NS SG VL
1440	C ARCUATA Pettitt	CS	-100	-	15.9 16.6 9.0	PVB	-	-	-	-
1362	ECHINOCORYS	FRAGS NC	-105	?	-	-	-	-	-	-
1366	SPONGES	NC	-55--80	?	-	-	-	-	-	-
18	BELEMNITELLA	G+A(XE)	-	?	49.9 13.9	3300630	N17N N NE NW	2200 4	CA DB	BU
1582	C ARCUATA Pettitt	CS	-	-	8.3 8.1 3.5	PVT	-	-	-	-
1473	C CARNEA (J. Sowerby)	NC	-	?	-	PVT	-	-	-	-
1462	ECHINOCORYS	FRAGS	-	?	-	PVU	-	-	-	BU CO
1367	INOCERAMID	NC	-	?	40cm+	-	-	-	-	-
1360	SPONGE	NC	-	?	-	-	-	-	-	-
1384	SPONGES	sev sp NC	-	?	-	-	-	-	-	-
1476	SPONGES	sev sp NC	-	?	-	-	-	-	-	-
1524	BELEMNITELLA	G	-10	0	59.6 15.6	2603470	FNN0 N SE|SW	1000 1	CA DB EN TA	BU
1557	BELEMNITELLA	G+A(XE)	-10	0	24.6 5.5	2302370	NNNN N ALL	0	CA DB	-
1566	BELEMNITELLA	G+A(2)	-10	0	55.7 9.1	8300200	N104 N NE	0	CA DB ?N	-
1621	BRACH	lost NC	-10	0	-	-	-	-	-	-
1620	C CARNEA (J. Sowerby)	FRAGS	-10	0	-	-	-	-	-	-
1508	CRET Sp	broke NC	-10	0	-	-	-	-	-	-
1604	BELEMNITELLA	G+A(4)	-15	0	60.7 12.2	1702170	FFF0 N	0200 2	CA DB ?N	BU
1532	C CARNEA (J. Sowerby)	FRAGS	-15	0	-	-	-	-	-	-
1613	C CARNEA (J. Sowerby)	FRAGS	-15	0	-	-	-	-	-	-
248	BELEMNITELLA	G	-20	0	41.8 8.0	2501380	0006 14	1000 1	CA DB TA	AP
1494	C CARNEA (J. Sowerby)	NC	-20	0	-	PVT	-	-	-	-
1507	C CARNEA (J. Sowerby)	int impr NC	-20	0	-	-	-	-	-	-
1536	C CARNEA (J. Sowerby)	CS	-20	0	20.0 10.7 10.3	PVT	-	-	-	-
199	C NORVICENSIS Pettitt	PS(CRU)	-20	0	11.0 11.4 7.2	PVB	-	-	-	-
200	C ARCUATA Pettitt	PS	-25	0	9.6 14.9 0.0	PVB	-	-	-	-
243	C ARCUATA Pettitt	CS	-25	0	13.8 14.3 0.2	PVT	-	-	-	-
1500	C CARNEA (J. Sowerby)	NC	-25	0	-	-	-	-	-	-
1614a	C CARNEA (J. Sowerby)	NC	-25	0	22.3 19.2 12.3	PVT	-	-	-	-
1614b	C CARNEA (J. Sowerby)	NC	-25	0	15.5 15.5 0.6	PVT	-	-	-	-
1617	C CARNEA (J. Sowerby)	NC	-25	0	21.9 18.9 12.3	PVB	-	-	-	-
1509	CRET Sp	broke NC	-25	0	-	-	-	-	-	-
45	BELEMNITELLA	G+A	-20	0	60.5 11.3	1303350	N31N N NW\NE	0001 1	CA DB TA	BU
1535	C ?ARCUATA Pettitt	CS(CR)	-30	0	13.1 14.7 6.1	PVB	-	-	-	-
207	C CARNEA (J. Sowerby)	FRAG	-30	0	13.9 13.2	-	-	-	-	-
231	C CARNEA (J. Sowerby)	CS(CRU)	-30	0	21.3 19.9 11.6	PVT	-	-	-	-
1499	C CARNEA (J. Sowerby)	NC	-30	0	-	PVT	-	-	-	-
1505	C CARNEA (J. Sowerby)	NC	-30	0	-	-	-	-	-	-
1556	C CARNEA (J. Sowerby)	PV	-30	0	20 15	PVT	-	-	-	-
1504	CRET Sp	NC	-30	0	-	-	-	-	-	-
225	C CARNEA (J. Sowerby)	NC	-32	0	17.5 16.8 9.1	OIS	-	-	-	-
205	BELEMNITELLA	G+A	-35	0	84.6 15.0	2314200	N32N N NE|NW	0	CA DB eb EN TA	-
1543	BELEMNITELLA	G+A(2)	-35	0	46.4 9.6	3035400	0	0	-	-
1595	BELEMNITELLA	G+A(3)	-35	0	40.3 8.2	9318100	00FF F	0	CA DB ?N	-
230	C CARNEA (J. Sowerby)	PS(CRU)	-35	0	20.2 16.2 10.1	-	-	-	EN	-
1506	C CARNEA (J. Sowerby)	NC	-35	0	-	-	-	-	-	-
1564	C CARNEA (J. Sowerby)	PV	-35	0	10 20	PVT	-	-	CA ?N	?DY
1639	C CARNEA (J. Sowerby)	NC	-35	0	-	-	-	-	-	-
1640	C CARNEA (J. Sowerby)	NC	-35	0	-	PVB	-	-	-	-
1519	CRET Sp	NC	-35	0	-	-	-	-	-	-
1641	CRET Sp	NC	-35	0	-	-	-	-	-	-
206	BELEMNITELLA	G(XE)	-40	0	34.8 12.9	2033000	NNNN N ALL	1112 5	CA DB EN	BU 4r
246	BELEMNITELLA	G+A(WN)	-40	0	60.0 9.7	322050	NNNN N ALL	0	CA DB TA	-
1570	BELEMNITELLA	G+A(XE)	-40	0	21.7 6.1	4201550	0001 1	1000 1	?N	VT
1599	BELEMNITELLA	G+A(XE)	-40	0	44.6 11.6	3203230	NNNN N ALL	0	CA DB ?N TA	-
203	C CARNEA (J. Sowerby)	CS	-40	0	17.3 16.5 10.2	PVB	-	-	-	-
1574	C CARNEA (J. Sowerby)	NC	-40	0	13.7 13.9 7.6	OIS	-	-	-	-
1597	C NORVICENSIS Pettitt	CS	-40	0	9.7 10.9 7.0	PVT	-	-	-	-
1565	BELEMNITELLA	G+A(XE)	-45	0	43.2 13.3	1206200	6004 10	0	CA DB TA	-
1616	BELEMNITELLA	G+A(XE)	-45	0	50.0 14.1	2030600	N00F N NE	3101 5	CA DB	BU ?cb
233	C CARNEA (J. Sowerby)	CS	-45	0	22.3 22.4 14.3	PVT	-	-	-	-
249	C CARNEA (J. Sowerby)	NC	-45	0	24.3 21.0 14.0	-	-	-	-	-
1593	K PENTANGULATA S. Woodward	PV	-45	0	15 10	PVT	-	-	-	-
1537	BELEMNITELLA	G+A	-50	0	63.5 10.2	4332960	N00N N NE|NW	0040 4	CA DB ?N	AP MO
1551	BELEMNITELLA	G(XE)	-50	0	27.2 11.9	1801500	NNNN N ALL	0100 1	CA DB EN	BU
1491	C CARNEA (J. Sowerby)	NC	-50	0	-	-	-	-	-	-
1534	BELEMNITELLA	A	-55	0	10.7 0.7	503330	000F F	0001 1	CA DB	BU
1549	BELEMNITELLA	G(XE)	-55	0	25.0 10.6	1501010	NF0N N NE|NW	0	CA DB	-
1586	BELEMNITELLA	G	-55	0	30.4 10.4	1400450	0NNF N SE|SW	2001 3	CA DB	BU
196	C CARNEA (J. Sowerby)	PS	-55	0	21.4 19.9 14.6	-	-	-	-	-
197	C CARNEA (J. Sowerby)	PS(CRU)	-55	0	15.0 13.1 5.2	-	-	-	-	-
198	C CARNEA (J. Sowerby)	PS	-55	0	10.3 19.3 16.0	-	-	-	-	-
1501	C CARNEA (J. Sowerby)	NC	-55	0	-	-	-	-	-	-
1585	C CARNEA (J. Sowerby)	POS	-55	0	15.2 17.3 0.3	PVT	-	-	-	HO
26	BELEMNITELLA	V WN	-57	0	46.5 10.7	5030620	NNNN N NE\NW	0100 1	CA DB ?N	BU
29	BELEMNITELLA	G+A(WN)	-60	0	44.9 6.9	1703560	NNNN N ALL	0	CA DB ?N	-
202	BELEMNITELLA	G	-60	0	50.2 15.2	2201120	0NNN N SW|NW	1001 2	CA DB ?N	BU
1571	BELEMNITELLA	G(2)	-60	0	16.0 13.0	900	0	0	-	-
1594	BELEMNITELLA	G+A(2)	-60	0	62.1 10.0	1601450	NNNN N ALL	1220 5	CA DB ?N	BU GI
2302	C ARCUATA Pettitt	NC	-60	0	-	PVT	-	-	-	-
1480	C CARNEA (J. Sowerby)	NC	-60	0	-	-	-	-	-	-
1492	C CARNEA (J. Sowerby)	NC	-60	0	-	-	-	-	-	-
1630	C CARNEA (J. Sowerby)	NC	-60	0	-	PVT	-	-	-	-
2301	C CARNEA (J. Sowerby)	NC	-60	0	-	PVT	-	-	-	-
1561	C NORVICENSIS Pettitt	NC	-60	0	15.9 20.4 14.5	PVB	-	-	?N	-
212	BELEMNITELLA	G	-65	0	26.2 0.7	2030470	NNNN N ALL	0	CA DB ?N	-
223	BELEMNITELLA	G(XE)	-65	0	51.9 14.0	1803300	NNNN N ALL	0010 1	CA DB ?N TA	BU
1523	BELEMNITELLA	G+A(XE)	-65	0	34.6 11.6	5601170	FFF0 N NE|SE|SW	1000 1	CA DB ?N TA	BU
1546	BELEMNITELLA	G	-65	0	43.3 11.1	331900	F00F F	0020 2	CA DB ?N	AN
1487	C CARNEA (J. Sowerby)	NC	-65	0	-	-	-	-	-	-
1496	C CARNEA (J. Sowerby)	FRAGS NC	-65	0	-	-	-	-	-	-
1642	C CARNEA (J. Sowerby)	1valve NC	-65	0	-	PVB	-	-	-	-
1643	C CARNEA (J. Sowerby)	1valve NC	-65	0	-	PVT	-	-	-	-
32	BELEMNITELLA	G	-70	0	30.0 14.9	302110	NNNN N ALL	0	CA DB	-
35	BELEMNITELLA	G(XE)	-70	0	26.5 0.3	320600	NNNN N NE\SW\NW	0	CA DB	-
213	BELEMNITELLA	A(WN)	-70	0	24.3 10.1	3030400	NNNN N ALL	0	CA DB	-
1541	BELEMNITELLA	G	-70	0	32.5 10.5	1030570	NFFN N NE|NW	0	CA DB ?N TA	-
1522	C CARNEA (J. Sowerby)	FRAG	-70	0	-	-	-	-	-	-
1560	C CARNEA (J. Sowerby)	NC	-70	0	10.2 15.3 9.6	OIS	-	-	-	-
11	BELEMNITELLA	G	-75	0	44.6 12.6	1022700	NNNN N NE\SW\NW	0	CA DB TA	-
1545	BELEMNITELLA	G	-75	0	27.3 10.2	2131300	NNNN N ALL	0	CA DB	-
1550	BELEMNITELLA	G+A(XE)	-75	0	31.3 0.3	6020790	02NN N SW|NW	0032 5	CA DB ?N	BU MO
1504	BELEMNITELLA	G+A(2)	-75	0	54.7 10.6	5232700	FNNF N SE|SW	0101 2	CA DB ?N TA	BU
42	C CARNEA (J. Sowerby)	SV	-75	0	14.5 11.0	-	-	-	-	-
209	C CARNEA (J. Sowerby)	PS	-75	0	15 10	-	-	-	-	-
1495	C CARNEA (J. Sowerby)	NC	-75	0	-	PVT	-	-	-	-
247	BELEMNITELLA	G+A(XE)(WN)	-80	0	66.2 10.2	120550	NNNN N ALL	0	CA DB TA	-
1575	BELEMNITELLA	G+A(XE)	-80	0	16.0 4.4	920730	0	0	-	-
1587	BELEMNITELLA	G	-80	0	24.6 0.5	2131570	F000 F	0	DB	-
1540	C CARNEA (J. Sowerby)	PS	-80	0	17.0 20.0 11.4	PVB	-	-	-	-
1485	INOCERAMID	NC	-80	0	10cm+	-	-	-	-	-
1486	INOCERAMID	NC	-80	0	10cm+	-	-	-	-	-
210	BELEMNITELLA	G(XE)	-85	0	45 9	03270	0116 16	0	CA DB PO	-
240	BELEMNITELLA	G(XE)(WN)	-85	0	35.5 9.2	1802040	NNNN N ALL	1002 3	CA DB	BU
1533	BELEMNITELLA	G(3)	-85	0	44.1 10.0	5402550	NNNN N ALL	1000 1	CA DB ?N	BU
1538	BELEMNITELLA	G+A(2)	-85	0	63.4 10.9	1200800	1002 3	2201 5	DB	DA
1539	BELEMNITELLA	G	-85	0	37.3 9.7	3030680	FFFN N NW	0	CA DB	-
1573	BELEMNITELLA	G	-85	0	22.4 6.5	921400	0	0	-	-
1482	INOCERAMID	NC	-85	0	20cm+	-	-	-	-	-
15	BELEMNITELLA	G+A	-90	0	72.1 11.3	1500900	N94N N NE|NW	0	DA DB ?N	-
1525	BELEMNITELLA	G	-90	0	30.7 9.9	1400900	F11N N NW	0	CA DB ?N	-
1563	ECHINOCORYS	FRAGS	-90	0	-	-	-	-	-	-
1510	INOCERAMID	NC	-90	0	10cm+	-	-	-	-	-
40	BELEMNITELLA	G(WN)	-95	0	45.0 9.6	5200950	NNNN N NE\NW	0	CA DB EN PO	-
1558	BELEMNITELLA	G+A(2)	-95	0	62.9 11.0	520900	NNNN N ALL	0	CA DB ?EN TA	-
1559	BELEMNITELLA	G+A	-95	0	49.5 0.0	03124	FNNF N SE|SW	0020 2	CA DB ?N TA	BU
1567	BELEMNITELLA	G+A(XE)	-95	0	36.4 5.6	1402570	0NF0 N SE	0	CA DB ?N	-
41	C CARNEA (J. Sowerby)	NC	-95	0	29.0 29.4 21.3	-	-	-	-	-
1484	INOCERAMID	NC	-95	0	15cm+	-	-	-	-	-
1489	INOCERAMID	NC	-95	0	20cm+	-	-	-	-	-
1503	INOCERAMID	NC	-95	0	10cm+	-	-	-	-	-
208	BELEMNITELLA	G+A(XE)	-100	0	55 7	1501160	NNNN N ALL	0	CA DB	-
211	BELEMNITELLA	G+A(SM)	-100	0	53.1 0.5	6201600	012N N SW	0	CA DB	-
227	BELEMNITELLA	G	-100	0	27.0 11.4	121000	N11N N NE|NW	1000 1	CA DB ?N	CO
1588	C ARCUATA Pettitt	CS?JUV	-100	0	12.3 13.2 5.2	PVB	-	-	-	-
235	C CARNEA (J. Sowerby)	FRAGS	-100	0	-	-	-	-	-	-
1515	ECHINOCORYS	CS NC	-100	0	-	USC	-	-	-	-
1502	INOCERAMID	NC	-100	0	15cm+	-	-	-	-	-
1517	INOCERAMID	NC	-100	0	10cm+	-	-	-	-	-
1511-3	INOCERAMID	in line NC	-100	0	20 20 25cm+	-	-	-	-	-
237	BELEMNITELLA	G(V WN)	-105	0	53.0 11.3	402600	NNNN N ALL	1000 1	CA DB EN TA	WW
1526	BELEMNITELLA	G+A(3)	-105	0	71.9 11.3	601020	NNNN N ALL	1000 1	CA DB ?N	BU
1516	INOCERAMID	NC	-105	0	25cm+	-	-	-	-	-
30	BELEMNITELLA	G	-108	0	30.1 11.3	1600300	300N N NW	1000 1	CA DB	AN
10	BELEMNITELLA	G(XE)	-110	0	22.9 10.7	3002700	3132 0	0	CA DB	-
204	BELEMNITELLA	G+A	-110	0	40.1 9.4	1000670	NN00 N NE|SE	0	CA DB ?N	-
1562	BELEMNITELLA	G+A(2)	-110	0	57.0 10.4	1601570	FNNF N SE|SW	0	CA DB	-
1569	BELEMNITELLA	G(WN)	-110	0	19.4 6.7	1100510	NNNN N ALL	0	CA DB	-
1572	BELEMNITELLA	G+A(2)	-110	0	56.5 9.4	903580	NF0N N NE|NW	1001 2	CA DB ?N	AN BU

NO	TAX	DES	POS	FB	DIM	ORI	BOP	EFI	B(D)	E(D)
23	C ARCUATA Pettitt	CS	-110	0	12.8 15.2 7.8	-	-	-	-	-
1510	INOCERAMID	NC	-110	0	25cm+	-	-	-	-	-
236	BELEMNITELLA	5	-115	0	42.6 10.6	420010D	1006 "	0010 1	CA DB	-
1408	C NORVICENSIS Pettitt	PS	-115	0	-	PVB	-	-	-	-
1381	INOCERAMID	NC	-115	0	30cm+	-	-	-	-	-
1382	INOCERAMID	NC	-115	0	30cm+	-	-	-	-	-
1493	INOCERAMID	NC	-115	0	40cm+	-	-	-	-	-
1497	INOCERAMID	NC	-115	0	40cm+	-	-	-	-	-
1520	BELEMNITELLA	A	-120	0	34.2 12.0	83313	F00F F	0002 2	CA DB TA	ANJ u*
1542	BELEMNITELLA	A	-120	0	31.6 16.0	531010U	NFFN N NE+NW	0001 1	CA DB ?N	fr
1548	BELEMNITELLA	G+A(2)	-120	0	40 4 6.5	1831040	FFFF F	0	CA DB	-
1379	INOCERAMID	NC	-120	0	40cm+	-	-	-	-	-
1521	BELEMNITELLA	G+A(XE)(2)	-125	0	42.0 10.0	1831670	FFFF N	0001 1	CA DB ?N TA	BU
1547	BELEMNITELLA	6	-125	0	73.7 11.0	2642000	F00F N	1000 1	CA DB TA	MO
1438	C CARNEA (J. Sowerby)	CS	-125	0	23.4 19.6 11.4	PVB	-	-	-	-
1544	ECHINOCORYS	FRAGS	-125	0	-	-	-	-	-	-
1527	BELEMNITELLA	G+A(2)	-130	0	63.2 14.1	1030370	FFNN N SW+NW	0	CA DB ?N TA	-
1401	C ?ARCUATA Pettitt	CS	-130	0	13.1 15.5 8.0	PVT	-	-	-	-
44	C NORVICENSIS Pettitt	CRUD	-130	0	15.4 15.2 7.1	-	-	-	-	-
1375	INOCERAMID	NC	-130	0	40cm+	-	-	-	-	-
1376	INOCERAMID	NC	-130	0	25cm+	-	-	-	-	-
1498	C CARNEA (J. Sowerby)	NC	-140	0	-	PVB	-	-	-	-
1483	BELEMNITELLA	A	-145	0	27.7 9.5	2333190	0	0	-	-
1397	C CARNEA (J. Sowerby)	NC	-145	0	-	-	-	-	-	-
1490	C CARNEA (J. Sowerby)	NC	-145	0	-	PVT	-	-	-	-
1406	CRET Sp	CS(V SM)	-145	0	-	-	-	-	-	-
1388	ECHINOCORYS	NC	-145	0	-	RWU	-	-	-	-
1395	ECHINOCORYS	NC	-145	0	-	-	-	-	-	-
1407	BELEMNITELLA	G(XE)	-150	0	29.7 11.6	520600U	NNNN N ALL	0001 1	CA DB ?N TA	MO
1391	C CARNEA (J. Sowerby)	NC	-150	0	-	-	-	-	-	-
1394	INOCERAMID	NC	-150	0	25cm+	-	-	-	-	-
47	BELEMNITELLA	6	-155	0	27.0 7.0	3331980	2110 4	0	DB	-
1458	ECHINOCORYS	FRAGS	-155	0	-	RWU	-	-	-	-
1560	BELEMNITELLA	G+A	-160	0	78.1 12.9	1403200	NNNN N ALL	0102 3	CA DB TA	AN BU
1398	BRACH	NC	-160	0	-	-	-	-	-	-
1452	C CARNEA (J. Sowerby)	NC	-160	0	14.3 15.2 7.0	PVT	-	-	EN	ANJ
1378	INOCERAMID	NC	-160	0	40cm+	-	-	-	-	-
1377	C CARNEA (J. Sowerby)	NC	-165	0	-	PVT	-	-	-	-
1	BELEMNITELLA	G+A (XE)	-175	0	32.9 9.0	1883520U	NNNN N ALL	0	CA DB ?N	-
1400	BELEMNITELLA	6	-175	0	42.1 14.1	1301730	NNNN N NW	0	CA DB ?EN ?N	-
1472	ECHINOCORYS	FRAGS	-175	0	-	-	-	-	-	-
1459	INOCERAMID	FRAGS	-175	0	20cm+	-	-	-	??CL ?N	ANJ BU DA
1425	BELEMNITELLA	G+G	-180	0	95.2 16.3	1022040	FFFF N	1013 5	CA DB ?N	BU CD MO
1426	BELEMNITELLA	6	-180	0	30.6 7.0	920270	F001 F	0	CA DB	-
1389	INOCERAMID	NC	-180	0	15cm+	-	-	-	-	-
1409	BELEMNITELLA	G(XE)(WN)	-185	0	35.8 11.9	223351U	NNNN N NE+NW	0100 1	CA DB EN	BU
1392	INOCERAMID	NC	-185	0	25cm+	-	-	-	-	-
1293	C CARNEA (J. Sowerby)	FRAGS	-190	0	-	PVT	-	-	-	-
1374	C CARNEA (J. Sowerby)	NC	-190	0	-	-	-	-	-	-
1390	C CARNEA (J. Sowerby)	FRAGS NC	-190	0	-	-	-	-	-	-
1436	C CARNEA (J. Sowerby)	NC	-190	0	20.0 15.5 13.2	PVB	-	-	-	-
1330	ECHINOCORYS	FRAGS	-190	0	-	RWU	-	-	-	-
1255	BELEMNITELLA	NC	-195	0	-	2031660	-	-	-	-
1411	BELEMNITELLA	6	-195	0	42.1 10.2	2202330	N00N NE+NW	0	CA DB	-
1412	BELEMNITELLA	G+A(XE)(3)	-195	0	53.5 8.7	3030090U	FFFF N ALL	1000 1	CA DB TA	BU
1454	BELEMNITELLA	G+A(2)	-195	0	28.1 5.0	3030000U	NNNN N ALL	0	CA DB	-
1457	BELEMNITELLA	G+A(2)	-195	0	87.0 15.6	1303530	NFFN N NE+SW	0011 2	CA DB ?N TA	BU
1437	N CHITONIFORMIS (Schlotheim)	CS	-195	0	6.2 5.9 3.0	-	-	-	-	-
1417	C CARNEA (J. Sowerby)	NC	-200	0	20.6 17.0 9.5	PVT	-	-	-	-
1466	ECHINOCORYS	FRAGS	-200	0	-	RWU	-	-	-	-
1393	INOCERAMID	NC	-200	0	20cm+	-	-	-	-	-
1301	BELEMNITELLA	G+A	-205	0	53.8 10.0	2201120	FFFF N ALL	1111 4	CA DB ?N TA	BU ?SA ww
1331	BELEMNITELLA	G(XE)	-205	0	31.5 10.6	2600250	NFFN N NE+NW	1001 2	CA DB ?N TA	AN MO
1383	C CARNEA (J. Sowerby)	NC	-205	0	-	-	-	-	-	-
1325	BELEMNITELLA	G+A	-210	0	62.7 10.4	20270U	63NN N NE+NW	0	CA DB ?N	-
1253	BRACH	FRAGS NC	-210	0	-	-	-	-	-	-
1435	BELEMNITELLA	G+A(2)	-215	0	40.6 7.3	2300320U	0NNN N NW+SW+SE	0	CA DB TA	-
1252	C CARNEA (J. Sowerby)	FRAGS NC	-215	0	-	-	-	-	-	-
1265	INOCERAMID	NC	-215	0	30cm+	-	-	-	-	-
1315	BELEMNITELLA	6	-220	0	22.5 7.3	4030920	NNNN N ALL	1000 1	CA DB	ANJ
1372	BELEMNITELLA	NC	-220	0	-	3031200	-	-	-	-
1418	BELEMNITELLA	6	-220	0	22.7 7.4	131200U	FFFF N ALL	0	CA DB	-
1264	C CARNEA (J. Sowerby)	NC	-220	0	-	-	-	-	-	-
1313	C CARNEA (J. Sowerby)	PS	-220	0	18 20	PVT	-	-	-	-
1404	N SEXCOSTATA (S. Woodward)	FRAGS	-220	0	-	-	-	-	-	-
1299	BELEMNITELLA	G+A(XE)	-225	0	54.7 12.2	1223430	NNNN N NW+SW	1000 1	CA DB ?N	BU
1292	C NORVICENSIS Pettitt	PS	-225	0	23 19	-	-	-	-	-
1453	?C CARNEA (J. Sowerby)	FRAG	-230	0	-	-	-	-	-	-
1434	BELEMNITELLA	A	-230	0	24.3 9.7	32077U	1512 9	0001 1	CA DB TA	AN
1529	BELEMNITELLA	6	-230	0	31.2 9.1	1732900	3300 6	0	CA DB	-
1257	CRET Sp	FRAG NC	-230	0	-	-	-	-	-	-
1480	CRET Sp	NC	-235	0	-	-	-	-	-	-
1294	BELEMNITELLA	A	-235	0	15.1 8.1	1102020	FFFF N ALL	0	CA DB ?N	-
1416	BELEMNITELLA	6	-235	0	23.9 10.5	2501130	000F F	0	CA DB	-
1455	BELEMNITELLA	G(XE)	-235	0	23.6 7.6	1401730	0	0	-	-
1261	BRACH	NC	-240	0	-	-	-	-	-	-
1380	C CARNEA (J. Sowerby)	NC	-240	0	-	OIS	-	-	-	-
1427	C CARNEA (J. Sowerby)	FRAG	-240	0	-	-	-	-	-	-
1570	CRET Sp	PS	-240	0	-	PVB	-	-	-	-
1258	C CARNEA (J. Sowerby)	FRAGS NC	-245	0	-	-	-	-	-	-
1415	C ARCUATA Pettitt	CS	-250	0	10.4 10.9 6.9	PVT	-	-	-	-
1590	C ARCUATA Pettitt	CS	-250	0	11.0 13.0 5.5	PVT	-	-	-	-
1251	CRET Sp	FRAGS NC	-250	0	-	-	-	-	-	-
1312	K PENTANGULATA S. Woodward	FRAG	-250	0	-	-	-	-	-	-
1302	BELEMNITELLA	G	-255	0	24.0 7.9	393335U	FFFF F	2010 3	DB ?N	BU
1304	BELEMNITELLA	G(XE)(WN)	-255	0	23.0 9.1	833210U	NNNN N ALL	3001 4	CA DB ?N	BU fr
1327	C CARNEA (J. Sowerby)	PS	-255	0	-	PVT	-	-	-	-
1260	ECHINOCORYS	FRAGS NC	-255	0	-	-	-	-	-	-
0	BELEMNITELLA	G(XE)	-260	0	33.1 9.4	1031560	NINN N NE+SW+NW	0	CA DB	-
1402	BELEMNITELLA	A	-260	0	28.1 9.0	5230230	NFFN N NE+NW	0001 1	CA DB	BU
1456	BELEMNITELLA	G(WN)	-260	0	41.7 8.6	1130500	NNNN N SE+SW	0	CA DB ?N	-
1552	BELEMNITELLA	G(XE)	-260	0	26.0 9.5	1030900	NNNN N ALL	0010 1	CA DB	BU
1581	BELEMNITELLA	G+A	-260	0	59.3 11.5	4102370	NNNN N ALL	3313 10	CA DB ?N TA	BU MO
1399	C CARNEA (J. Sowerby)	PS	-260	0	19.0 18.6 9.9	OIS	-	-	-	-
1262	INOCERAMID	NC	-260	0	15cm+	-	-	-	-	-
1577	C ARCUATA Pettitt	CS(JUV)	-265	0	8.0 9.0 3.7	PVB	-	-	-	-
1254	C CARNEA (J. Sowerby)	FRAGS NC	-265	0	-	-	-	-	-	-
1300	BELEMNITELLA	G+A	-270	0	63.0 11.9	2233110	0FNN N NW+SW	0	CA DB	-
1305	BELEMNITELLA	G(XE)	-270	0	14.1 8.8	1433210	N00N N NE+NW	0	CA DB	-
1314	BELEMNITELLA	6	-270	0	31.0 9.0	4223540	NNNN N ALL	0010 1	CA DB ?N	BU
1329	BELEMNITELLA	G+A(XE)(2)	-270	0	36.5 9.0	531790U	NFFN N NE+NW	0001 1	CA DB ?N	BU
1296	C ARCUATA Pettitt	CS?JUV	-270	0	9.3 10.7 5.7	PVB	-	-	-	-
1250	ECHINOCORYS	NC	-270	0	-	-	-	-	-	-
1328	ECHINOCORYS	FRAGS	-270	0	-	-	-	-	-	CO MO ?HS ?PO PR ?by
1591	ECHINOCORYS	FRAGS	-275	0	-	OIS	-	-	-	-
27	BELEMNITELLA	G+A(XE)	-275	0	69.5 10.0	3433200	NNNN N ALL	1000 1	CA DB ?N TA	?MO
1424	BELEMNITELLA	6	-275	0	50.6 11.3	243320U	NNNN N ALL	0	CA DB TA	-
1290	C CARNEA (J. Sowerby)	NC	-275	0	21.5 20.0 12.1	PVT	-	-	-	-
1554	C CARNEA (J. Sowerby)	PS	-275	0	18 17	PVB	-	-	-	-
1267	INOCERAMID	NC	-275	0	35cm+	-	-	-	-	-
1528	BELEMNITELLA	6	-280	0	26.5 10.1	63272U	N00N N NE+NW	1000 1	CA DB	BU
1385	SPONGES	sev sp NC	-280	0	-	-	-	-	-	-
1297	BELEMNITELLA	G+A(2)	-285	0	64.7 9.9	6031500	NNFF N NE+SE	1000 1	CA DB	BU
1303	BELEMNITELLA	A	-285	0	22.4 16.4	292110	NNNN N ALL	1201 4	CA DB PD	AN BU
1553	BELEMNITELLA	G+A(4)	-285	0	74.0 14.9	230347U	1011 3 (TIP)	0	GG	-
1259	C CARNEA (J. Sowerby)	NC	-285	0	-	PVT	-	-	-	-
1263	C CARNEA (J. Sowerby)	NC	-285	0	-	-	-	-	-	-
1479	C CARNEA (J. Sowerby)	NC	-285	0	-	PVT	-	-	-	-
1295	G GORDIALIS (Schlotheim)	2	-285	0	-	-	-	-	-	-
1576	K PENTANGULATA S. Woodward	FRAG	-285	0	-	-	-	-	-	-
1579	BELEMNITELLA	6	-290	0	31.9 7.5	132080U	NNNN N ALL	2200 4	CA DB ?N	AN BU
1337	C ?ARCUATA Pettitt	CS JUV	-290	0	8.2 8.3 3.7	-	-	-	-	-
1580	C ARCUATA Pettitt	CS?JUV	-290	0	10.6 11.0 6.0	PVB	-	-	-	-
1373	C CARNEA (J. Sowerby)	NC	-295	0	-	PVT	-	-	-	-
214	BELEMNITELLA	G+A(XE)(WN)	-295	0	70.4 10.5	3030650	NNNN N ALL	1100 2	CA DB ?N TA	BU
5	C CARNEA (J. Sowerby)	PS	-295	0	17.0 18.2 13.0	PVT	-	-	-	-
1589	C CARNEA (J. Sowerby)	PS	-295	0	15.6 15.1 5.9	PVT	-	-	-	-
1266	CRET Sp	NC	-295	0	-	-	-	-	-	-
1306	BELEMNITELLA	G+A(WN)	-300	0	54.0 8.7	8301110	NNNN N ALL	0100 1	CA DB	BU
1531	BELEMNITELLA	A	-300	0	34.0 10.0	3101200	NNNN N ALL	0	CA DB	-
1324	C CARNEA (J. Sowerby)	CS	-305	0	15.5 15.4 8.3	PVB	-	-	-	-
1321	C ARCUATA Pettitt	PS?JUV	-310	0	-	PVT	-	-	-	-
1341	N SEXCOSTATA (S. Woodward)	FRAGS	-310	0	-	-	-	-	-	-
1514	SPONGES	scat NC	-75--125	0	-	-	-	-	-	-
1396	SPONGES	nu spec NC	-100--160	0	-	-	-	-	-	-
1387	SPONGES	sev sp NC	-130--135	0	-	-	-	-	-	-
1478	SPONGES	scat NC	-250--325	0	-	-	-	-	-	-
1386	SPONGES	sev sp NC	-260--250	0	-	-	-	-	-	-
1481	SPONGES	nu sp NC	-280--260	0	-	-	-	-	-	-
1475	SPONGES	sev sp NC	-295--280	0	-	-	-	-	-	-

NO	TAX	DES	POS	FB	DIM	ORI	BOR	EPI	B(D)	E(D)
1600	BELEMNITELLA	G+A(XE)(2)	-	8	78.2 14.9	4a005C	NNF N NE SE	1000	CA DE TA	BU
1483	SPONGES	scat NC	-	8--100 8	-	-	-	-	-	-
217	C CARNEA (J. Sowerby)	NC	90	9	24.1 20 6 13.3	P E	-	-	-	-
33	BELEMNITELLA	G+A	50	9	66.9 10.9	[illegible]	NNN N ALL	[illegible]	CA DE DN TA	
216	BELEMNITELLA	G+A	40	9	78.0 12.4	[illegible]	NNN N NE NW	2001	CA DE TN RO	MC
1627	C NORVICENSIS Pettitt	CS(CR)	25	9	15.5 18.4 8.5	P/T	-	-	-	-
37	BELEMNITELLA	G+A(SM)	-5	9	54.5 8.8	[illegible]	NNN N ALL	4101	[illegible]	MS [illegible]
34	BELEMNITELLA	G+A?JUV	-15	9	57.1 8.6	[illegible]	NNS N NE	[illegible]	CA DE TA	BU
46	BELEMNITELLA	G+A(WN)	-15	9	51 7 12.1	[illegible]	NNN N ALL	0020 2	CA DB TN TA	B.
1633	BELEMNITELLA	G+A(2)	-15	9	40.9 6.5	[illegible]	000F F NW	.	CA DE	-
36	C CARNEA (J. Sowerby)	PV	-15	9	12.3 14.3	-	-	-	-	-
1638	C CARNEA (J. Sowerby)	FRAGS	-15	9	-	DIS	-	-	-	-
38	BELEMNITELLA	G+A(XE)	-20	9	31.4 6.6	[illegible]	0300 3	[illegible]	CA	-
1626	BELEMNITELLA	G(XE)(V WN)	-20	9	33.2 10.5	[illegible]	NNN N NE NW	1000 1	CA DE EN TN	[illegible]
1610	C CARNEA (J. Sowerby)	NC	-20	9	16.3 19.2 12.9	[illegible]	-	-	UD	-
1611	C CARNEA (J. Sowerby)	FRAG	-20	9	-	[illegible]	-	-	-	-
1635	C CARNEA (J. Sowerby)	broke NC	-20	9	-	-	-	-	-	-
201	BELEMNITELLA	G+A(XE)(SM)	-30	9	34.6 6.8	[illegible]	20ve E		CA DE	-
1618	BELEMNITELLA	G(3)	-30	9	40.0 10.0	[illegible]	[illegible]	0	-	-
1631	C CARNEA (J. Sowerby)	FRAGS	-30	9	-	-	-	-	-	-
1601	BELEMNITELLA	A	-35	9	14.6 6.9	3303080	00FF F	[illegible]	CA DE	-
39	BELEMNITELLA	G	-40	9	40.6 10.4	[illegible]	NSWN N NE NW	1000 1	CA DE TN TA	[illegible]
1603	BELEMNITELLA	G(4)	-40	9	29 6 0.0	[illegible]	NNN N ALL	[illegible]	CA DE	-
1628	BELEMNITELLA	G(WN)	-40	9	30.7 10.0	[illegible]	NNN N NE SE	2000 2	CA DB TN	BU
1608	C CARNEA (J. Sowerby)	PS	-40	9	11.4 9.9 6.7	P/T	-	-	-	-
1632	C CARNEA (J. Sowerby)	CS	-40	9	24.0 22.0 12.9	P/T	-	-	-	-
1629	BELEMNITELLA	G	-45	9	29.3 7.8	[illegible]	NF00 N NE	1000 1	CA DB TA	BU
195	C CARNEA (J. Sowerby)	CS	-45	9	22.5 18.3 11.6	DIS	-	-	-	-
1636	C CARNEA (J. Sowerby)	NC	-45	9	-	P/T	-	-	-	-
1607	BELEMNITELLA	G+A(3)	-50	9	100.2 17.0	430080	NFFN N NE	2001 3	CA DB TN TA	BU GI MO
1612	BELEMNITELLA	G+A	-50	9	45.7 8.1	4500630	NFFN N NE NW	1100 2	CA DB TN TA	CO
1596	BELEMNITELLA	G+A(2)	-55	9	54.2 9.9	1400200	NNNO N SE SW	0030 3	CA DB	BU
1602	BELEMNITELLA	G+A(2)	-55	9	66.4 8.7	5001290	NNNN N ALL	0	CA DB TN PO TA	-
1609	BELEMNITELLA	A	-55	9	33.3 10.5	5003580	FNNF N SE SW	6	CA DB TN	-
1634	C CARNEA (J. Sowerby)	PS NC	-60	9	-	P/T	-	-	-	-
226	BELEMNITELLA	G+A(XE)(V WN)	-65	9	34.3 11.7	1032600	NNNN N ALL	[illegible]	CA DB ?EN TN	-
1622	BELEMNITELLA	G+A(XE)(3)	-65	9	36.0 9.9	430190	0	[illegible]	-	-
1623	BELEMNITELLA	G(XE)(WN)	-65	9	27.1 10.5	5800020	FNNF N SE SW	1001 2	CA DE TN	NS ?TR
1624	BELEMNITELLA	A(V BD)	-65	9	18.7 10.0	232080	FFNN N SW NW	0	CA DB EN TA	-
1625	BELEMNITELLA	G	-70	9	22.9 8.0	1503020	NNNN N ALL	0	CA DE	-
1637	CRET Sp	broke NC	-70	9	-	-	-	-	-	-
1615	C ARCUATA Pettitt	CS	-85	9	12.9 14.0 8.2	P/T	-	-	-	-
1590	BELEMNITELLA	G(3)	-90	9	24.2 6.9	2000280	NFFN N NE NW	0	CA DB TN TA	-
1606	BELEMNITELLA	G(2)	-90	9	49.3 10.4	2200390	NNNN N ALL	[illegible]	CA DE TN	-
1605	BELEMNITELLA	G	-100	9	25.2 8.5	900900	NNNN N ALL	3	CA DB TA	-
1619	BELEMNITELLA	G+A(XE)	-100	9	41.6 11.9	5103140	NNNN N ALL	4000 4	CA DB TN	BU

c) List of all fossils recorded from the former quarry at Frettenham (W.M. Howes) (TG 24600 17300). Abbreviations as in appendices 3a and 3b.

NO	TAX	DES	POS	FB	DIM	ORI	BOR	EPI	B(D)	E(D)
2591	BELEMNITELLA	NC	-	1	-	-	-	-	-	-
2349	BRACH	FRAGS NC	-85	1	-	-	-	-	-	-
2523	C NORVICENSIS Pettitt	CS	-85	1	17.6 18.7 13.6	-	-	-	-	-
2352	BELEMNITELLA	NC	-90	1	-	1702130	-	-	-	-
2524	BELEMNITELLA	G+A(XE)(3)	-80	1	69.7 16.5	2030510	0002 2	1000 1	CA DB	HE
2317	BELEMNITELLA	NC	-75	1	-	703290	-	-	-	-
2347	CRET Sp	FRAG NC	-75	1	-	-	-	-	-	-
2525	CRET Sp	FRAG	-75	1	-	-	-	-	-	-
2527	P ?MARROTIANA d Orbigny	PS	-75	1	-	-	-	-	-	-
2532	BELEMNITELLA	G+A(3)	-70	1	117.3 18.6	302100	NNNN N ALL	3343 13	CA DB TN	AN BU CO MS SA
2579	INOCERAMID	FRAG NC	-70	1	-	-	-	-	-	-
2583	C CARNEA (J. Sowerby)	FRAG NC	-60	1	-	-	-	-	-	-
2586	C CARNEA (J. Sowerby)	FRAG(JUV) NC	-60	1	-	-	-	-	-	-
2627	C CARNEA (J. Sowerby)	PS	-60	1	24 0 17.6 16.1	P/T	-	-	-	-
2528	ECHINOCORYS	FRAG	-60	1	-	-	-	-	-	-
2603	ECHINOCORYS	FRAG NC	-60	1	-	-	-	-	-	-
2626	?AMMONITE	FRAGS	-55	1	-	-	-	-	-	-
2343	BELEMNITELLA	NC	-55	1	-	3201990	-	-	-	-
2344	BELEMNITELLA	NC	-55	1	-	2402280	-	-	-	-
2353	BELEMNITELLA	NC	-55	1	-	203180	-	-	-	-
2631	BELEMNITELLA	G(WN)	-55	1	30.5 12.1	4601400	NNNN N NE SE	2000 2	CA DB	BU
2582	C CARNEA (J. Sowerby)	FRAG NC	-55	1	-	-	-	-	-	-
2584	C CARNEA (J. Sowerby)	FRAG NC	-55	1	-	-	-	-	-	-
2589	C NORVICENSIS Pettitt	PS NC	-55	1	-	-	-	-	-	-
2623	C NORVICENSIS Pettitt	FRAG	-55	1	5.0 8.7 3.1	-	-	-	-	-
2629	P VESICULARE (Lamarck)	FRAGS	-55	1	-	-	-	-	-	AP OY PV
2625	BELEMNITELLA	A	-50	1	35.5 15.9	703500	3FNF N SW	0	CA DB	-
2358	C CARNEA (J. Sowerby)	FRAG NC	-40	1	-	-	-	-	-	-
2544	C NORVICENSIS Pettitt	CS(CR)	-30	1	16.5 16.0 11.4	P/T	-	-	-	-
2592	C NORVICENSIS Pettitt	?JUV NC	-30	1	-	-	-	-	-	-
2590	SPONGE	NC	-30	1	-	-	-	-	-	-
2357	C CARNEA (J. Sowerby)	FRAG NC	-15	1	-	-	-	-	-	-
2604	ECHINOCORYS	FRAGS NC	-10	1	-	-	-	-	-	-
2605	C NORVICENSIS Pettitt	CS(FR) NC	30	1	-	-	-	-	-	-
2354	C CARNEA (J. Sowerby)	NC	40	1	-	-	-	-	-	-
2628	BELEMNITELLA	G+A(4)	45	1	65.5 10.5	503510	FFFF F	4160 11	TN	ANJ CO Fr MS ww
2356	BELEMNITELLA	NC	50	1	-	2003500	-	-	-	-
2630	BELEMNITELLA	G+A(3)	70	1	33.8 6.3	1603300	NFFN N NE NW	0001 1	CA DB TA	MO
2346	BELEMNITELLA	NC	-	2	-	1402370	-	-	-	-
2348	BELEMNITELLA	in fl NC	-	2	-	1001560	-	-	-	-
2622	BELEMNITELLA	G+A(XE)(WN)	-	2	32.5 9.2	1902190	NNNN N ALL	0	CA DB TN	BU ?MS
2321	BRACH	FRAG NC	-	2	-	-	-	-	-	-
2345	C CARNEA (J. Sowerby)	FRAGS NC	-	2	-	-	-	-	-	-
2526	C NORVICENSIS Pettitt	CS(CR)	-	2	19.5 23.3 12.2	-	-	-	-	-
2578	ECHINOCORYS	FRAG NC	-	2	-	-	-	-	-	-
2602	INOCERAMID	FRAG NC	-	2	-	-	-	-	-	-
2529	C CARNEA (J. Sowerby)	CS	-	2	24.6 22.1 13.6	P/B	-	-	-	-
2580	C CARNEA (J. Sowerby)	FRAG NC	-90	2	-	-	-	-	-	-
2342	BELEMNITELLA	NC	-85	2	-	7001800	-	-	-	-
2531	BELEMNITELLA	G+A(3)	-75	2	61.9 10.5	500210	0001 1	0	TN TA	-
2565	C CARNEA (J. Sowerby)	FRAGS NC	-70	2	-	-	-	-	-	-
2324	BELEMNITELLA	NC	-60	2	-	1002520	-	-	-	-
2351	BELEMNITELLA	NC	-50	2	-	-	-	-	-	-
2320	SPONGE	NC	-45	2	-	-	-	-	-	-
2355	C CARNEA (J. Sowerby)	FRAG NC	-40	2	-	-	-	-	-	-
2577	C CARNEA (J. Sowerby)	PS NC	-40	2	-	P/T	-	-	-	-
2510	ECHINOCORYS	PS NC	-35	2	-	-	-	-	-	-
2581	INOCERAMID	FRAG NC	-30	2	-	-	-	-	-	-
2323	C CARNEA (J. Sowerby)	FRAG NC	-25	2	-	-	-	-	-	-
2350	C CARNEA (J. Sowerby)	FRAGS NC	-25	2	-	P/T	-	-	-	-
2322	C CARNEA (J. Sowerby)	FRAG NC	-20	2	-	-	-	-	-	-
2530	C CARNEA (J. Sowerby)	CS	-20	2	25.1 26.6 15.4	R/B	-	-	-	-
2588	C CARNEA (J. Sowerby)	FRAG NC	-20	3	-	-	-	-	-	-
2567	ECHINOCORYS	FRAG NC	-20	3	-	-	-	-	-	-
2519	INOCERAMID	FRAG NC	-20	3	-	-	-	-	-	-
2524	S INELEGANS Lonsdale	FRAG	-10	?	-	-	-	-	-	-

APPENDIX FOUR

a) List of all fossils found in the Weybourne Hope - Old Butts Gap cliff section (TG 11150 43690 - 12360 43620). Abbreviations as in appendices 3a and 3b.

NO	TAX	DES	POS	FE	DIM	DET	BGP	EPI	BIO	[illegible]
2136	?ECHINOCORYS	FRAGS NC	-10	2	-	-	-	-	-	-
2128	BELEMNITELLA	NC	-10	2	-	[illegible]	-	-	-	-
21??	CIDARIS Sp	SPINE NC	-10	2	-	-	-	-	-	-
2128	P VESICULARE Lamarck	FRAGS NC	-1	2	-	-	-	-	-	-
2?1	BELEMNITELLA	6(E)	-20	2	43.1 10.9	140275	[illegible]	9	[illegible]	-
2?1	BELEMNITELLA	6+A(E)	-30	2	35.2 1?.?	5?????	[illegible]	10?? 1	CA	AN
211?-?	P VESICULARE Lamarck	NC	-20	2	-	-	-	-	-	-
21??	P VESICULARE Lamarck	NC	-20	2	-	-	-	-	-	-
24??	OSTREA Sp	FRAG	-3?	2	-	-	-	-	-	-
2126	MICRASTER Sp	FRAGS NC	-35	2	-	-	-	-	-	-
2???	P VESICULARE Lamarck	FRAG NC	-35	2	-	-	-	-	-	-
2470	BPr	LOST NC	-40	2	-	-	-	-	-	-
2134	ECHINOCORYS	FRAGS NC	-40	2	-	3?3	-	-	-	-
2113	P VESICULARE Lamarck	NC	-40	2	-	-	-	-	-	-
2114	P VESICULARE (Lamarck)	FRAGS NC	-40	2	-	-	-	-	-	-
2121-3	P VESICULARE (Lamarck)	NC	-40	3	-	-	-	-	-	-
95	P VESICULARE (Lamarck)	PS	-55	2	37.3 32.7 18.7	-	-	-	-	MS P
290	BELEMNITELLA	6+A(3H)	-??	2	44.6 9.4	.126200	4 11 12 3 3?	8	CA D6	-
2464	C ?NOPVICENSIS(JUV) Pettitt	CS	-??	2	6.6 ?.8 4.1	DIS	-	-	-	-
259	BELEMNITELLA	6+A(E)	-35	2	30.0 11.5	131710	0	?	-	-
293	BELEMNITELLA	6(E)	-35	2	46.3 12.0	28352C	NOON N NEINW	3	CA DE	-
29?	C WOODWARDI (Davidson)	PS	-35	2	16.9 18.2 12.0	-	-	-	-	-
264	P VESICULARE (Lamarck)	PS(+JUV)	-35	2	25.1 29.1 40.2	-	-	-	-	-
2130	BIV	broke NC	-80	2	-	-	-	-	-	-
2129	BELEMNITELLA	NC	-85	2	30.0 27.9 8.?	2?0540	-	-	-	-
2463	P VESICULARE (Lamarck)	PS	-??	2	27.2 13.8	DIS	-	-	-	-
258	BELEMNITELLA	6	-90	2	-	283340	8	0001 1	-	VT??
267	BELEMNITELLA	6(E)	-90	2	33.5 13.6	1683460	5474 20	0310 4	CA D8 TA	AP BU
2462	BELEMNITELLA	6	-90	2	40.1 13.6	1082080	NNNN N ALL	1100 2	CA D6 TN	AA BU
2120	M CRETOSA (Defrance)	NC	-95	2	-	-	-	-	-	-
2132	BELEMNITELLA	6 NC	-106	2	-	-	-	-	-	-
1717	INOCERAMID	FRAG NC	-100	2	-	-	-	-	-	-
29?	P VESICULARE (Lamarck)	FRAG	-100	2	24.1 27.2 17.1	-	-	-	-	-
2131	P VESICULARE (Lamarck)	FRAGS NC	-100	2	-	-	-	-	-	-
21?1	BELEMNITELLA	NC	-105	2	-	3020030	-	-	-	-
2132	BELEMNITELLA	NC	-105	2	-	4332600	-	-	-	-
2119	BELEMNITELLA	NC	-110	2	-	28238C	-	-	-	-
2479	M ?GLYPHUS Schlueter	CS	-110	3	52.6 55.3 29.2	USC	-	-	-	-
2109	BELEMNITELLA	NC	-125	2	-	1330300	-	-	-	-
1716	CRET Sp	FRAGS	-125	2	-	-	-	-	-	-
1718	INOCERAMID	FRAG NC	-125	2	-	-	-	-	-	-
2?2	BELEMNITELLA	6	-130	2	26.4 10.5	52064C	N10N N NEINW	6	CA	-
2??	BELEMNITELLA	6	-130	2	65.6 16.0	?1400	?	0110 2	-	AA MS
2??	BELEMNITELLA	6+A(E)	-	2	56.4 16.6	682730	8	0	-	-
27?	BELEMNITELLA	6+A(E)	-	2	37.5 15.9	93290	TNM	-	TA	?MO
925	ECHINOCORYS	FRAGS(IN FL)	-	2	30 20	-	-	-	-	-
?2a	P VESICULARE (Lamarck)	PS(INFL)	-	3	40 25	-	-	-	-	-
1711	SPONGES	no NC	ABOVE	3	-	-	-	-	-	-
313	BELEMNITELLA	6	-5	3	41.2 13.1	6827?	5153 14	2010 3	CA D8	AN, ML ?MO
1691	?ECHINOCORYS	FRAGS	-10	3	-	-	-	-	-	AF AN DS DT EF GI MM PO
1667	M CRETOSA (Defrance)	FRAG	-10	3	-	-	-	-	-	-
1686	?C Sp(JUV)	CS	-15	3	5.7 5.5 2.8	PVB	-	-	-	-
303	ECHINOCORYS	PS	-15	3	55 50 30	-	-	-	-	-
284	BELEMNITELLA	6+A(E)	-20	3	34.6 13.0	281640	NOON N NEINW	1500 1	CA D8 TN TA	AN,
1669	BELEMNITELLA	6	-25	3	21.1 10.7	420340	0F00 F	0100 1	CA D8	AN,
271	BELEMNITELLA	6+A(E)	-35	3	26.4 11.5	023000	1310 5	0010 1	D8	AP
1671	BELEMNITELLA	6	-40	3	45.4 14.2	1920460	FFFF N ALL	0100 1	CA D8 TN	AN
287	BELEMNITELLA	6+A	-50	3	59.2 12.4	1461580	210 30 15	?	CA D8 PC	-
1675	CRET Sp	PS	-50	3	-	-	-	-	-	-
1718	INOCERAMID	FRAG NC	-50	3	-	-	-	-	-	-
1672	BELEMNITELLA	A	-55	3	31.4 16.2	2882190	F00F F	0	CA D8 TN	-
1678	BELEMNITELLA	6(E)	-55	3	18.9	1930540	1001 2	2130 6	CA D8 TN	AN, CO ww
269	BELEMNITELLA	6+A(E)	-60	3	35.9 12.7	5020600	8	8	-	-
304	ECHINOCORYS	FRAGS	-60	3	-	-	-	-	-	-
282	P PENTANGULATA S. Woodward	NC	-60	3	8.9 6.4 5.2	PVB	-	-	-	-
305	ECHINOCORYS	FRAGS	-65	3	65 45 40	-	-	-	-	0?
268	P VESICULARE (Lamarck)	FRAG	-70	3	16.0 17.0 10.0	-	-	-	-	-
280	BELEMNITELLA	6+A(E)	-80	3	23.0 11.4	2881420	1001 2	0	TN	-
279	BELEMNITELLA	6	-100	3	20.9 11.0	282700	0	0	-	-
285	BELEMNITELLA	6	-110	3	27.0 10.4	4021120	NNNN N NEINW	5111 6	CA D8	AN, BU
1673	BELEMNITELLA	6	-110	3	37.3 12.4	382000	F00E F	0	CA D6 TN	-
1701	BELEMNITELLA	6+A(2)FSH	-	3	71.0 15.2	282140	F0FF F	1000 1	D6 TN	?MO
1706	ECHINOCORYS	FRAGS	-	3	-	RWU	-	-	-	SA
1724	ECHINOCORYS	NC	-	3	-	RWU	-	-	-	-
1725	ECHINOCORYS	NC	-	3	-	RWU	-	-	-	-
1726	ECHINOCORYS	NC	-	3	-	RWU	-	-	-	-
2135	GLOMERULA Sp	NC	-	3	5	-	-	-	-	-
1762	METOPASTER Sp	OSSCICLE FSH	-	3	-	-	-	-	-	-
1727	PECTINID	NC	-	3	-	-	-	-	-	-
1709	SPONGES	in 41 NC	-	3	-	-	-	-	-	-
1644	BELEMNITELLA	6(E)	-10	4	32.0 11.2	?0U	NOON N NEINW	1100 2	CA D8 ?TA	BU
1643	BELEMNITELLA	6+A(2)	-10	4	79.5 17.0	2532700	NNNN N ALL	2111 5	CA D8 ?EN TN	AF AN CO 4r SP
309	P VESICULARE (Lamarck)	PS	-10	4	30.5 46.5 30.1	-	-	-	-	-
1712	SPONDYLID	NC	-10	4	-	-	-	-	-	-
265	BELEMNITELLA	6	-15	4	38.9 12.6	1130930	1000 1	0	TN	-
1654	BELEMNITELLA	A(1'2)	-15	4	26.4 9.2	1521020	FF00 F	1000 1	CA D8	AN
1656	BELEMNITELLA	6+A(2)	-15	4	70.5 14.3	1420050	6	0	-	-
1714	INOCERAMID	FRAG NC	-15	4	-	-	-	-	-	-
316	BELEMNITELLA	6+A	-20	4	64.5 13.4	1922200	2010 3	0	CA D8	-
1703	ECHINOCORYS	FRAGS	-20	4	-	-	-	-	-	-
1705	M ?GLYPHUS Schlueter	PS	-20	4	-	RWU	-	-	-	AN MS PF
1657	BELEMNITELLA	6+A(4)(WH)	-25	4	56.2 11.1	1032000	NNNN N ALL	0	CA D8	-
1659	BELEMNITELLA	6	-25	4	55.0 13.2	1601750	NNNN N ALL	0110 2	CA D8	AN
1662	BELEMNITELLA	6	-25	4	24.5 11.3	832140	0NNF N SEISW	0200 2	CA D8	AF AN
1675	BELEMNITELLA	6	-25	4	43.7 12.4	832200	6104 5	0	CA D8	-
1651	ECHINOCORYS	FRAGS	-25	4	-	-	-	-	-	-
1690	ECHINOCORYS	FRAGS	-30	4	-	RWU	-	-	-	-
1653	BELEMNITELLA	6+A(E)(2)	-30	4	43.7 17.7	631000	NNF0 N NEISE	0	CA D8 TN	-
1699	ECHINOCORYS	FRAGS	-30	4	-	RWU	-	-	-	AN DS MS ST
286	BELEMNITELLA	6+A(E)	-35	4	30.6 14.5	2220420	110019 24	0011 2	CA D8 TA	ww
1676	BELEMNITELLA	6+A(E)	-35	4	61.4 15.7	03152	F00F F	3100 4	CA D8	AF BU CO ww
1677	BELEMNITELLA	6	-35	4	25.2 11.3	1430000	F0FF N NEISWNW	1001 2	CA D8 TN	AN GI
1729	AMMONITE	foreshore NC	-40	4	50cm	-	-	-	-	-
295	BELEMNITELLA	6	-40	4	42.0 12.4	530740	0	0	-	-
1680	BELEMNITELLA	TIP	-40	4	12.0 7.9	1320720	F000 F	0001 1	TN	SA
1665	BELEMNITELLA	A	-45	4	34.0 13.0	2623570	NF0N N NEINW	1100 2	CA D8	AA BU
1655	C ?NOPVICENSIS Pettitt	CS?JUV	-45	4	7.0 8.0 6.5	P/T	-	-	-	-
1720	ECHINOCORYS	foreshore NC	-45	4	-	RWU	-	-	-	-
1024	ECHINOCORYS	PS FSH	-45	4	-	-	-	-	-	AF DL MS GI PO SA SP
1650	BELEMNITELLA	6+A(E)(2)	-50	4	56.2 14.2	4031710	NF0F N NE	0	CA D8 DI BN	-
1658	BELEMNITELLA	6+A(4)	-50	4	64.0 10.1	3323420	0	0110 2	-	PLum SA
1674	BELEMNITELLA	6+A(E)(2)	-55	4	36.2 12.9	1020360	FNNF N SEISW	1000 1	CA D8	AN
1652	BELEMNITELLA	6+A(3)	-60	4	76.4 15.2	1202130	N00N N NEINW	2212 7	CA D6	AN SA ST
315	BELEMNITELLA	6	-65	4	30.0 10.4	0310?0	0930 12	0	CA D8	-
1681	BELEMNITELLA	6(E)	-65	4	20.5 11.5	3032000	2410 7	2011 4	D8 TN	AN CO
1684	C ?NOPVICENSIS(JUV) Pettitt	CS	-75	4	9.1 6.3 5.5	DIS	-	-	-	-
1687	ECHINOCORYS	FRAG	-80	4	-	-	-	-	-	-
1695	ECHINOID	broke NC	-80	4	-	-	-	-	-	-
1692	?CRET Sp	FRAGS	-85	4	-	-	-	-	-	-
1666	BELEMNITELLA	6(2)	-85	4	49.0 14.6	2620270	0	0	-	-
1707	M ?GLYPHUS Schlueter	PS	-85	4	70 70 40	-	-	-	-	DT MP
1668	BELEMNITELLA	6+A(2)	-90	4	63.2 13.1	6821?60	0	0010 1	-	AF
1679	BELEMNITELLA	A	-95	4	30.1 14.6	032050	F0FN N NW	0	CA D8 ?EN TN	-
1664	BELEMNITELLA	6	-100	4	39.9 14.4	93146	FFFF N	0030 3	CA D8	AN, SA
1693	ECHINOCORYS	FRAGS	-100	4	-	-	-	-	-	0?
1697	P GRANULATA (Nilsson)	FRAG	-100	4	-	-	-	-	-	-
1660	BELEMNITELLA	6	-	4	31.7 10.0	620310	NNN0 N NEISE	1200 3	CA D8	BU CO
1688	M CHITONIFORMIS (Schlotheim)	CS	-10	5	8.9 7.0 5.0	P/T	-	-	-	-
266	BELEMNITELLA	6+A	-15	5	82.3 16.5	1032520	0074 11	0011 2	CA TN	AN,
294	BELEMNITELLA	6	-20	5	30.5 10.4	1032360	NNNN N ALL	0002 2	CA D8	?
1661	BELEMNITELLA	6+A(E)	-20	5	53.6 12.2	7032700	0	5010 14	-	AN CO PV SA VT
1696	MICRASTER	FRAG	-25	5	-	-	-	-	-	-
1609	METOPASTER Sp	OSSCICLE	-40	5	-	-	-	-	-	-
1640	BELEMNITELLA	6	-50	5	25.9 13.0	1132140	1000 1	0001 1	C8	DT
1702	ECHINOCORYS	FRAGS	-55	5	-	-	-	-	-	MS
?0	ECHINOCORYS	CS	-	5	57.0 56.4 54.3	-	-	-	BN	AN AP DA MP MS PO
1708	BELEMNITELLA	6	-5	6	51.9 13.6	920120	NN0F N NEISE	1100 2	CA D8 TN	CO 4r
1777	BELEMNITELLA	6+A(3)	-5	6	56.0 11.6	?6?190	0005 5	0	D8	-
2141	INOCERAMID	FRAGS NC	-5	6	-	-	-	-	-	-
?10	BELEMNITELLA	6+A(E)	-10	6	52.9 11.8	1032330	1000? 1?	0	CA D8	-
1649	BELEMNITELLA	6	-10	6	30.1 13.0	1000?20	0	0502 2	-	PS ww
2140	BELEMNITELLA	NC	-10	6	-	1?0?630	-	-	-	-
2478	ECHINOCORYS	PS (CR)	-10	6	71.7 52.0	DIS	-	-	-	?? AN CO GI MS ww
1687	M CRETOSA (Defrance)	FRAG	-10	6	-	-	-	-	-	-
1645	BELEMNITELLA	6	-15	6	26.3 8.4	03070	FNNF N SEISW	0010 1	CA D8	CO
1646	BELEMNITELLA	6+A(E)(WH)	-15	6	54.9 15.4	?0?670	NNNN N ALL	0111 3	CA D8 TN	BA ST
39	CRET Sp	PU	-15	3	4.7	-	-	-	-	-
1647	ECHINOCORYS	FRAG	-15	6	27 30	-	-	-	-	-
1809	I COSTATA (Sowerby)	BU	-15	6	4.7 4.9	-	-	-	-	-
1685	C ?NOPVICENSIS(JUV) Pettitt	CS	-20	6	10.7 10.7 7.2	PUB	-	-	-	-

NO	TAX	GES	POS	FB	DIM	ORI	BMP	EFI	B-D	E-D
1694	E BRYDONEI Rasmussen	9 OSSICLES	-25	?	-	-	-	-	-	-
1682	BELEMNITELLA	G+A(E)	-25	6	43.9 13.1	931712	FFFF N ALL	1012 4	CA DE TN	MG ST
1695	RECURVASTER Sp	OSSICLE	-25	6	-	-	-	-	-	-
906	C NORVICENSIS(JUV) Pettitt	PS	-30	6	9.1 9.8 4.9	-	-	-	-	-
1796-8	MICRASTER	FRAGS	-35	6	-	-	-	-	-	SS
1704	ECHINOCORYS	PS	-40	6	-	USO	-	-	EN	-
175	BELEMNITELLA	G(PART)	-5	-	31.9 12.3	1601690U	4030 4	0	CA DB	-
1765	BELEMNITELLA	G	-5	-	35.6 11.1	682520	8336 22	6010 1	CA DE TN	ANJ
1770	BELEMNITELLA	G	-5	-	29.6 12.8	1702700	0	0	-	-
1779	BELEMNITELLA	G+A(2)	-5	?	79.1 14.1	2500620U	FNNF N SE/SW	0010 1	CA DB TN	CO
1604	BELEMNITELLA	G	-10	-	46.4 14.6	1202420	F00F F	0010 1	CA DB TN	?AN
1734	CIDARID Sp	SPINE NC	-10	?	-	-	-	-	-	-
1786	BELEMNITELLA	G	-15	?	57.1 14.1	1501570	NF0F N NW	1231 7	CA DB	AN, AP BU DA PV
1902	BELEMNITELLA	G+A(3)	-15	-	61.5 13.2	702670	FN00 N SE	0200 2	CA DB	fr MC
1812	C NORVICENSIS(JUV) Pettitt	CS	-15	?	10.2 9.3 7.0	PVT	-	-	-	-
301	ECHINOCORYS	FRAGS	-15	-	-	-	-	-	-	-
1803	N OBESA Sahni	PS(CR)	-15	-	29.6 18.2 20.0	OIS	-	-	-	-
1811	C NORVICENSIS(JUV) Pettitt	CS	-20	-	9.2 8.9 6.6	PVG	-	-	-	-
1815	M CRETOSA (Defrance)	FRAGS	-20	-	-	-	-	-	-	-
1817	M MANTELLIANA (d'Orbigny)	FRAGS	-25	7	-	-	-	-	-	-
1821	ECHINOCORYS	FRAGS	-35	?	-	RWU	-	-	-	-
1752	SPONGES	NC	-40	-	-	-	-	-	-	-
1775	BELEMNITELLA	G+A	-45	-	77.8 15.3	4701080U	N00F N NE	1112 5	CA DB TN	AN CO GI
1768	CRET Sp	FRAG	-50	?	-	-	-	-	-	-
2140	INOCERAMID	FRAGS NC	-50	?	-	-	-	-	-	-
1778	BELEMNITELLA	G+A(5)	-55	-	105.3 17.5	2030770	NF0F N NE	2002 4	CA DB	CO ?MO MS NC
1763	BELEMNITELLA	G+A(2)	-60	-	68.7 14.6	302560	N00N N NE/NW	0001 1	CA DB TN	CO
1782	C NORVICENSIS(JUV) Pettitt	CS	-60	-	9.3 8.9 5.4	PVB	-	-	-	-
1733	ECHINOCORYS	FRAG NC	-60	-	-	-	-	-	-	-
2147	ECHINOCORYS	NC	-60	-	-	-	-	-	-	-
1791	M CHITONIFORMIS (Schlotheim)	CS	-60	?	6.9 6.5 4.1	PVB	-	-	-	-
1776	CIDARID Sp	SPINE	-65	-	-	-	-	-	-	-
1774	BELEMNITELLA	G+A(3)	-70	7	53.7 10.7	1601680	000N N NW	0010 1	CA DB PD	SA
1781	BELEMNITELLA	G+A(2)	-75	?	75.5 12.9	1002900	F0FF F	3014 8	CA DB	AN Ukog
2138	CIDARID Sp	SPINE	-75	-	-	-	-	-	-	-
2150	CRET Sp	broke NC	-80	?	-	-	-	-	-	-
2139	ECHINOCORYS	NC	-80	-	-	OIS	-	-	-	-
1790	K KONGIELI Popiel Barczyk	CS(no orn)	-80	?	10.4 8.1 4.0	PVT	-	-	-	-
1720	ECHINOCORYS	NC	-85	?	-	RWU	-	-	-	-
2471	RECURVASTER Sp	OSSICLE	-85	?	-	-	-	-	-	-
1731	-	V H CHALK	-90	?	-	-	-	-	-	-
1822	ECHINOCORYS	PS	-90	?	54.1 43.4 58.4	OIS	-	-	-	DS ?
2146	N SEXCOSTATA (S. Woodward)	FRAG NC	-90	?	-	-	-	-	-	-
2144	ECHINOCORYS	FRAGS NC	-95	?	-	-	-	-	-	-
2137	BIV	FRAG NC	-100	?	-	-	-	-	-	-
2151	ECHINOCORYS	FRAGS NC	-100	-	-	-	-	-	-	-
1739	INOCERAMID	FRAG	-105	?	-	-	-	-	-	-
904	C NORVICENSIS(JUV) Pettitt	CS	-108	-	9.2 8.5 5.1	-	-	-	-	-
2143	BELEMNITELLA	NC	-110	?	-	1021450	-	-	-	-
2468	BRACH	FRAG	-110	?	-	-	-	-	-	-
1764	C NORVICENSIS Pettitt	CS(JUV)	-110	?	9.9 9.2 7.2	OIS	-	-	-	-
1920	BELEMNITELLA	A	-115	?	30.3 13.4	1701750U	0	2001 3	-	AN SS
1814	AMMONITE	-	-120	?	12 6	-	-	-	-	-
1769	BELEMNITELLA	G	-120	?	33.5 14.3	1502980	C0FN N NW	0	CA DB	-
2145	C NORVICENSIS(JUV) Pettitt	NC	-120	?	-	PVT	-	-	-	-
1793	CRET Sp	FRAGS	-120	?	-	-	-	-	-	-
1810	C NORVICENSIS(JUV) Pettitt	CS(CR)	-125	?	9.1 8.4 3.3	PVT	-	-	-	-
1819	ECHINOCORYS	NC	-125	?	57.0 51.5 60.5	OIS	-	-	-	CO
2149	S DUTEMPLEANUS d'Orbigny	FRAG NC	-130	?	-	-	-	-	-	-
366	BELEMNITELLA	G	-	?	44.1 15.4	4022200	0	0010 1	-	AN
1738	CRET Sp	broke NC	-	7	-	-	-	-	-	-
1784	BELEMNITELLA	G+A(XE)(2)	-5	8	42.3 11.9	1302840	NNNN N NE/SE	0	CA DB TN	-
297	BELEMNITELLA	G(WN)	-10	8	52.8 12.0	4601650	NNNN N ALL	1006 1	DI TN	DS
1793	BELEMNITELLA	G+A(2)	-15	8	59.3 11.9	221090	N00N N NE/NW	0	CA DB	-
1798	BELEMNITELLA	A	-15	8	20.7 12.5	2701990	0	0	-	-
1799	Starfish	OSSICLE	-15	8	-	-	-	-	-	-
1772	BELEMNITELLA	A	-35	8	33.5 13.6	4231960	0	0	-	-
1741	ECHINOID	NC	-35	8	-	OIS	-	-	-	-
1753	MICRASTER	broke NC	-40	8	-	RWU	-	-	-	-
1747-50	INOCERAMID	FRAGS NC	-45	8	-	-	-	-	-	-
1745	ECHINOID	FRAGS NC	-50	8	-	-	-	-	-	-
1744	SPONDYLID	NC	-50	8	-	-	-	-	-	-
1743	SPONGES	NC	-55	8	-	-	-	-	-	-
1813	T STRIATA d'Orbigny	CS	-55	8	-	-	-	-	-	-
1786	BELEMNITELLA	G(2)	-60	8	27.2 12.2	634?0U	F1FN N NW	0	CA DB	-
1765	BOURGUETICRINUS Sp	COLUMNAL	-65	8	-	-	-	-	-	-
1757	BELEMNITELLA	G(2)	-75	8	31.7 12.2	701500	1060 1	0	DB	-
1737	ECHINOCORYS	FRAGS NC	-75	8	-	-	-	-	-	-
1616	M MANTELLIANA (d'Orbigny)	FRAGS	-75	8	-	-	-	-	-	-
1751	ECHINOCORYS	NC	-90	8	-	OIS	-	-	-	-
1785	BELEMNITELLA	G+A(XE)	-100	8	53.3 14.4	1531620U	F00N N NW	0	CA DB	-
1806	BELEMNITELLA	G(2)	-100	8	43.0 12.9	932900U	F10F F	0	CA DB	-
1721	ECHINOCORYS	NC	-100	8	-	RWU	-	-	-	-
1792	K KONGIELI Popiel Barczyk	CS	-100	8	13.0 12.5 7.3	-	-	-	-	-
1742	SPONGES	NC	-100	8	-	-	-	-	-	-
1766	BELEMNITELLA	G+A(E)	-105	8	41.1 13.4	2830010U	0	0110 2	-	MS VP
1767	BELEMNITELLA	G+A	-105	8	69.2 13.8	702240U	F000 F	3000 3	CA DB	BU CO MO
1771	BELEMNITELLA	G	-105	8	20.5 9.9	502080D	0	0	-	-
1735	CRET Sp	broke NC	-105	8	-	-	-	-	-	-
1823	ECHINOCORYS	FRAGS	-105	8	-	-	-	-	-	DA DS DT LM MM MS ST
1736	CRET Sp	NC	-115	8	-	-	-	-	-	-
1780	BELEMNITELLA	G	-120	8	35.9 12.0	2881710	200N N NW	0001 1	CA DB	ANJ
1773	BELEMNITELLA	G+A(2)	-125	8	57.5 10.8	2502310U	N2IN N NE/NW	0	CA DB TN	-
1805	BELEMNITELLA	G	-125	8	29.7 12.5	02168	NNNN N ALL	1100 2	CA DB EN	BU fr
1807	BELEMNITELLA	A	-125	8	21.0 6.9	020920	NNNN N ALL	1120 4	CA DB TN	CO fr ww
1740	SPONGES	no NC	-30--60	8	-	-	-	-	-	-
362	ECHINOCORYS	PS(IN FL)	-	8	-	-	-	-	-	-
1754	INOCERAMID	NC	-	8	30 20	-	-	-	-	-
1829	ECHINOCORYS	NC	-10	9	-	RWU	-	-	-	-
1794	BELEMNITELLA	G(XE)	-15	9	28.7 13.1	1421100	0N00 N SE	1100 2	CA DB TN	AN
1887	RECURVASTER Sp	OSSICLE	-20	9	-	-	-	-	-	-
91	ECHINOCORYS	PS(CRUSH)	-25	9	71.0 68.9 34.6	-	-	-	-	AN AP DA MM MS MW PM? PR SS ST
1818	ECHINOCORYS	FRAGS	-55	9	-	USO	-	-	-	MS
1800	BELEMNITELLA	G+A(XE)	-80	9	43.7 13.6	1020960	FFFF N ALL	0001 1	CA DB TN	ww
1757	P VESICULARE (Lamarck)	NC	-90	9	-	-	-	-	-	-
278	BELEMNITELLA	G+A(XE)	-100	9	46.0 10.5	733140	NNNN N NE/NW	3310 4	CA DB	BU ww
277	BELEMNITELLA	G(PART)	-105	9	20.0 14.0	1302240	0010 1	0	TN	-
1755	ECHINOCORYS	NC	-110	9	-	RWU	-	-	-	-
1796	BELEMNITELLA	G(XE)	-	9	17.5 6.9	1022620	F00F F	2001 3	DB	ANJ
1901	BELEMNITELLA	G+A(XE)(4)	-	9	38.7 9.6	402810U	FNNN N ALL	0010 1	CA DB TN	AN
1797	C NORVICENSIS Pettitt	PS	-	9	-	-	-	-	-	-
1835	CRET Sp	NC	-	9	-	-	-	-	-	-
1844	ECHINOCORYS	FRAGS NC	-5	10	-	-	-	-	-	-
1845	P VESICULARE (Lamarck)	FRAGS NC	-5	10	-	-	-	-	-	-
1857	C NORVICENSIS(JUV) Pettitt	CS	-10	10	8.6 7.0 4.9	PVT	-	-	-	-
1894	ECHINOCORYS	FRAG	-10	10	-	-	-	-	-	-
1851	BELEMNITELLA	G(2)	-15	10	42.1 10.6	2103260	F00F F	0010 1	CA DB	ww
1892	BOURGUETICRINUS Sp	COLUMNAL	-15	10	-	-	-	-	-	-
1900	ECHINOCORYS	PS	-15	10	69.6 56.9 36.4	USO	-	-	-	AN
1893	METOPASTER Sp	OSSICLES	-15	10	-	-	-	-	-	-
318	BELEMNITELLA	G+A(XE)	-20	10	59.5 13.3	131850	6010 7	0001 1	DB TN	CO
1852	BELEMNITELLA	G+A(XE)	-20	10	45.3 12.7	5701240	1053 9	0011 2	DB TN	DA DT
1897	CIDARID Sp	SPINE	-20	10	-	-	-	-	-	-
97	ECHINOCORYS	PS(CRUSH)	-20	10	75 65	-	-	-	-	-
1888	C NORVICENSIS(JUV) Pettitt	CS	-25	10	8.8 8.4 6.1	PVT	-	-	-	-
1843	ECHINOID	NC	-25	10	-	-	-	-	-	-
1850	BELEMNITELLA	G	-30	10	10.6 10.6	5022600	F00F F	0	CA DB	-
320	BELEMNITELLA	G+A	-35	10	63.6 15.1	1203000	2000 2	4003 7	CA DB	ANJss ML
1898	P AMPULLACEA (Sowerby)	PS	-35	10	-	-	-	-	-	-
1830	ECHINOCORYS	NC	-40	10	-	OIS	-	-	-	-
1834	ECHINOCORYS	NC	-40	10	-	-	-	-	-	-
1879	BELEMNITELLA	G(XE)	-50	10	13.9 12.5	1201540	F00F F	0010 1	CA DB	CO
1870	C NORVICENSIS(JUV) Pettitt	CS	-55	10	10.5 10.2 5.6	PVB	-	-	-	SA
1874	BELEMNITELLA	G(XE)	-60	10	32.0 7.2	1203570U	NNNN N ALL	0	CA DB EN	-
1941	CRET Sp	JUV NC	-65	10	-	-	-	-	-	-
1846	BELEMNITELLA	G+A(2)	-70	10	82.0 16.6	1401600	NNNN N ALL	1000 1	CA DB EN TN TA	AF
1856	BELEMNITELLA	G	-70	10	53.0 15.9	1201470	NNNN N ALL	2121 6	CA DB TN TA	CO fr
1663	BELEMNITELLA	G+A(2)	-70	10	72.9 14.3	1121160	NI3N N NE/NW	1001 2	CA DB TN	AN CO
1964	BELEMNITELLA	G	-70	10	44.1 12.3	1001720	NFII N NE	1000 1	CA DB TN TA	ME
1889	SPONGE	FRAGS	-70	10	-	-	-	-	-	-
1855	CRET Sp	FRAG	-75	10	-	-	-	-	-	-
1896	M CHITONIFORMIS (Schlotheim)	FRAG	-85	10	-	PVT	-	-	-	-
1853	BELEMNITELLA	G+A(E)	-90	10	54.7 12.0	02278	N20N N NE/NW	0001 1	CA DB	AN
1662	BELEMNITELLA	G+A(2)	-90	10	70.4 13.1	1202110	0	0	-	-
1571	C NORVICENSIS(JUV) Pettitt	CS(CR)	-90	10	9.6 9.9 7.0	PVG	-	-	-	-
1859	METOPASTER Sp	OSSICLES	-90	10	-	-	-	-	-	-
1982	C NORVICENSIS(JUV) Pettitt	CS(CP)	-95	10	11.0 10.6 5.1	PVT	-	-	-	-
1354	BELEMNITELLA	A	-105	10	27.1 10.5	203000	3005 0	0	CA DB	-
1677	BELEMNITELLA	G+A(2)	-105	10	50.7 9.1	1401450	NNNN N ALL	0010 1	CA DB TN	CO
1648	BELEMNITELLA	G(E)	-110	10	26.0 11.8	420940U	0	0	-	-

NO	TAX	DES	POS	FE	GIM	OPI	BOP	EFI	B·D·	E·D
1861	BELEMNITELLA	G(3)	-110	10	29.1 8.0	1023590	NOON N NE(NW	0	CA DB	-
1875	BELEMNITELLA	-	-110	10	29.5 16.5	?30960	F11F F	0	CA DB ?N ?RB	-
1865	C NORVICENSIS(JUV) Pettitt	CS	-120	10	9.5 10.0 5.6	PVB	-	-	-	-
1864	P VESICULARE (Lamarck)	NC(on ech)	-120	10	16.4 17.4 8.4	-	-	-	-	-
1547	BELEMNITELLA	G(XE)	-125	10	28.1 12.5	501900	NNNN N ALL	0	CA DB EN	-
1837	CRET Sp	NC	-125	10	-	-	-	-	-	-
1836	CRET Sp	NC	-125	10	-	-	-	-	-	-
1895	RECUPUASTER Sp	OSSICLE	-125	10	-	-	-	-	-	-
1825	CRET Sp	broke NC	-130	10	-	-	-	-	-	-
1828	ECHINOCORYS	CR NC	-130	10	-	-	-	-	-	-
1863	OSTREA Sp	FRAG	-130	10	-	-	-	-	-	AN;sa
1859	?P VESICULARE (Lamarck)	FRAGS	-135	10	-	-	-	-	-	-
1856	C NORVICENSIS(JUV) Pettitt	CS	-135	10	9.9 9.2 6.2	OIS	-	-	-	-
1885	C NORVICENSIS(JUV) Pettitt	CS(CR)	-135	10	10.5 11.0 5.1	PVB	-	-	-	-
1853	CRET Sp	NC	-135	10	-	PVE	-	-	-	-
1832	P VESICULARE (Lamarck)	NC	-135	10	-	-	-	-	-	-
1860	P VESICULARE (Lamarck)	PS	-135	10	31.7 32.1 19.0	OIS	-	-	-	AN PR
1872	P VESICULARE (Lamarck)	PS	-135	10	28.4 30.5 19.6	OIS	-	-	-	-
1873	P VESICULARE (Lamarck)	FRAG	-135	10	-	-	-	-	-	-
1867	BELEMNITELLA	G(XE)	-140	10	27.6 10.3	431600	NFFN N NE(NW	0	CA DB ?N	-
1858	P VESICULARE (Lamarck)	NC	-140	10	-	-	-	-	-	-
1840	P VESICULARE (Lamarck)	NC	-140	10	-	-	-	-	-	-
1866	P VESICULARE (Lamarck)	FRAG	-140	10	-	-	-	-	CA DB	-
1800	BELEMNITELLA	G+A(XE)	-145	10	64.0 13.6	1931990	NFFN N NE(NW	2011 4	CA DB ?N TA	ANss
1868	C NORVICENSIS(JUV) Pettitt	CS	-145	10	9.1 9.9 6.7	PVT	-	-	-	-
1869	P VESICULARE (Lamarck)	FRAG	-145	10	-	-	-	-	-	PV
1795	C NORVICENSIS(JUV) Pettitt	CS(CR)	-150	10	10.6 11.5 4.7	PVT	-	-	-	-
83	MICRASTER	PS	-150	10	55.7 50.0 27.3	-	-	-	-	BU cb DA DT LM MO PO
1842	P VESICULARE (Lamarck)	NC	-150	10	-	-	-	-	-	-
1831	P VESICULARE (Lamarck)	NC	-165	10	-	-	-	-	-	-
1876	P VESICULARE (Lamarck)	V	-170	10	23.6 18.0 18.6	OIS	-	-	-	-
1808	BELEMNITELLA	G(XE)	-175	10	23.4 10.0	3032390	F11F F	1301 5	CA DB	AN; BU PV
1826	ECHINOCORYS	FRAG NC	-175	10	-	-	-	-	-	-
283	C NORVICENSIS(JUV) Pettitt	CS(CR)	-180	10	8.7 8.9 6.3	PVB	-	-	-	-
1758	CRET Sp	NC	-180	10	-	-	-	-	-	-
312	BELEMNITELLA	G(PART)	-	10	15.9 9.8	1231640	NOON N NE(NW	0	CA DB	-
1849	BELEMNITELLA	G+A(3)	-	10	49.5 9.7	1132560	0	0	-	-
1878	BELEMNITELLA	A	-	10	19.5 11.2	1062110	FFFF N ALL	0120 3	CA DB EN ?N ?TA	uw
1927	P VESICULARE (Lamarck)	NC	-5	11	-	-	-	-	-	-
1992	CRET Sp	FRAG	-10	11	-	-	-	-	-	-
1983	M CRETOSA (Defrance)	FRAGS	-10	11	-	-	-	-	-	-
2010	P VESICULARE (Lamarck)	NC	-10	11	-	-	-	-	-	-
2011	P VESICULARE (Lamarck)	NC	-10	11	-	-	-	-	-	-
2012	P VESICULARE (Lamarck)	NC	-10	11	-	-	-	-	-	-
1974	C NORVICENSIS(JUV) Pettitt	CS	-15	11	9.1 8.9 5.7	PVE	-	-	-	-
1994	C NORVICENSIS(JUV) Pettitt	CS	-15	11	8.9 9.5 4.3	PVT	-	-	-	-
1996	ECHINOCORYS	FRAGS	-15	11	-	AWU	-	-	-	DT uw
1917	P VESICULARE (Lamarck)	NC	-15	11	-	-	-	-	-	-
1933	P VESICULARE (Lamarck)	NC	-15	11	-	-	-	-	-	-
1934	ECHINOCORYS	NC	-20	11	-	AWU	-	-	-	-
1918	P VESICULARE (Lamarck)	NC	-20	11	-	-	-	-	-	-
1920	P VESICULARE (Lamarck)	NC	-20	11	-	-	-	-	-	-
1973	P VESICULARE (Lamarck)	PS	-20	11	16.5 20.2 19.9	USD	-	-	-	-
2668	P VESICULARE (Lamarck)	NC	-20	11	-	-	-	-	-	-
1991	S cf MACROPUS (J. Sowerby)	FRAG	-20	11	-	-	-	-	-	-
1910	BRACH	NC	-25	11	-	-	-	-	-	-
1911	CIDARID Sp	SPINE NC	-25	11	-	-	-	-	-	-
1912	CIDARID Sp	SPINE NC	-25	11	-	-	-	-	-	-
1988	M CRETOSA (Defrance)	FRAGS	-25	11	-	-	-	-	-	-
279	P VESICULARE (Lamarck)	FRAG	-25	11	13.3 21.5 12.4	-	-	-	-	PV
324	P VESICULARE (Lamarck)	PS	-25	11	20.4 32.1	-	-	-	-	-
1929	P VESICULARE (Lamarck)	NC	-25	11	-	-	-	-	-	-
1976	P VESICULARE (Lamarck)	FRAGS	-25	11	-	-	-	-	-	-
1965	BELEMNITELLA	G+A(XE)	-30	11	26.4 10.0	831920	NOON N ALL	1000 1	CA DB	CO
1987	C NORVICENSIS Pettitt	CS	-30	11	16.0 14.9 10.0	PVT	-	-	-	MT PV ?TR
323	P VESICULARE (Lamarck)	FRAG	-30	11	16.5 13.0 13.0	-	-	-	-	-
1990	P VESICULARE (Lamarck)	FRAG	-30	11	-	-	-	-	-	-
1959	C NORVICENSIS Pettitt	CS	-35	11	12.1 14.7 8.1	PVT	-	-	-	-
1937	P VESICULARE (Lamarck)	NC	-35	11	-	-	-	-	-	-
1969	BELEMNITELLA	G+A(XE)	-40	11	56.0 12.7	931640	NOON N NE/NW	1000 1	CA DB	fr
1932	ECHINOCORYS	NC	-40	11	-	AWU	-	-	-	-
298	P VESICULARE (Lamarck)	PS	-40	11	25.6 28.4 27.5	-	-	-	CB	-
1913	P VESICULARE (Lamarck)	FRAGS NC	-40	11	-	-	-	-	-	-
2459	P VESICULARE (Lamarck)	NC	-40	11	-	-	-	-	-	-
2669	P VESICULARE (Lamarck)	NC	-40	11	-	-	-	-	-	-
1995	A cfINCURVA Nilsson	FRAGS	-45	11	-	-	-	-	-	-
1960	C NORVICENSIS Pettitt	CS	-45	11	14.5 14.7 9.6	PVB	-	-	-	-
1985	CIDARID Sp	BOSS	-45	11	-	-	-	-	-	-
1989	P VESICULARE (Lamarck)	NC	-45	11	-	-	-	-	-	-
1914	P VESICULARE (Lamarck)	FRAGS NC	-45	11	-	-	-	-	-	-
1916	P VESICULARE (Lamarck)	NC	-45	11	-	-	-	-	-	-
1981	P VESICULARE (Lamarck)	PS	-45	11	18.9 18.0 9.2	AWU	-	-	-	AN
1982	P VESICULARE (Lamarck)	FRAGS	-45	11	-	-	-	-	-	PV
1979	C NORVICENSIS Pettitt	CS	-50	11	18.1 20.5 13.2	PVE	-	-	-	AF uw
1980	P VESICULARE (Lamarck)	PS	-50	11	19.5 22.0 14.1	AWU	-	-	-	-
1935	ECHINOID	PS NC	-65	11	-	-	-	-	-	-
1972	C NORVICENSIS(JUV) Pettitt	CS	-70	11	8.7 67.3 5.3	OIS	-	-	-	-
1978	C NORVICENSIS(JUV) Pettitt	CS	-70	11	8.5 7.2 5.4	PVB	-	-	-	-
1925	BRACH	NC	-75	11	-	-	-	-	-	-
1970	C NORVICENSIS(JUV) Pettitt	CS	-75	11	6.5 8.0 4.1	PVT	-	-	-	-
1926	ECHINOID	NC	-75	11	-	AWU	-	-	-	-
1881	C NORVICENSIS(JUV) Pettitt	CS	-80	11	8.2 7.9 4.5	PVT	-	-	-	-
1901	CRET Sp	FRAG NC	-85	11	-	-	-	-	-	-
1915	CRET Sp	NC	-85	11	-	-	-	-	-	-
1949	BELEMNITELLA	G+A(XE)	-90	11	30.9 11.9	433063U	NNNN N ALL	0	CA DB ?N TA	-
1962	BELEMNITELLA	G+A(3)	-95	11	65.9 13.0 -	773010	2FNF N SW	0	CA DB ?N	-
1880	BELEMNITELLA	A	-100	11	15.2 10.1	330900	3006 9	1000 1	CA DB	MS
1967	BELEMNITELLA	G	-100	11	40.3 16.3	253330U	NFFN N NE/NW	3700 10	CA DB ?N	CO SA
1902	ECHINOCORYS	NC	-100	11	-	AWU	-	-	-	-
1975	BELEMNITELLA	G	-105	11	20.9 13.0	1032900	31FN N NW	0010 1	CA DB	ML
1904	ECHINOCORYS	FRAG NC	-105	11	-	-	-	-	-	-
1977	P SUBTORQUATA (Munster)	FRAG	-105	11	-	-	-	-	-	-
1961	BELEMNITELLA	G+A(XE(2)	-120	11	59.0 13.7	2401650	F20F F	1010 2	CA DB ?N	?NF fr
1971	BELEMNITELLA	G+A(XE)(2)	-125	11	53.6 14.0	202250	0	1000 1	-	AN
1997	MICRASTER	PS	-130	11	34.0 57.2 27.0	AWU	-	-	-	bv CO MO
1968	C NORVICENSIS(JUV) Pettitt	CS	-135	11	8.8 9.8 3.9	PVB	-	-	-	-
1899	ECHINOCORYS	PS	-140	11	-	AWU	-	-	-	CO CP DA ML SA ST VP
1986	C NORVICENSIS(JUV) Pettitt	CS	-145	11	8.1 8.4 5.2	PVT	-	-	-	-
1907	CRET Sp	NC	-145	11	-	-	-	-	-	-
1891	P AMPULLACEA (Sowerby)	3	-145	11	-	-	-	-	-	-
1958	BELEMNITELLA	G	-150	11	25.5 10.9	321470	F00F F	1001 2	CA DB	BU PV
1903	ECHINOCORYS	FRAGS (hc)NC	-150	11	-	-	-	-	-	-
1905	ECHINOCORYS	FRAG NC	-150	11	-	-	-	-	-	-
1964	BELEMNITELLA	G+A(2)	-160	11	62.3 11.6	821800	FFFF N ALL	0	CA DB ?N	-
1921-4	P VESICULARE (Lamarck)	in small area NC	-25--35	11	-	-	-	-	-	-
319	BELEMNITELLA	G(XE)	-	11	26.2 13.4	82004	NOON N NE(NW	1000 1	CA DB	?CO
1944	BELEMNITELLA	NC	-	11	-	531700	-	-	-	-
1955	BELEMNITELLA	G(XE)	-	11	20.1 10.9	7400140	F00F F	0100 1	DB	SA
299	ECHINOCORYS	FRAGS	-	11	-	-	-	-	-	DA MS ST
328	ECHINOCORYS	FRAGS	-	11	-	-	-	-	-	AN; ST
1919	ECHINOCORYS	smashed NC	-	11	-	AWU	-	-	-	-
1936	ECHINOCORYS	NC	-	11	-	-	-	-	-	-
1930	P VESICULARE (Lamarck)	NC	-	11	-	-	-	-	-	-
1931	P VESICULARE (Lamarck)	NC	-	11	-	-	-	-	-	-
336	P VESICULARE (Lamarck)	FRAG	-10	12	41.5 23.1 16.0	-	-	-	EN	AN
337	P VESICULARE (Lamarck)	PS	-10	12	39.1 31.6 15.9	-	-	-	EN ?N	AN
330	P VESICULARE (Lamarck)	PS	-10	12	27.3 20.4 11.3	-	-	-	CA DB ?EN	-
2156	P VESICULARE (Lamarck)	FRAG NC	-10	12	-	-	-	-	-	-
2085	BELEMNITELLA	G+A(XE)	-15	12	69.4 15.5	900	NOON N NE(NW	0	CA DB	-
2106	ECHINOCORYS	FRAG	-15	12	-	USD	-	-	-	-
2034	BELEMNITELLA	G+A(XE)	-25	12	45.1 15.1	2020550	F00F F	0	CA DB	-
2046	BELEMNITELLA	G+A(2)	-25	12	71.0 13.1	1102950	NNNN N NE(NW	0	CA DB ?TA	-
2000	ECHINOCORYS	too high NC	-25	12	-	-	-	-	-	-
2023	ECHINOCORYS	PS	-25	12	-	-	-	-	-	MS
2053	BELEMNITELLA	G+A(XE)	-30	12	45.2 14.4	202110	F00F F	1001 2	CA DB ?N	CO fr
2105	ECHINOCORYS	FRAG	-30	12	-	OIS	-	-	-	AF BA VT
302	-	CONCRETIONS	-40	12	-	-	-	-	-	-
274	BELEMNITELLA	G+A(XE)	-40	12	34.0 9.0	90319	3104 0	1001 2	CA DB ?N	AN
2032	BELEMNITELLA	G+A(2)	-40	12	70.2 13.9	9?220	NF0F N NE	0001 1	CA DB ?N RO	BU
2155	BELEMNITELLA	NC	-40	12	-	372146C	-	-	-	-
1940	ECHINOCORYS	NC	-40	12	-	AWU	-	-	-	-
2015	ECHINOCORYS	FRAGS NC	-40	12	-	-	-	-	-	-
2049	BELEMNITELLA	G+A(XE)(2)	-45	12	99.6 11.0	801530	NNNN N ALL	0	CA DB ?N	-
2070	BELEMNITELLA	G+A(XE)	-45	12	29.0 14.6	4402950	NFFO F	3	CA DB	-
321	C NORVICENSIS Pettitt	CS(CR)	-45	12	18.6 20.5 13.0	PVE	-	-	-	AN
2467	CRET Sp	NC	-45	12	-	-	-	-	-	-
2154	ECHINOCORYS	NC	-45	12	-	OIS	-	-	-	-
214	I COSTATA (Sowerby)	CV	-45	12	6.9 7.0 1.9	-	-	-	-	-
2190	P VESICULARE (Lamarck)	PS	-45	12	26.5 20.9 14.3	AWU	-	-	-	-
2003	BELEMNITELLA	G(2)	-50	12	55.4 14.2	902330	FF0F N NE	2200 4	CA DB TA	AF PV

NO	TAX	DES	POS	FB	DIM	ORI	BOP	EFI	B·D·	E·D·
2103	BELEMNITELLA	G+A(XE)(2)	-50	12	45.8 16.2	601150	2000 2	0	DE	-
322	C NORVICENSIS Pettitt	FRAG	-50	12	9.7 20.1 8.3	-	-	-	-	-
2959	C NORVICENSIS Pettitt	CS(CR)	-50	12	17.2 25.3 7.4	PVT	-	-	-	uw
325	BELEMNITELLA	G+A(XE)	-55	12	43.3 15.4	301510	0362 5	2000 2	CA DE	MO
2051	BELEMNITELLA	G+A(XE)(2	-55	12	32.7 11.3	240026U	NNNN N ALL	0001 1	CA DB	CO
2012	ECHINOCORYS	FRAGS NC	-55	12	-	-	-	-	-	-
334	P VESICULARE (Lamarck)	FRAG	-55	12	11.4 11.1	-	-	-	-	-
296	BELEMNITELLA	G	-60	12	22.1 13.0	302208U	0001 1	1000 1	?N	MS
2044	BELEMNITELLA	G	-60	12	39.9 14.4	201560	NNFF N NE,SE	0	CA DB	-
2048	BELEMNITELLA	G+A(XE)(3)	-60	12	30.4 9.7	700	NNNN N ALL	0	CA DB	-
2067	NYMPHASTER Sp	OSSICLE	-60	12	-	-	-	-	-	-
2062	BELEMNITELLA	G+A(2)	-65	12	65.6 10.7	921890	000F F	0	CA DE	-
2096	ECHINOCORYS	NC	-65	12	-	OIS	-	-	-	-
298	BELEMNITELLA	G+A	-70	12	69.4 13.1	00298	N00N N NEINW	1000 1	CA DB	BU
326	BELEMNITELLA	G+A(XE)	-70	12	23.0 11.1	4023060U	6100 7	0	DB	-
2042	BELEMNITELLA	G+A(XE)(2)	-70	12	30.5 13.3	1002560	NNNN N ALL	0001 1	CA DB ?N	BU
2045	BELEMNITELLA	G+A	-70	12	60.0 15.6	301780	0	0410 5	-	ANJ uw
2089	M CRETOSA (Defrance)	FRAGS	-70	12	-	-	-	-	-	-
2666	P VESICULARE (Lamarck)	NC	-70	12	-	-	-	-	-	-
2088	? ECHINOCORYS	frag	-75	12	-	-	-	-	-	-
2094	C ?NORVICENSIS(JUV) Pettitt	CS	-75	12	10.2 18.5 6.4	PVE	-	-	-	-
2008	P VESICULARE (Lamarck)	FRAG NC	-75	12	-	-	-	-	-	-
2104	P VESICULARE (Lamarck)	PS	-75	12	24.8 42.7 17.6	OIS	-	-	-	SA
2041	BELEMNITELLA	A	-80	12	25.1 15.3	301760	FF0F F	0101 2	CA DB ?N	AA BU
2069	BELEMNITELLA	G	-80	12	21.1 9.5	80020U	F01F F	0	CA DB	-
1938	ECHINOCORYS	NC	-80	12	-	AWU	-	-	-	-
329	?ECHINOCORYS	FRAG	-85	12	-	-	-	-	-	BU
2022	BELEMNITELLA	G+A(XE)(2)	-85	12	59.5 14.3	500820	2000 2	1001 2	DB	CO DA
2021	P AMPULLACEA (Sowerby)	PS	-85	12	32.6 24.9 10.5	OIS	-	-	DB DI ?N	AA MS
2040	P VESICULARE (Lamarck)	PS	-85	12	17.6 19.3 6.6	OIS	-	-	-	-
281	BELEMNITELLA	G+A(XE)	-90	12	42.5 13.4	1031620U	4009 13	0001 1	CA DB	BU
2091	BELEMNITELLA	G+A	-90	12	56.8 12.1	232420	F0FN N NW	0	CA DB ?EN	-
2068	C ?NORVICENSIS(JUV) Pettitt	CS(CR)	-90	12	9.9 9.4 3.6	PVT	-	-	-	-
2001	CRET Sp	broke NC	-90	12	-	-	-	-	-	-
1945	ECHINOCORYS	NC	-90	12	-	AWU	-	-	-	-
1966	P VESICULARE (Lamarck)	NC(atch ech)	-90	12	26.0 20.3 29.3	AWU	-	-	-	-
2075	P VESICULARE (Lamarck)	PS	-90	12	25.2 26.2 24.3	OIS	-	-	-	-
1993	S DUTEMPLEANUS d'Orbigny	FRAGS	-90	12	-	-	-	-	-	-
2055	BELEMNITELLA	G(3)	-95	12	49.5 12.7	130005U	F00F F	1000 1	CA DB ?N	BU
2056	BELEMNITELLA	G+A(3)	-95	12	56.8 15.0	1800110	F00F F	0	CA DB PO	-
1946	ECHINOCORYS	NC	-95	12	-	-	-	-	-	-
2091	MICRASTER	PS	-95	12	56.8 68.6 29.6	AWU	-	-	-	BU fr MO
2077	P VESICULARE (Lamarck)	PS	-95	12	27.2 16.8 29.5	OIS	-	-	EN	-
333	BELEMNITELLA	G(XE)	-100	12	59.8 12.7	702500	0	0	-	-
2064	BELEMNITELLA	G+A(XE)	-100	12	24.3 13.4	00275	0NF0 N SE	0	CA DB ?N	-
330	ECHINOCORYS	PS	-100	12	-	-	-	-	-	AN PV SA ST VFcf
1999	ECHINOCORYS	FRAG NC	-100	12	-	-	-	-	-	-
2037	BELEMNITELLA	G+A(2)	-105	12	64.6 11.8	170060	N0IN N NEINW	6	CA DB	-
2052	BELEMNITELLA	A	-105	12	42.4 17.1	721060	N0BN N NEINW	0	CA DB	-
335	BELEMNITELLA	G+A(XE)	-110	12	59.6 11.9	303242U	5N34 N SE	8000 8	CA DB	CO
2035	BELEMNITELLA	A	-115	12	34.6 15.0	270250D	100F F	0010 1	CA DB	PV
2038	BELEMNITELLA	G+A(2)	-115	12	96.2 15.6	270325D	F00F N	4100 5	CA DB	AA fr PV ST
2078	BELEMNITELLA	A	-115	12	24.2 13.2	1830800	0	1000 1	-	ST
2079	BELEMNITELLA	G(XE)	-115	12	20.6 12.1	1131200	0010 1	0010 1	?RO	ST
2014	ECHINOCORYS	FRAGS NC	-115	12	-	-	-	-	-	-
1989	ECHINOID	frags	-115	12	-	-	-	-	-	-
327	BELEMNITELLA	G+A(XE)	-120	12	67.4 13.8	130200	0300 3	0	?N RO	-
1956	BELEMNITELLA	G(XE)	-120	12	34.5 14.6	303206U	F10N N NW	1011 3	CA DB RO	BU CO SA
2097	M ?GLYPHUS Schlueter	PS	-120	12	50 45 38	AWU	-	-	-	CO DT MO
2036	BELEMNITELLA	G+A(2)	-125	12	61.5 15.3	1720190U	NF0N N NEINW	0	CA DB RO	-
2080	BELEMNITELLA	G	-125	12	43.9 15.4	1403450	NNNN N ALL	2000 2	CA DB ?N	BU fr
2101	BELEMNITELLA	A	-125	12	27.2 13.4	1900500	3000 3	-	CA DB ?EN	-
2010	P VESICULARE (Lamarck)	NC	-125	12	-	-	-	-	-	-
308	BELEMNITELLA	G	-130	12	38.7 13.4	231600	N00N N NEINW	2000 2	CA DB	ANJ SA
317	BELEMNITELLA	G+A	-130	12	36.5 14.5	532140	N113 N NW	0	CA DB	-
1958	BELEMNITELLA	A	-130	12	37.3 15.5	121480	2043 9	1202 5	CA PO	PO SA
2057	BELEMNITELLA	G(XE)	-130	12	27.5 12.2	631710	F115 F	1000 1	CA DB EN	PV
2065	BELEMNITELLA	G+A(XE)(2)	-130	12	59.1 14.2	603107U	0	1101 3	-	MS PV uw
2064	BELEMNITELLA	G+A	-135	12	54.3 12.1	133006U	F00N N NW	0132 6	CA DB	BU CO fr PV
2002	ECHINOCORYS	FRAGS NC	-135	12	-	-	-	-	-	-
2011	MICRASTER	FRAGS NC	-135	12	-	AWU	-	-	-	-
273	BELEMNITELLA	G	-140	12	30.0 11.6	1602140	0	0	-	-
311	BELEMNITELLA	G(XE)	-140	12	32.6 16.1	3431380	NONN N	3300 6	DB	ANJss CO MS
1943	BELEMNITELLA	NC	-140	12	-	43098U	-	-	-	-
2039	BELEMNITELLA	G+A(XE)(2)	-140	12	57.4 13.3	2302440	FF1F N NEINW	2214 9	CA DB EN ?N	CO fr MO PV SA ST
2074	P VESICULARE (Lamarck)	PS	-140	12	14.4 15.3 14.3	USD	-	-	-	DI PVJ SA
1963	BELEMNITELLA	G+A(3)	-145	12	52.0 11.0	2402960U	0NN0 N SE/SW	2010 3	CA DB	AP CO SA
2063	BELEMNITELLA	G(2)	-145	12	36.5 11.4	631800	1001 2	0	CA DB ?N	-
1952	BELEMNITELLA	G(XE)	-150	12	31.9 12.9	03009	F00F F	0010 1	CA DB ?N	PV
2071	BELEMNITELLA	G	-150	12	19.6 11.1	53337U	0	0	-	-
2007	ECHINOCORYS	FRAG NC	-150	12	-	-	-	-	-	-
2067	BELEMNITELLA	G+A(XE)	-155	12	31.3 12.4	1830190	1002 3	0022 4	CA DB	ANJ BU SA
1941	CRET Sp	NC	-160	12	-	-	-	-	-	-
1996a	ECHINOCORYS	PS	-160	12	-	-	-	-	-	ANJ AP CS DA MO PO PV SA SU uw
2004	ECHINOID	FRAG NC	-150	12	-	-	-	-	-	-
307	P VESICULARE (Lamarck)	PS	-160	12	25.5 10.3 13.0	-	-	-	CA DB	SA
2083	P VESICULARE (Lamarck)	NC	-160	12	-	-	-	-	-	-
2009	P VESICULARE (Lamarck)	NC	-160	12	-	-	-	-	-	-
1996b	S DUTEMPLEANUS d'Orbigny	in M ?GLYPHUS	-160	12	-	-	-	-	-	-
1948	BELEMNITELLA	NC	-165	12	-	1120410	-	-	-	-
1954	BELEMNITELLA	G+A(2)	-165	12	93.6 16.3	1821050	NFFN N NEINW	1101 3	CA DB	BU CO MO
1942	CRET Sp	NC	-170	12	-	-	-	-	-	-
2061	P VESICULARE (Lamarck)	PS	-170	12	14.5 10.0 6.1	-	-	-	-	-
1953	BELEMNITELLA	G	-175	12	25.7 10.2	1032160	0200 2	0200 2	CA DB	SA
2072	C ?NORVICENSIS(JUV) Pettitt	CS	-175	12	9.4 9.0 5.3	PVT	-	-	-	-
2095	ECHINOCORYS	NC(CR)	-175	12	64.1 61.0 40.2	AWU	-	-	EN	ANJ BU CO ?OS
1939	P VESICULARE (Lamarck)	NC	-175	12	-	-	-	-	-	-
1951	P VESICULARE (Lamarck)	FRAG	-175	12	-	-	-	-	-	-
2102	P VESICULARE (Lamarck)	FRAGS	-175	12	-	-	-	-	-	-
1957	BELEMNITELLA	G+A(XE)	-180	12	55.2 14.4	2033170	FFFF N ALL	1022 5	CA DB ?N	AP MO SA
2025	BELEMNITELLA	G+A(XE)	-180	12	30.5 15.0	1681220	F0IN N NW	1000 1	CA DB ?N TA	uy
2058	BELEMNITELLA	G	-180	12	17.7 9.5	932100	0	2001 3	-	AN MS SA
1947	ECHINOID	NC	-190	12	-	-	-	-	-	-
2073	BELEMNITELLA	G(2)	-195	12	37.0 13.0	1530500	00NN N SWINW	1000 1	CA DB ?N RO	uw
1906	ECHINOCORYS	NC	-200	12	-	-	-	-	-	-
2017	CRET Sp	FRAGS NC	-	12	-	-	-	-	-	-
2076	CRET Sp	FRAGS	-	12	-	-	-	-	-	-
346	ECHINOCORYS	FRAGS	-	12	-	-	-	-	-	-
1722	ECHINOCORYS	in fl NC	-	12	-	OIS	-	-	-	-
1723	ECHINOCORYS	in fl NC	-	12	-	OIS	-	-	-	-
2107	ECHINOCORYS	FRAG	-	12	-	-	-	-	-	AA ANJ uw
2152	BELEMNITELLA	NC	80	13	-	2320380	-	-	-	-
2161	BELEMNITELLA	NC	75	13	-	3032010	-	-	-	-
2470	C ?NORVICENSIS Pettitt	PS	50	13	10.6 11.0 6.7	PVG	-	-	-	-
347	ECHINOCORYS	NC(CRU)	50	13	67.7 64.9 47.1	-	-	-	-	by CO DA DG MS SA ST
2441	C ?NORVICENSIS(JUV) Pettitt	CS (CR)	45	13	9.5 10.9 4.6	-	-	-	-	-
2473	FISH	TOOTH PS	45	13	-	-	-	-	-	-
2464	P VESICULARE (Lamarck)	FRAG	45	13	-	-	-	-	-	-
2467	P VESICULARE (Lamarck)	FRAG	40	13	-	-	-	-	-	-
2086	B BRYDONEI Rasmussen	OSSICLE	35	13	-	-	-	-	-	-
2159	CRET Sp	PS NC	35	13	-	-	-	-	-	-
2094	ECHINOCORYS	PS	35	13	50.4 51.0 32.5	USD	-	-	-	-
2160	ECHINOCORYS	FRAGS NC	35	13	-	-	-	-	-	CR DA DT ?MS
339	MICRASTER	CS(CRU)	35	13	45.4 27.6 27.3	-	-	-	-	-
340	MICRASTER	PS(CRU)	35	13	45.0 40.5 21.2	-	-	-	-	-
2465	CIDARID Sp	FRAG	30	13	-	-	-	-	-	-
2020	ECHINOCORYS	NC	30	13	-	-	-	-	-	-
2093	ECHINOCORYS	CS(CR)	30	13	50.6 50.3 46.4	OIS	-	-	-	DS DT MS
2096	ECHINOCORYS	PS(CR)(FLFL)	30	13	-	-	-	-	-	AN DT PO UP
2026	BELEMNITELLA	G+A(XE)	25	13	19.7 12.4	922130	01FN N NW	0	CA DB ?N	-
2157	CRET Sp	NC	25	13	-	PVT	-	-	-	-
2469	P GRANULATA (Nilsson)	FRAGS	25	13	-	-	-	-	-	-
2018	ECHINOID	FRAGS NC	20	13	-	-	-	-	-	-
2029	BELEMNITELLA	G+A(3)(fl fill)	-10	13	90.9 16.1	1403000	0	0002 2	-	DT ID MS
2150	CRET Sp	broke NC	-10	13	-	OIS	-	-	-	-
343b	ECHINOCORYS	NC(+PV)	-10	13	74.1 74.1 41.4	-	-	-	-	-
344	M GIBBA (Lamarck)	CS(CRU)	-10	13	54.3 55.0 26.7	-	-	-	-	-
343a	P VESICULARE (Lamarck)	NC	-10	13	-	-	-	-	-	-
2475	Starfish	OSSICLE	-10	13	-	-	-	-	-	DS
345	BELEMNITELLA	G+A(XE)	-15	13	39.6 12.4	1021400	1001 2	0	?N TA	-
342	P VESICULARE (Lamarck)	FRAG	-15	13	50.2 40.4 19.6	-	-	-	-	-
2047	BELEMNITELLA	G+A(XE)	-20	13	36.0 12.3	520150	F100 F	1000 1	DB ?N	ANJ
2163	CRET Sp	NC	-20	13	-	PVT	-	-	-	-
341	P VESICULARE (Lamarck)	NC	-20	13	44.6 45.4 30.3	-	-	-	CA EN	ANJ CO SA
2031	BELEMNITELLA	G(XE)	-30	13	21.6 14.1	5920180	FF00 F	1001 2	CA DB ?N	BU fr
2460	BELEMNITELLA	G+A(XE)	-30	13	39.9 12.7	2902180U	NN00 N NEISE	0020 2	CA DB	AA MS
2050	BELEMNITELLA	G+A(2)	-35	13	37.0 12.5	601880	0	0	-	-
2033	BELEMNITELLA	G	-45	13	30.2 12.3	1602260	NNNN N ALL	0102 3	CA DB ?N	BU
2024	CRET Sp	FRAGS	-45	13	-	-	-	-	-	-
300	?ECHINOCORYS	NC	-50	13	67.2 51.4 45.5	-	-	-	-	MO

NO	TAX	DES	POS	FE	DIM	ORI	BOR	EPI	B(D)	E(D)
332	BELEMNITELLA	G+E)	-50	13	53.1 12.2	182950	N000 N NE	1000 1	CA D8	CO
2032	BELEMNITELLA	G+E	-56	13	25.8 12.1	150180U	N30F N NE	0	CA DE 7N	-
2162	BIV	FRAGS NC	-50	13	-	-	-	-	-	-
2599	ECHINOCORYS	FRAGS	-50	13	-	-	-	-	-	NE
331	BELEMNITELLA	FE	-55	13	45.9 14.9	683200	0020 2	0	CA	-
2090	CRET Sp	FRAG	-65	13	-	-	-	-	-	-
2054	BELEMNITELLA	?	-75	13	26.4 13.3	243340U	1F13 F	2000 2	CA D8 7N	BU 4r
2560	C NORVICENSIS JUV Pettitt	PS	-76	13	-	-	-	-	-	-
2472	C NORVICENSIS Pettitt	JUV	-78	13	10.8 10.6 8.4	PVT	-	-	CA	-
2016	CRET Sp	FRAGS NC	-78	13	-	-	-	-	-	-
2043	ECHINOCORYS	FRAGS	-79	13	-	-	-	-	-	-
2036	BELEMNITELLA	G+E)	-75	13	24.1 11.9	1283260	0	1000 1	-	UY
.2019	ECHINOCORYS	FRAGS NC	-75	13	-	-	-	-	-	-
2092	ECHINOCORYS	FRAGS	-75	13	-	RWU	-	-	-	-
2098	ECHINOCORYS	FRAG	-75	13	-	-	-	-	-	-
2100	ECHINOCORYS	FRAGS	-75	13	-	-	-	-	-	-
2627	BELEMNITELLA	0	-80	13	42.4 15.2	3420000	NFFN N NEINW	0020 2	CA D8	AN
2474	?	?	-	13	-	-	-	-	-	-
2426	BELEMNITELLA	G+A(2)	-	13	63.5 13.9	380630	NNNN N ALL	0	CA D8 7EN	-
2153	ECHINOCORYS	FRAGS NC	-	13	-	-	-	-	-	-
1708	SPONGES	nu NC	-	2-3	-	-	-	-	-	-
2115	SPONGES	sev sp NC	-	2-3	-	-	-	-	-	-
1715	SPONGES	nu NC	-	3-4	-	-	-	-	-	-
1715	SPONGES	nu NC	-	3-4	-	-	-	-	-	-
1719	SPONGES	band NC	-	4-5	-	-	-	-	-	-
2142	SPONGES	scat NC	-	5-7	-	-	-	-	-	-
1752	SPONGES	scat NC	-	7-8	-	-	-	-	-	-
1746	SPONGES	nu NC	-	9-?	-	-	-	-	-	-
1756	SPONGES	nu NC	-	8-9	-	-	-	-	-	-
1752	SPONGES	nu (esp 30-66T9	-	9-10	-	-	-	-	-	-
.627	SPONGES	NC	-	9-10	-	-	-	-	-	-
2005	SPONGES	scat NC	-	11-12	-	-	-	-	-	-
2013	SPONGES	scat NC	-	11-12	-	-	-	-	-	-
1720	SPONGES	foreshore nu NC	-	2-60 3	-	-	-	-	-	-
.536	SPONGES	nu NC	-	2-140 9	-	-	-	-	-	-
1515	SPONGES	scat NC	-	10-100 10	-	-	-	-	-	-
1920	SPONGES	nu NC	-	11--175 1	-	-	-	-	-	-

b) List of all fossils found in miscellaneous sections.

Abbreviations as in appendices 2, 3a, and 3b.

NO	DAT	LOC	TAX	DES	POS	FE	DIM	ORI	BOR	EPI	B(D)	E(D)
2613	23987	CB	INOCERAMID	FRAG	-	1	11.3 6.9 4.0	-	-	-	-	-
2614	23957	CB	A CINCUMA N.Isson	FRAG	-20	B2	12.7 14.3	-	-	-	-	UY
2615	26987	NFF	BELEMNITELLA	G(XE)	-165	B2	21.4 14.0	2581080	NNNN N ALL	2245 13	CA D8 EN	AN AP BU MO PL,
2616	26987	NFF	ECHINOCORYS	PS	-10	B2	44.7 31.9 36.4	-	-	-	-	AA ANJ BU CM CO CS MS PO
2617	27987	UEAI	CIDARID Sp	SPINE	-70	B1	31.3 4.4	-	-	-	-	PL
2619	27987	UEAI	CIDARID Sp	SPINE	-75	B1	13.2 4.2	-	-	-	-	PL
2638	241287	NFF	BELEMNITELLA	A(E)	-60	B2	18.6 13.8	1803120	0202 9	9010 1	CA D6	BU
2639	241287	NFF	G GORDIALIS (Schlotheim)	-	-75	B2	-	-	-	-	-	-
2640	241287	NFF	P AMPULLACEA (Sowerby)	FRAG	-75	B1	8.3 2.2	-	-	-	-	-
2641	241287	NFF	BELEMNITELLA	G(E)+A	-60	B1	36.9 14.6	1703240	FFFF N	1211 9	CA D8 EN	ANJ BU CO GI MS PO ST
2642	241287	NFF	CIDARID Sp	spine	-95	B2	-	-	-	-	-	-
2643	241287	NFF	I COSTATA (Sowerby)	VALVE	-175	B2	6.9 6.3	OIS	-	-	-	-
2644	241267	NFF	starfish	ossc	-10	B1	-	-	-	-	-	-
2645	241287	NFF	BELEMNITELLA	G(XE)+A	-25	B1	20.5 7.4	88179	FNNF N SE SW	1121 9	CA D8	AP LM
2646	241287	NFF	BIV	FRAGS	-115	B2	-	81BS D	-	-	-	-
2647	241287	NFF	BIV	FRAGS	-60	B2	-	81BS D	-	-	-	-
2648	241287	NFF	P VESICULARE (Lamarck)	FRAG	-145	B2	12.3 13.2	ATT D	-	-	-	-
2649	241287	NFF	I PAUCICOSTATA (Bosquet)	V WN	-180	B2	6.8 7.8	ORN U	-	-	-	-
2650	241287	NFF	TEREBRATULID Sp	NC	-120	B2	-	-	-	-	-	?DA MS
2651	241287	NFF	BELEMNITELLA	G(XE)+A(2)	-95	B2	64.8 15.3	8520500	FFFF N	0210 3	CA D8	UY
2656	24486	AB	CRET Sp	PS	-65	B6	-	-	-	-	-	-
2657	24488	AB	P GLOBULARIS (Phillips)	CS	-	B9	10.7 13.0	-	-	-	-	-
2658	24488	AB	Starfish	ossc	-85	B9	-	-	-	-	-	-
2659	241287	NFF	CRET Sp	NC	-130	B2	-	-	-	-	-	-
2660	241267	NFF	G GORDIALIS (Schlotheim)	NC	-110	B2	-	-	-	-	-	-
2661	241287	NFF	OSTREA Sp	NC	-95	B2	-	-	-	-	-	-
2670	24488	AB	BELEMNITELLA	NC	30	T0	-	-	-	-	-	-
2671	3688	SP2	??TEICHASTER Sp	OSC	-80	B1	-	-	-	-	-	-
2672	8688	WHE	M GIBBA (Lamarck)	NC	65	B5	44.5 43.0 34.6	OIS	-	-	-	BU
2673	8688	WHE	TEREBRATULINA Sp	FRAG	-80	B4	-	-	-	-	-	-
2674	8688	WHE	MICRASTER	PS(3P)	-90	B4	-	-	-	-	-	-
2675	9688	WL	ECHINOCORYS	CS	-	9	74.6 59.7 52.5	RWU	-	-	-	-
2676	12688	WHE	P VESICULARE (Lamarck)	FRAG	-20	B4	17.3 12.5 7.8	-	-	-	-	SA
2677	12688	WHE	BELEMNITELLA	A(2)	-100	B4	44.3 20.2	1032260	NEON N	0	CA D8	-
2678	22688	WIT	C CARNEA (J. Sowerby)	PV	-65	B2	20.0 20.5 12.9	OIS	-	-	7N	-
2679	22688	WIT	INOCERAMID	FRAG	-15	B2	33.8 23.2	-	-	-	CA	DA MO SA
2680	22688	WIT	ECHINOCORYS	FRAG(IN F)	-	2	-	OIS	-	-	-	-
2681	23688	WRD	C NORVICENSIS(JUV) Pettitt	NC	-100	B2	9.8 8.5 5.6	-	-	-	-	-
2682	23688	WRD	BELEMNITELLA	G+A(o)	-10	B1	84.6 15.9	830920	F08F F	1001 2	CA D8	BU 7NE
2683	23688	WRD	CRET Sp	?JUV CS	-100	B2	9.7 7.7 4.1	PVT	-	-	-	-
2684	23688	WRD	C NORVICENSIS(JUV) Pettitt	NC	-10	B1	9.6 9.5 5.5	PVT	-	-	-	-
2685	23688	WRD	C NORVICENSIS(JUV) Pettitt	CS	-	B1	10.1 10.6 6.5	-	-	-	-	-
2686	23688	WRD	ECHINOCORYS	FRAGS	-110	B.	-	USD	-	-	-	AN
2687	23688	WRD	BELEMNITELLA	G+A(2)	-50	B1	42.4 9.5	1o22300	NFFN N	1000 1	CA CE 7N	BU
2688	23688	WRD	BELEMNITELLA	G(XE)+A	-110	B2	52.1 13.5	14a26?D	F00F F	0	D8	-
2689	23688	WRD	ECHINOCORYS	FRAGS	-110	B2	-	-	-	-	-	-
2690	3688	SP2	ECHINOCORYS	FRAG NC	-160	B1	-	-	-	-	-	-
2691	8688	WHE	MICRASTER	PS NC	-105	B4	-	OIS	-	-	-	-
2692	8688	WHE	BELEMNITELLA	NC	-75	B4	-	25a1o6U	-	-	-	-
2693	8688	WHE	ECHINOCORYS	PS NC	-50	B4	-	RWU	-	-	-	-
2694	8688	WHE	BELEMNITELLA	NC	-60	B6	-	?a017D	-	-	-	-
2695	8688	WHE	BELEMNITELLA	NC	-75	B6	-	3a140U	-	-	-	-
2696	8688	WHE	ECHINOCORYS	FRAGS NC	-40	B6	-	RWU	-	-	-	-
2697	8688	WHE	BELEMNITELLA	NC	-10	B12	-	1a2800	-	-	-	-
2698	9688	WL	INOCERAMID	FRAGS NC	-50	B4	-	-	-	-	-	-
2699	12688	WHE	BELEMNITELLA	NC	-75	B4	-	83270	-	-	-	-
2700	12686	WHE	BELEMNITELLA	NC	-15	B4	-	3a3186U	-	-	-	-
2701	12688	WHE	BELEMNITELLA	FRAGS NC	-20	B4	-	1?a204D	-	-	-	-
2702	12688	WHE	ECHINOCORYS	COL NC	-10	B4	-	-	-	-	-	-
2703	12688	WHE	BOURGUETICRINUS Sp	NC	-	4	-	-	-	-	-	-
2704	12686	WHE	BELEMNITELLA	FRAGS NC	-100	B4	-	1a3104C	-	-	-	-
2705	12688	WHE	MICRASTER	NC	-40	B6	-	-	-	-	-	-
2706	12688	WHE	BELEMNITELLA	NC	-45	B2	-	2a3344U	-	-	-	-
2707	23688	WRC	BELEMNITELLA	NC	-130	B2	-	21a3?5	-	-	-	-
2708	23688	WRC	C NORVICENSIS(JUV) Pettitt	NC	-20	B.	-	-	-	-	-	-
2709	23689	WRC	M CHITONIFORMIS (Schlotheim)	SPINE NC	-30	B1	-	PVT	-	-	-	-
2710	23688	WRD	CIDARID	NC	-90	B2	-	-	-	-	-	-
2711	23688	WRD	C NORVICENSIS(JUV) Pettitt	NC	-110	B2	-	-	-	-	-	-
2712	23686	WRD	BELEMNITELLA	NL	-115	B2	-	1a213U	-	-	-	-
2713	23688	WRD	BELEMNITELLA	NC	-40	B1	-	2a2?0D	-	-	-	-
2714	23688	WRD	BELEMNITELLA	FRAGS NC	-140	B2	-	?5a?10D	-	-	-	-
2715	23688	WRD	ECHINOCORYS	CS NC	-10	B1	-	OIS	-	-	-	-
2716	23688	WRG	C NORVICENSIS(JUV) Pettitt	-	-	-	-	PVT	-	-	-	-

APPENDIX FIVE

List of all fossils found in the quarry at Keswick (TG 21200 04850). Abbreviations as in appendices 3a and 3b.

NC	Tax	DES	POS	FB	DIM	OPC	BOP	EPI	BID	EID
2426	-	[illegible]	-	-	-	-	-	-	-	-
373	BELEMNITELLA	G+A AN	-21	A	68.3 12.4	770092U	-	-	CA DG 7N RO	AN,
2165	BELEMNITELLA	NC	-35	B	-	921570	-	-	-	-
2166	BELEMNITELLA	NC	-45	B	-	60357	-	-	-	-
2167	BELEMNITELLA	NC	-50	B	-	432960	-	-	-	-
493	BELEMNITELLA	G+A(E)(2)(621	-65	B	675 15	703250	0	2003 5	-	BU MO MS
492	BELEMNITELLA	G+A(E)(621	-65	B	46.4 10.9	2202200	2100 3	1100 2	7N	70P MS
497	BELEMNITELLA	G+A(5)(621	-65	B	658 16	1501500	0001 1	1000 1	SI	DA
501	BELEMNITELLA	G+A(621	-65	B	56.9 10.6	2103040	1111 4	0220 4	CA DE	CO PU SA
503	BELEMNITELLA	G(621	-65	B	17.3 9.2	00257	0	0104 5	-	BU DT SA 77P
510	BELEMNITELLA	G(E)(2)(621	-65	B	75.0 15.1	4003400	0200 2	0100 1	DE	SA
492	ECHINOCORYS	PS(621	-65	B	29.3 12.3 16.9	-	-	-	-	-
496	BELEMNITELLA	G+A(E)(621	-70	B	79.1 15.6	1001210	000N N NW	2102 5	CA RO	AN, 70L SA
495	BELEMNITELLA	G+A(YE)(4)(621	-70	B	56.7 10.9	302000	0	(	-	-
499	BELEMNITELLA	G+A(YE)(2)(621)	-70	B	65.5 13.4	2002580	NNNN N SEISW	1021 4	7N PO	BU CO MO
506	BELEMNITELLA	A(621)	-70	B	32.3 12.4	1002700	NNNN N ALL	0210 3	7N	BU MO SA
509	BELEMNITELLA	G(E)(2)(621)	-70	B	54.4 15.0	700580	2004 6	0100 1	CA DB 7N	CO
491	BELEMNITELLA	G+A(2)(621)	-75	B	77.4 15.0	2502700	0	0	-	-
494	BELEMNITELLA	G+A(4)(621)	-75	B	670 11	403300	0	0	-	-
495	BELEMNITELLA	G+A(XE)(621)	-75	B	50.4 11.4	2003450	0	0002 2	-	DA SA
500	BELEMNITELLA	G(XE)(621)	-75	B	44.6 13.3	00330	1012 4	0101 2	DG 7N	CO MO
502	BELEMNITELLA	G+A(E)(621)	-75	B	40.5 11.3	100700	5017 13	5005 10	CA DB RO	BU MS
504	BELEMNITELLA	G+A(2)(621)	-75	B	69.0 12.6	3600010	0	0110 2	-	AN, CO
505	BELEMNITELLA	G+A(XE)(3)(621)	-75	B	80 14	2001260	NNNN N ALL	2224 10	CA DB 7N TA	BU CO DS MO SA
507	BELEMNITELLA	G+A(3)(621)	-75	B	82.3 15.6	00338	0	3024 9	-	CO MP MS
508	BELEMNITELLA	G+A(3)(621)	-75	B	97.3 17.4	801700	0010 1	3322 10	RO	MS PU SA
474	BELEMNITELLA	G+A(2)	-150	B	90.5 14.3	703150	N000 N NE	0140 5	77N	AA AM AN CC EP MEaf
4??	C 7NORVICENSIS(JUV) Pettitt	CS(CRU)	-175	B	8.1 8.4 4.5	-	-	-	-	-
59?	CRET Sp	CP	-185	B	9.1 11.1 3.0	PUB	-	-	-	-
454	I COSTATA (Sowerby)	CV	-5	C	7.4 8.3	-	-	-	-	-
368	BELEMNITELLA	G+A	-10	C	71.5 12.9	370020U	-	-	CA RO TA	BU MS
451	C 7NORVICENSIS(JUV) Pettitt	CS	-10	C	9.0 8.7 6.1	PUG	-	-	-	-
488	?ECHINOCORYS	FRAGS(68)	-20	C	-	-	-	-	-	AA CDaf uw
467	BELEMNITELLA	G+A(XE)	-20	C	63.6 13.2	1001550	1110 3	1101 3	RO	CO DT
466	BELEMNITELLA	IN FL NC	-20	C	-	-	-	-	-	-
469	BELEMNITELLA	A	-20	C	36.9 14.0	701470	0430 7	2910 3	7N	AN, BU
483	BELEMNITELLA	G+A(66)	-20	C	77.4 14.9	301300	0	0	-	-
464	BELEMNITELLA	A(68)	-20	C	34.7 11.6	00338	0	0	-	-
485	BELEMNITELLA	A(68)	-20	C	36.0 12.6	2300910	0020 2	0	7N PO	-
486	BELEMNITELLA	A(56)	-20	C	35.7 15.3	2700380	0	1221 6	-	DA DT
467	BELEMNITELLA	G(68)	-20	C	40.8 15.9	1203570	1000 1	0101 2	RO	DA
482	ECHINOCORYS	PS(68)	-20	C	-	-	-	-	-	?DA
469	ECHINOCORYS	CS(FLFL)(68)	-20	C	68.8 57.4 46.3	-	-	-	EN PO	AN DA ?OL DS ?SS
464	BELEMNITELLA	G+A	-25	C	75.3 14.0	2301820	3000 3	2010 3	CA PO	OS VP
527	C 7NORVICENSIS(JUV) Pettitt	CS	-25	C	8.8 8.4 5.0	-	-	-	-	-
449	ECHINOCORYS	FRAGS	-25	C	-	-	-	-	-	CG
516	BELEMNITELLA	G+A	-30	C	39.7 7.6	2001910	3110 5	1100 2	PO	BU
533	BELEMNITELLA	G+A(2)	-30	C	43.7 7.5	00140	0	0	-	-
529	BELEMNITELLA	G+A(YE)	-35	C	43.1 8.4	1000150	N000 N NE	1000 1	SA DB	AN
81	BELEMNITELLA	G+A(XE)	-40	C	64.0 11.3	002460	0	2100 3	-	DS ?SS
458	BELEMNITELLA	G(XE)	-40	C	37.5 14.6	1001730	2101 4	1121 5	DB 7N	BU fr ?VP
474	BELEMNITELLA	G	-40	C	31.7 15.2	501500	0	0012 3	-	AN PU,
515	BELEMNITELLA	A	-40	C	49.8 13.2	2702740	4243 13	0213 6	CA 7N TA	?AN MS
534	BELEMNITELLA	G+A(XE)	-40	C	39.6 6.7	520200	5223 12	0002 2	CA DB 7N PO	SA
514	BELEMNITELLA	G	-45	C	31.0 13.2	2001800	1000 1	0100 1	DB	CO
536	BELEMNITELLA	G	-45	C	23.0 9.9	2002340	0	6	-	-
539	BELEMNITELLA	G+A	-45	C	30.3 5.9	00020	0001 1	4001 5	CA	BU
481	ECHINOCORYS	FRAGS	-45	C	-	-	-	-	-	PU
455	CRET Sp	broke up	-50	C	-	-	-	-	-	-
531	G GORDIALIS (Schlotheim)	-	-50	C	-	-	-	-	-	-
452	?CIDARID Sp	FRAGS	-55	C	-	-	-	-	-	-
453	BELEMNITELLA	A(2)	-55	C	22.3 12.6	503250	0	0	-	-
457	BELEMNITELLA	A	-55	C	26.1 14.1	3002180	5143 13	1300 4	CA 7N RO	PU, uw
470	BELEMNITELLA	A	-55	C	20.3 6.5	00245	4004 8	1001 2	CA DB	CO MO
472	BELEMNITELLA	G+A	-55	C	65.5 11.4	1502000	1001 2	1000 1	CA	fr
450	ECHINOCORYS	FRAG	-55	C	15 11	-	-	-	-	-
460	BELEMNITELLA	G+A(XE)	-60	C	50.5 11.3	5300310	1031 5	0	RO	-
465	BELEMNITELLA	G+A(XE)	-60	C	47.6 12.2	3401600	0100 1	0	RO	-
479	P VESICULARE (Lamarck)	FRAGS	-60	C	-	-	-	-	-	-
68a	C 7NORVICENSIS(JUV) Pettitt	CS CR	-70	C	8.0 8.6 4.9	-	-	-	-	-
520	C 7NORVICENSIS(JUV) Pettitt	CS	-75	C	9.5 9.9 5.6	PUB	-	-	-	-
73	BELEMNITELLA	G+A(XE)	-80	C	60.9 14.6	2500300	0	4639 22	-	BU SA ?SS
519	BELEMNITELLA	A(2)	-80	C	22.0 12.9	2202350	10 9810 37 ALL	0	DB 7N PO	-
525	BELEMNITELLA	G+A(3)	-80	C	86.3 15.2	1201170	0	3311 0	-	AN, LM SA
547	ECHINOCORYS	FRAGS	-80	C	-	-	-	-	-	MO PU ST
526	BELEMNITELLA	G+A(XE)	-90	C	32.1 9.3	1203240	1001 2	0	CA RO	-
548	ECHINOCORYS	FRAGS	-90	C	-	USD	-	-	-	DA MS PO SA ?VP
473	BELEMNITELLA	G+A(2)	-95	C	42.9 10.7	500240	N00N N NEINW	0	DG	-
523	BELEMNITELLA	G+A(XE)	-95	C	56.5 15.0	1100350	NNNN N NEINW	3115 10	CA DB RO	AN, BU CO PU
535	BELEMNITELLA	G	-95	C	9.6 3.4	202180	0	0	-	-
461	BELEMNITELLA	G+A(XE)(2)	-100	C	90.2 15.3	1003160	2002 4	0003 3	RO	BU
517	BELEMNITELLA	A	-100	C	36.4 10.0	1003200	N00N N NEINW	11 201 14	7N RO	AN, AP BU SA
546	ECHINOCORYS	FRAGS	-100	C	-	AWU	-	-	RO	AN BI BU LM MS PO PU
542	BELEMNITELLA	G	-115	C	40.6 11.6	1202700	NNNN N NEINW	6114 12	CA DB EN 7N	BU ?CO fr
68b	C 7NORVICENSIS(JUV) Pettitt	CS CR	-115	C	7.4 0.3 5.2	-	-	-	-	-
545	ECHINOCORYS	FRAGS	-120	C	-	AWU	-	-	-	AN BU DA HE PU VP
400	ECHINOID	FRAGS	-125	C	-	-	-	-	EN	-
476	P VESICULARE (Lamarck)	PS(CRU)	-125	C	11.6 16.9	-	-	-	-	-
363	BELEMNITELLA	A	-128	C	29.1 11.8	1201420	TNN	-	RO	SA uw
442	BELEMNITELLA	A	-130	C	31.4 10.0	100200	1000 1	0	DB	-
521	C 7NORVICENSIS(JUV) Pettitt	CS	-135	C	7.0 7.2 4.0	PVT	-	-	-	-
383	BELEMNITELLA	G+A(XE)	-142	C	44.6 13.7	00232	-	-	CA DB PO	AN
536	BELEMNITELLA	G(XE)	-145	C	20.5 15.6	4001530	NN02 N NEISE	0001 1	CA DB	SA
512	CRET Sp	PS	-145	C	0.9 0.4 5.6	-	-	-	-	-
528	P VESICULARE (Lamarck)	2	-145	C	27.3 18.6 4.5	-	-	-	-	-
2286	CRET Sp	FRAG NC	-160	C	-	OIS	-	-	-	-
2289	BELEMNITELLA	NC	-165	C	-	22320U	-	-	-	-
2501	M CHITONIFORMIS (Schlotheim)	CS	-165	C	7.6 7.5 4.1	PVB	-	-	-	-
522	BELEMNITELLA	G+A	-170	C	46.2 11.8	3202730	0110 2	0001 1	CA DB	AN,
2285	CRET Sp	NC	-175	C	-	OIS	-	-	-	-
456	?CRET Sp	FRAG	-	C	7.0 11.2 2.2	-	-	-	-	-
448	BELEMNITELLA	G+A(XE)	-	C	41.7 11.9	3102120	0100 1	0	DB	-
463	BELEMNITELLA	G+A(XE)(3)	-	C	37.3 7.6	4030090	0011 2	0	DB SI	-
2283	BELEMNITELLA	NC	-5	D	-	221600	-	-	-	-
2273	CRET Sp	NC	-5	D	-	-	-	-	-	-
478	P VESICULARE (Lamarck)	FRAG	-10	D	6.0 14.3 5.1	-	-	-	-	-
349	I COSTATA (Sowerby)	SV	-19	D	6.9 7.0	-	-	-	-	-
2277	CRET Sp	broke NC	-20	D	-	-	-	-	-	-
390	BELEMNITELLA	A(PART)	-30	D	22.5 15.0	-	-	-	CA DB	CO
2282	C 7NORVICENSIS(JUV) Pettitt	NC	-30	D	-	PVT	-	-	-	-
2284	ECHINOCORYS	NC	-30	D	-	OIS	-	-	-	-
2267	BRACHIOPOD	NC	-35	D	-	-	-	-	-	-
2274	CIDARID Sp	BOSS NC	-35	D	-	-	-	-	-	-
2275	CRET Sp	CR NC	-35	D	-	-	-	-	-	-
524	BELEMNITELLA	G+A(XE)	-40	D	40.2 11.0	1531570	NNNN N NEINW	1001 2	CA DB	CO MO
2509	ECHINOCORYS	FRAGS	-45	D	-	AWU	-	-	-	CO DA DS MS PU SA ST
388	BELEMNITELLA	G+A(XE)	-50	D	94.2 14.3	-	-	-	DB TA	AN BU DL GG MO PO SA
540	BELEMNITELLA	G	-50	D	42.4 12.0	532070	0	0100 1	-	uy
2276	CRET Sp	broke NC	-50	D	-	-	-	-	-	-
530b	K PENTANGULATA S. Woodward	CS	-50	D	6 6	-	-	-	-	-
530a	M CHITONIFORMIS (Schlotheim)	CS	-50	D	4 4	-	-	-	-	-
372	BELEMNITELLA	G+A(XE)	-53	D	48.5 8.0	90U	-	-	-	-
367	BELEMNITELLA	G+A(XE)	-61	D	85.2 13.9	532930	-	-	CA DB	CO HL MS SA
2288	CRET Sp	SV NC	-65	D	-	OIS	-	-	-	-
2290	CRET Sp	NC	-65	D	-	PVT	-	-	-	-
2281	INOCERAMID	FRAG NC	-65	D	-	-	-	-	-	-
351	C 7NORVICENSIS(JUV) Pettitt	CS	-71	D	9.0 8.9 6.0	-	-	-	-	-
553	BELEMNITELLA	G+A(XE)	-75	D	67.9 15.5	930520	NNNN N NEINW	1230 6	CA DB 7N	BU CO ?PU SA uw
2280	C 7NORVICENSIS(JUV) Pettitt	NC	-75	D	-	PVT	-	-	-	-
573	BELEMNITELLA	G+A(XE)	-80	D	62.0 10.7	1820690	0	0100 1	DG	AN,
2270	CRET Sp	CR NC	-80	D	-	PVG	-	-	-	-
2291	C 7NORVICENSIS(JUV) Pettitt	NC	-85	D	-	OIS	-	-	-	-
2500	C 7NORVICENSIS(JUV) Pettitt	CS	-85	D	7.0 8.3 5.4	PVG	-	-	-	-
2292	CIDARID Sp	BOSS NC	-85	D	-	-	-	-	-	-
569	BELEMNITELLA	G+A(XE)	-90	D	56.0 12.9	1003120	3NNN N SEISWINW	1110 3	CA DB	fr SA
353	C 7NORVICENSIS(JUV) Pettitt	CS	-98	D	9.1 6.0 6.6	-	-	-	-	-
2502	METOPASTER Sp	OSSCICLE	-100-	D	-	-	-	-	-	-
544	BELEMNITELLA	G	-105	D	33.2 14.6	3700540	NNNN N ALL	0312 5	CA DE 7N	CO MS uw
532	K KONGIELI Popeil-Barczyk	CS	-110	D	14.3 11.3 7.6	-	-	-	-	-
354	PECURVASTER Sp	ossc	-114	D	-	-	-	-	-	-
75	C 7NORVICENSIS(JUV) Pettitt	CS	-120	D	7.9 7.8 4.9	-	-	-	-	-
2278	C 7NORVICENSIS(JUV) Pettitt	NC	-	D	-	PVT	-	-	-	-
2279	C 7NORVICENSIS(JUV) Pettitt	NC	-	D	-	PVG	-	-	-	-
2271	CRET Sp	NC	-	D	-	-	-	-	-	-
2272	CRET Sp	NC	-	D	-	-	-	-	-	-
2508	P VESICULARE (Lamarck)	PS	-	D	24.1 20.6 11.6	-	-	-	-	uy
518	BELEMNITELLA	G+A	-5	E	70.2 13.5	0202100	0	9	-	-
2269	ECHINOCORYS	FRAGS NC	-5	E	-	-	-	-	-	-
356	C NORVICENSIS Pettitt	CS(CRU)	-17	E	10.2 20.5 14.1	-	-	-	-	-
389	BELEMNITELLA	G	-20	E	12.0 3.3	232700	-	-	-	-

NO	TAX	DES	POS	FB	DIM	AI	ECP	EP	ED	EC
360	G PLEXUS (Sowerby)	-	-21	E	-	-	-	-	-	[illegible]
513	BELEMNITELLA	G+A(XE)(2)	-25	E	72.8 12.4	[illegible]	NNNN N NE [illegible]	[illegible]	CA DE	MC
541	BELEMNITELLA	G+A	-25	E	42.1 7.5	[illegible]	NNNN N ALL	-	CA DE	-
543	BELEMNITELLA	G+A(XE)	-25	E	63.7 14.6	[illegible]	NNNN N NE(NW	3552 [illegible]	CA DE ?N	[illegible] MS P
511	BELEMNITELLA	G+A(XE)(2)	-35	E	62.7 11.5	[illegible]	NNNN N ALL	[illegible]	CA DE TA	-
366	BELEMNITELLA	G(V BD)	-45	E	47.9 15.4	[illegible]	-	-	EN	AN
430	BELEMNITELLA	G+A(2)	-50	E	56.9 12.2	1280200	[illegible]	2230 [illegible]	CA DE ?N	AN [illegible]
537	P VESICULARE (Lamarck)	PS	-	E	12.1 16.7 6.2	-	-	-	-	-
360	BELEMNITELLA	G+A(XE	-	F	62.8 11.0	[illegible]	-	-	CA DE	-
576	BELEMNITELLA	G+A(XE)	-5	H	65.0 12.0	[illegible]	[illegible]	1000 [illegible]	CA DE ?N	MU
412	BELEMNITELLA	G	-10	H	35.3 12.5	[illegible]	0	[illegible]	-	-
566	BELEMNITELLA	G+A	-10	H	62.2 11.4	[illegible]	[illegible]	[illegible]	?N	BU MC
56	BELEMNITELLA	G+A	-20	H	81.4 15.8	1560950	2520 [illegible]	1210 4	DE	[illegible] MC ww
378	BELEMNITELLA	G+A	-20	H	70.6 14.6	562100	-	-	-	BU
379	BELEMNITELLA	G+A	-26	H	61.6 10.9	683480	-	-	CA DB ?N	?C0
561	BELEMNITELLA	G+A	-30	H	81.2 15.5	4201680	0	0101 [illegible]	-	[illegible] MF
355	BELEMNITELLA	FRAG	-35	H	6.0 3.9	[illegible]	-	-	-	-
570	BELEMNITELLA	A	-35	H	40.8 13.6	1401260	-	2100 3	-	MC MS
364	BELEMNITELLA	G+A	-38	H	63.2 13.0	2501830	TNM	-	DE ?O	ww
550	BELEMNITELLA	G(XE)	-40	H	16.6 7.9	00290	-	0	-	-
564	BELEMNITELLA	G+A(XE)	-40	H	50.2 11.7	1530790	NOON N NE(NW	[illegible]	CA DE EN ?N	AN ME
471	C ?NORVICENSIS(JUV) Pettitt	CS	-45	H	9.2 8.6 5.5	015	-	-	-	-
439	BELEMNITELLA	G+A(XE)	-50	H	76.1 14.1	[illegible]0480	0	0010 1	-	?0
555	C ?NORVICENSIS(JUV) Pettitt	CS(CR)	-50	H	8.1 8.2 6.2	PVB	-	-	-	-
2169	CRET Sp	FRAGS NC	-55	H	-	-	-	-	-	-
374	BELEMNITELLA	G+A	-58	H	79.3 12.5	-	-	-	CA DB	-
405	BELEMNITELLA	G+A(XE)	-60	H	63.6 11.6	360060	1024 [illegible]	0010 [illegible]	CA DE ?N	MO
436	BELEMNITELLA	A	-60	H	38.4 11.3	2201400	0020 [illegible]	0100 1	CA DE	?C0
442	BELEMNITELLA	G	-60	H	39.9 13.3	4001490	0011 [illegible]	2000 2	?N	ME ?55
387	BELEMNITELLA	G+A(XE)	-65	H	52.8 11.7	[illegible]	-	-	DB	AN
435	BELEMNITELLA	A	-65	H	38.8 15.1	1003590	0	1001 [illegible]	-	AN
2266	BIV	NC	-65	H	-	-	-	-	-	-
2265	ECHINOID	SPINE NC	-70	H	-	-	-	-	-	-
2505	J ?NELEGANS Lonsdale	FRAGS	-70	H	-	-	-	-	-	-
352	BRACHIOPOD	PS	-71	H	-	-	-	-	-	-
466	BELEMNITELLA	G+A(XE)	-75	H	51.4 15.6	10 300	F00F F	[illegible]	CA DE ?N	-
577	BELEMNITELLA	G+A(XE)	-80	H	43.6 7.9	[illegible]	0		-	-
551	CRET Sp	PS	-80	H	5 3	-	-	-	-	-
417	BELEMNITELLA	G+A	-85	H	85.4 13.6	1002090	1000 [illegible]	0001 [illegible]	?N PO	AN
2168	CRET Sp	FRAGS NC	-85	H	-	-	-	-	-	-
2257	SPONGE	NC	-85	H	-	-	-	-	-	-
446	BELEMNITELLA	G+A(4)	-90	H	[illegible] 10.5	[illegible]	0	0001	-	ww
445	BELEMNITELLA	G+A(XE)	-110	H	29.1 16.3	2002270	[illegible]	0	-	-
2498	CRET Sp	FRAG	-110	H	-	-	-	-	-	-
2254b	ECHINOCORYS	PS NC	-110	H	-	PWU	-	-	-	-
2238	INOCERAMID	FRAG NC	-118	H	-	-	-	-	-	-
481	C ?NORVICENSIS(JUV) Pettitt	CS	-122	H	8.8 8.5 5.3	PVE	-	-	-	-
2249	BELEMNITELLA	NC	-125	H	-	856350U	-	-	-	-
2267	C ?NORVICENSIS(JUV) Pettitt	NC	-125	H	-	015	-	-	-	-
2244	CRET Sp	FRAG NC	-125	H	-	-	-	-	-	-
2262	CRET Sp	NC	-125	H	-	-	-	-	-	-
2237	BELEMNITELLA	NC	-130	H	-	150257U	-	-	-	-
2247	BELEMNITELLA	NC	-130	H	-	470220	-	-	-	-
2480	C ?NORVICENSIS(JUV) Pettitt	CS	-130	H	8.7 9.1 6.0	PVE	-	-	-	-
2268	CRET Sp	NC	-130	H	-	PVT	-	-	-	-
2248	ECHINOCORYS	FRAG NC	-130	H	-	-	-	-	-	-
2497	C ?NORVICENSIS(JUV) Pettitt	CS	-135	H	9.9 10.1 6.6	015	-	-	-	-
2255	CRET Sp	FRAGS NC	-135	H	-	-	-	-	-	-
416	BELEMNITELLA	G+A(XE)	-140	H	72.0 14.2	[illegible]	0	0	-	-
554	C ?NORVICENSIS(JUV) Pettitt	CS(CR)	-140	H	8.1 9.0 6.0	PVT	-	-	-	-
571	CRET Sp	PS	-140	H	8.9 10.1 6.1	PVE	-	-	-	-
2606	C ?NORVICENSIS(JUV) Pettitt	CS NC	-145	H	-	PVT	-	-	-	-
579	ECHINOCORYS	FRAG(62)	-145	H	60 40 30	-	-	-	-	-
580	ECHINOCORYS	NC(62)	-145	H	70.0 56.0 54.5	-	-	-	-	MS
76	BELEMNITELLA	G+A(XE) WN	-150	H	54.0 12.4	1330630	NNNN N ALL	-	?N ?TA	-
2607	C ?NORVICENSIS(JUV) Pettitt	NC	-150	H	-	PVT	-	-	-	-
574	?CRET Sp	FRAGS	-155	H	7.5 7.0 5.0	-	-	-	-	-
606	C ?NORVICENSIS(JUV) Pettitt	CS	-160	H	9.9 9.5 4.3	-	-	-	-	-
88	? SHARK TOOTH	-	-	H	-	-	-	-	-	-
79a	C ?NORVICENSIS(JUV) Pettitt	CS	-5	I	8.9 9.6 5.5	PVT	-	-	-	-
79b	C ?NORVICENSIS(JUV) Pettitt	CS	-5	I	8.2 8.4 5.6	[illegible]	-	-	-	-
2258	C ?NORVICENSIS(JUV) Pettitt	NC	-5	I	-	-	-	-	-	-
2259	C ?NORVICENSIS(JUV) Pettitt	NC	-5	I	-	015	-	-	-	-
2485	K KONGIELI Popiel-Barczyk	CS	-5	I	8.1 7.4 4.6	-	-	-	-	-
57	BELEMNITELLA	G+A	-10	I	76.8 14.9	[illegible]	0	0021 [illegible]	-	AN SA SS
575	BELEMNITELLA	A	-10	I	33.2 10.6	6101830	0033 [illegible]	[illegible]	[illegible]	-
2170	BELEMNITELLA	NC	-10	I	-	1520520	-	-	-	-
2242	BELEMNITELLA	NC	-10	I	-	[illegible]	-	-	-	-
2252	C ?NORVICENSIS(JUV) Pettitt	NC	-10	I	-	PVB	-	-	-	-
2253	C ?NORVICENSIS(JUV) Pettitt	NC	-10	I	-	PVB	-	-	-	-
2256	C ?NORVICENSIS(JUV) Pettitt	NC	-10	I	-	PVT	-	-	-	-
2608	C ?NORVICENSIS(JUV) Pettitt	CS NC	-10	I	-	PVT	-	-	-	-
418	BELEMNITELLA	G+A(XE)	-15	I	81.0 15.0	880200	[illegible]	1101 3	CA DE ?N	BU CO ww
459	BELEMNITELLA	A	-15	I	42.3 12.7	1401960	1000 1	0	CA	-
2245	BELEMNITELLA	NC	-15	I	-	683280	-	-	-	-
69	C ?NORVICENSIS(JUV) Pettitt	CS	-15	I	8.9 9.4 7.1	015	-	-	-	-
441	BELEMNITELLA	G+A(XE)	-20	I	56.4 13.6	2700250	1001 2	1106 2	TA	CO MO
549	BELEMNITELLA	G+A(XE)(WN)	-20	I	45.6 11.1	3533560	NNNN N NE(NW	0110 2	CA DB ?N	?? MO
2479a	C ?NORVICENSIS(JUV) Pettitt	CS	-20	I	10.9 10.4 6.2	PVT	-	-	-	-
2481	C ?NORVICENSIS(JUV) Pettitt	CS	-20	I	10.1 10.5 6.6	PVB	-	-	-	-
2609	C ?NORVICENSIS(JUV) Pettitt	NC	-20	I	-	PVB	-	-	-	-
2246	ECHINOID	SPINE NC	-20	I	-	-	-	-	-	-
2254a	M CRETOSA (Defrance)	NC	-20	I	-	-	-	-	-	-
2494	ASTROPECTEN Sp	OSSCICLE	-25	I	-	-	-	-	-	-
49	BELEMNITELLA	G+A	-25	I	65.2 11.1	6200900	0	0001 1	-	?55
62	BELEMNITELLA	G+A	-25	I	62.9 11.4	602850	0	5202 7	-	AN
572	BELEMNITELLA	G+A(XE)	-25	I	41.0 8.2	3600960	0	0011 2	-	??
2496	BELEMNITELLA	G+A(2)	-25	I	100.0 17.6	701370	F01F [illegible]	0023 5	DB PO	AN
80a	C ?NORVICENSIS(JUV) Pettitt	CS(SBU)	-25	I	9.9 9.0 7.0	-	-	-	-	-
2205	C ?NORVICENSIS(JUV) Pettitt	NC	-25	I	-	015	-	-	-	-
2499	C NORVICENSIS Pettitt	CAST	-25	I	-	-	-	-	-	-
2243	ECHINOCORYS	FRAG NC	-25	I	-	-	-	-	-	-
2233	BELEMNITELLA	NC	-30	I	-	302340	-	-	-	-
2235	BELEMNITELLA	NC	-30	I	-	7603230	-	-	-	-
2254c	BELEMNITELLA	NC	-30	I	-	1603450	-	-	-	-
2194	INOCERAMID	FRAG NC	-30	I	-	-	-	-	-	-
2195	S DUTEMPLEANUS d Orbigny	NC	-30	I	-	-	-	-	-	-
53	BELEMNITELLA	G(WN)	-35	I	26.0 5.8	1701430	0020 2	0	CA	-
420	BELEMNITELLA	G+A	-35	I	72.4 12.3	4032900	NNNN N ALL	1009 1	CA DB TA	AP
2204	BELEMNITELLA	NC	-35	I	-	1301640	-	-	-	-
2216	C ?NORVICENSIS(JUV) Pettitt	NC	-35	I	-	PVT	-	-	-	-
2260	ECHINOCORYS	FRAGS NC	-35	I	-	-	-	-	-	-
86	BELEMNITELLA	G+A(XE)	-40	I	62.5 14.1	1700080	2000 2	0004 4	?N	AN BU ?? MO
393	BELEMNITELLA	G+A	-40	I	15.9 8.6	201200	N3IN N NE(NW	0001 1	CA ?N	CD
432	BELEMNITELLA	G+A(XE)	-40	I	61.9 12.8	2001880	NNNN N NW(SW	0	S? CB	-
2208	BELEMNITELLA	NC	-40	I	-	8002040	-	-	-	-
2224	BELEMNITELLA	NC	-40	I	-	502400	-	-	-	-
2239	BELEMNITELLA	NC	-40	I	-	303320	-	-	-	-
552	C ?NORVICENSIS(JUV) Pettitt	CS	-40	I	8.4 7.6 5.2	PVT	-	-	-	-
2193	C ?NORVICENSIS(JUV) Pettitt	NC	-40	I	-	015	-	-	-	-
2483	C ?NORVICENSIS(JUV) Pettitt	CS	-40	I	9.5 9.5 5.4	PVT	-	-	-	-
87	M CRETOSA (Defrance)	FRAGS	-40	I	-	-	-	-	-	-
2241	M CRETOSA (Defrance)	FRAG NC	-40	I	-	-	-	-	-	-
437	BELEMNITELLA	G+A	-45	I	59.2 10.6	4501320	1000 1	1001 [illegible]	TA	AN
438	BELEMNITELLA	G(XE)	-45	I	35.6 16.5	3001090	NNNN N ALL	2010 3	CA DB	AN
444	BELEMNITELLA	G+A(XE)	-45	I	49.7 11.1	2002020	0	0010 1	-	AN,
562	BELEMNITELLA	G+A	-45	I	61.2 10.9	[illegible]	NNNN N ALL	0190 1	CA DB TA	AN,
60a	C ?NORVICENSIS ?JUV Pettitt	CS	-45	I	9.0 10.3 5.5	-	-	-	-	-
60b	C ?NORVICENSIS ?JUV Pettitt	CS	-45	I	9.5 9.3 6.5	-	-	-	-	-
60c	C ?NORVICENSIS ?JUV Pettitt	CS	-45	I	8.7 8.1 5.0	-	-	-	-	-
2222	C ?NORVICENSIS(JUV) Pettitt	NC	-45	I	-	PVE	-	-	-	-
2223	C ?NORVICENSIS(JUV) Pettitt	NC	-45	I	-	015	-	-	-	-
2201	CRET Sp	NC	-45	I	-	PVT	-	-	-	-
2207	CRET Sp	NC	-45	I	-	PVT	-	-	-	-
2229	BELEMNITELLA	NC	-50	I	-	2020570	-	-	-	-
2182	C ?NORVICENSIS(JUV) Pettitt	NC	-50	I	-	015	-	-	-	-
2215	C ?NORVICENSIS(JUV) Pettitt	NC	-50	I	-	-	-	-	-	-
2197	BELEMNITELLA	NC	-55	I	-	502660	-	-	-	-
409	C ?NORVICENSIS(JUV) Pettitt	CS	-55	I	8.6 8.7 5.2	015	-	-	?TA	-
2219	CRET Sp	FRAGS NC	-55	I	-	-	-	-	-	-
2495	CRET Sp	FRAGS	-55	I	-	-	-	-	-	-
2218	ECHINOCORYS	FRAGS NC	-55	I	-	-	-	-	-	-
2206	ECHINOID	NC	-55	I	-	-	-	-	-	-
2183	SPONGE	NC	-55	I	-	-	-	-	-	-
407	BELEMNITELLA	G+A(2)	-60	I	90.1 13.6	[illegible]	[illegible]	[illegible]	CA DB	-
568	BELEMNITELLA	A	-60	I	44.5 11.2	[illegible]	0	[illegible]	-	AF
2240	BELEMNITELLA	NC	-60	I	-	300470	-	-	-	-
2200	INOCERAMID	FRAG NC	-60	I	-	-	-	-	-	-
48	TEREBRATULID	V WN	-60	I	[illegible]	-	-	-	-	-
429	BELEMNITELLA	G+A(XE)(4)(WN)	-65	I	55 12	[illegible]	NNNN N NE(NW	1111 4	CA DE EN	AN CO ?? MO

NG	TAX	DES	POS	FE	DIM	[illegible]	E(A	EPI	E(G)	E(C)
2185	C ?NORVICENSIS(JUV) Pettitt	NC	-65	I	-	??	-	-	-	-
2217	C ?NORVICENSIS(JUV) Pettitt	NC	-65	I	-	?-	-	-	-	-
2156	CRET Sp	NC	-65	I	-	PVE	-	-	-	-
2190	ECHINOID	FRAG NC	-65	I	-	-	-	-	-	-
2210	P VESICULARE (Lamarck)	FRAG NC	-65	I	-	-	-	-	-	-
2227	SPONGE	NC	-65	I	-	-	-	-	-	-
432	BELEMNITELLA	G+A(XE)	-70	I	31.7 11.5	?0???	0?00 ?	?110 2	?N	?C
440	BELEMNITELLA	G+A(XE)	-70	I	25.6 12.0	?02340	NOUN N NE(NW	???	?N CE ?N	AN
2231	C ?NORVICENSIS(JUV) Pettitt	NC	-70	I	-	PUT	-	-	-	-
2212	CRET Sp	FRAG NC	-70	I	2.5 2.5	-	-	-	-	-
2230	CRET Sp	NC	-70	I	-	-	-	-	-	-
2487	CRET Sp	PS(CR)	-70	I	-	-	-	-	-	-
2171	ECHINOCORYS	FRAGS NC	-70	I	-	-	-	-	-	-
92	BELEMNITELLA	G	-75	I	37.0 12.5	?40300	0	?410 2	-	??
2225	CIDARID Sp	SPINE NC	-75	I	-	-	-	-	-	-
2202	CRET Sp	FRAGS NC	-75	I	-	-	-	-	-	-
2203	CRET Sp	FRAGS NC	-75	I	-	-	-	-	-	-
2220	CRET Sp	NC	-75	I	-	OIS	-	-	-	-
2236	CRET Sp	NC	-75	I	-	-	-	-	-	-
2213	INOCERAMID	FRAG NC	-75	I	-	-	-	-	-	-
64	P AMPULLACEA (Sowerby)	24 PCS	-75	I	-	-	-	-	-	-
410	?CRET	FRAGS	-80	I	-	-	-	-	-	-
50	BELEMNITELLA	G+A	-80	I	76.4 13.0	4503190	0015 6	0010 1	CA DG TA	AN
65	BELEMNITELLA	G+A(XE)	-80	I	47.0 13.5	502000	0	1000 1	-	AN
421	BELEMNITELLA	G(XE)	-80	I	25.5 12.1	1500200	0150 4	0	CA DG ?N	-
2232	?CRET Sp	NC	-85	I	-	-	-	-	-	-
52	BELEMNITELLA	G+A	-85	I	66.2 13.2	1002780	0003 ?	20?2 4	CA DG	BU CO MO SM??
55	BELEMNITELLA	G+A(XE)	-85	I	47.0 14.0	3021310	0	"	-	-
2187	BELEMNITELLA	NC	-85	I	-	402020	-	-	-	-
2191	CIDARID Sp	SPINE NC	-85	I	-	-	-	-	-	-
559	BELEMNITELLA	G	-90	I	33.2 13.1	1001060	NNNN N ALL	6022 4	?N TA	AN
560	BELEMNITELLA	G+A(XE)(2)	-90	I	60.0 13.7	2025?0	NNNN N SE(SW	2101 4	EN	AN CS PO ST
2175	C ?NORVICENSIS(JUV) Pettitt	NC	-90	I	-	OIS	-	-	-	-
2173	P VESICULARE (Lamarck)	FRAGS NC	-90	I	-	-	-	-	-	-
443	BELEMNITELLA	G+A	-95	I	65.9 14.2	600317U	0	0	-	-
2214	C ?NORVICENSIS(JUV) Pettitt	NC	-95	I	-	PVE	-	-	-	-
2486	C ?NORVICENSIS(JUV) Pettitt	CS	-95	I	10.6 9.8 6.2	PVG	-	-	-	-
2489	C ?NORVICENSIS(JUV) Pettitt	CS	-95	I	10.4 9.7 6.2	PUT	-	-	-	-
2198	SPONGES	sev sp NC	-95	I	-	-	-	-	-	-
67	BELEMNITELLA	G+A	-100	I	49.2 8.6	2522900	0	1091 2	-	BU ?GI
434	BELEMNITELLA	FRAG	-100	I	18.5 12.4	00224	1000 1	-	CA	-
563	BELEMNITELLA	G+A(XE)	-100	I	63.9 12.1	00011	NNNN N SW	0021 3	CA DG ?N	AN ??
??	C ?NORVICENSIS(JUV) Pettitt	CS	-100	I	10.7 10.0 6.2	PVG	-	-	-	-
415	C ?NORVICENSIS(JUV) Pettitt	CS	-100	I	10.3 10.2 6.2	OIS	-	-	-	-
2184	C ?NORVICENSIS(JUV) Pettitt	NC	-100	I	-	-	-	-	-	-
2226	C ?NORVICENSIS(JUV) Pettitt	NC	-100	I	-	PUT	-	-	-	-
2484	M SEXANGULAPIS (Munster)	FRAG	-100	I	-	-	-	-	-	-
84	C ?NORVICENSIS(JUV) Pettitt	PS	-103	I	10.1 10.2 4.3	-	-	-	-	-
558	BACULITID Sp	NC	-105	I	25 20 12	-	-	-	-	-
2221	CRET Sp	NC	-105	I	-	-	-	-	-	-
408	BELEMNITELLA	G+A(XE)	-110	I	24.4 7.3	3222700	0	0	-	-
557	BELEMNITELLA	G+A(XE)	-110	I	55.9 11.2	6000140	NNNN N ALL	0012 3	CA DG	AN ++ SP
2482	BELEMNITELLA	G+A(2)	-110	I	87.9 15.1	103500	-	0100 1	-	ww
76b	C ?NORVICENSIS(JUV) Pettitt	CS	-110	I	8.5 8.5 5.6	-	-	-	-	-
2491	C ?NORVICENSIS(JUV) Pettitt	CS	-110	I	9.4 9.3 5.9	OIS	-	-	-	-
2228	ECHINOCORYS	FRAGS(AN on test)	-110	I	-	-	-	-	-	-
2211	PENTADITRUPTA Sp	NC	-110	I	-	-	-	-	-	-
51	BELEMNITELLA	G(XE)	-115	I	31.0 13.0	2300940	0100 1	3010 1	EN	MS
63	BELEMNITELLA	G+A(XE)?JUV	-115	I	24.4 4.2	220600	1212 6	0	CA DG	-
2188	BELEMNITELLA	NC	-115	I	-	220700	-	-	-	-
61a	C ?NORVICENSIS(JUV) Pettitt	CS	-115	I	9.9 10.0 5.0	-	-	-	-	-
61b	C ?NORVICENSIS(JUV) Pettitt	CS	-115	I	7 0	-	-	-	-	-
5?	P SUBTORQUATA (Munster)	-	-115	I	0 1.5	-	-	-	-	-
431	BELEMNITELLA	A	-120	I	31.6 14.1	2700400	0100 1	2130 1	?N	?L
394	BRACHIOPOD	FRAGS	-120	I	-	-	-	-	-	-
423	C ?NORVICENSIS(JUV) Pettitt	CS	-120	I	11.0 11.0 6.2	-	-	-	-	-
2189	C ?NORVICENSIS(JUV) Pettitt	FRAG NC	-120	I	-	OIS	-	-	-	-
2199	C ?NORVICENSIS(JUV) Pettitt	NC	-120	I	-	PUT	-	-	-	-
75a	C ?NORVICENSIS(JUV) Pettitt	CS	-125	I	8.9 8.5 5.6	-	-	-	-	-
2177	C ?NORVICENSIS(JUV) Pettitt	NC	-125	I	-	PUT	-	-	-	-
391	BELEMNITELLA	G+A(XE)	-130	I	53.4 13.5	1901240	?	2200 ?	-	AP MS ST
411	BELEMNITELLA	G+A(XE)	-130	I	20.5 5.5	102??0	?	0	-	-
426	BELEMNITELLA	G+A	-130	I	36.0 6.9	2002560	0	?	-	-
2209	BELEMNITELLA	NC	-130	I	-	602520	-	-	-	-
398	C ?NORVICENSIS Pettitt	C(CRU)?JUV	-130	I	11.5 12.1 7.0	PUT	-	-	-	-
556a	C ?NORVICENSIS(JUV) Pettitt	CS(65)	-130	I	9.2 8.9 5.5	-	-	-	-	-
556b	C ?NORVICENSIS(JUV) Pettitt	CS(65)	-130	I	10.0 9.9 6.0	-	-	-	-	-
556c	C ?NORVICENSIS(JUV) Pettitt	CS(65)	-130	I	9.1 9.0 3.7	-	-	-	-	-
556d	C ?NORVICENSIS(JUV) Pettitt	CS(65)	-130	I	8.7 8.1 5.5	-	-	-	-	-
556e	C ?NORVICENSIS(JUV) Pettitt	CS(65)	-130	I	-	-	-	-	-	-
2192	C ?NORVICENSIS(JUV) Pettitt	NC	-130	I	-	PUT	-	-	-	-
66	BELEMNITELLA	G+A	-	I	73.2 14.1	2522250	?	2010 3	-	AN, MO ?SS
72	BELEMNITELLA	G+A(XE)	-	I	42.4 15.1	1232960	6017 14 NE(NW	0212 3	CA DG	BU CO MO
85	BELEMNITELLA	G+A	-	I	64.4 12.4	03045	0	0?1? ?	-	++ PO
576	BELEMNITELLA	G+A(XE)(WN)	-	I	61.0 13.0	3501430	0	0111 3	TA	AN ++
2261	C ?NORVICENSIS(JUV) Pettitt	NC	-	I	-	OIS	-	-	-	-
2264	C ?NORVICENSIS(JUV) Pettitt	NC	-	I	-	-	-	-	-	-
2234	CRET Sp	NC	-	I	-	-	-	-	-	-
2250	CRET Sp	FRAG NC	-	I	-	-	-	-	-	-
2251	CRET Sp	FRAGS NC	-	I	-	-	-	-	-	-
2263	INOCERAMID	FRAG NC	-	I	-	-	-	-	-	-
2504	M CHITONIFORMIS (Schlotheim)	CS ?spec var	-	I	8.2 7.7 5.0	-	-	-	-	-
565	BELEMNITELLA	G+A(XE)	-10	J	66.1 11.0	03282	0	1001 2	-	BU PS
567	BELEMNITELLA	G+A(XE)	-10	J	57.9 11.0	3421940	1111 4	3235 13	CA TA	AN BU ++
2492	C ?NORVICENSIS(JUV) Pettitt	CS(CR)	-10	J	9.9 11.3 4.7	PUG	-	-	-	-
428	S HYSTRIX d'Orbigny	INT MOULD	-10	J	0 0	-	-	-	-	-
2493	?M CRETOSA (Defrance)	FRAGS	-15	J	-	-	-	-	-	-
2480	CRET Sp	FRAG	-15	J	-	-	-	-	-	-
399	BELEMNITELLA	G+A	-20	J	69.0 12.2	5430000	1000 1	NNNN ALL	EN	AN AP DA DT ++ SA
2174	BELEMNITELLA	NC	-20	J	-	2802700	-	-	-	-
2181	BELEMNITELLA	NC	-20	J	-	431070	-	-	-	-
2179	ECHINOCORYS	FRAGS NC	-20	J	-	-	-	-	-	-
361	M CRETOSA (Defrance)	PS	-20	J	15 10	-	-	-	-	-
2100	SPONGE	NC	-20	J	-	-	-	-	-	-
384	BELEMNITELLA	G	-25	J	33.9 12.3	501250	-	-	-	LM MS NS
2172	BELEMNITELLA	NC	-25	J	-	2701?90	-	-	-	-
78	BELEMNITELLA	G	-20	J	40.2 14.7	2731240	0	0003 3	-	AN, NE NS
2186	C ?NORVICENSIS(JUV) Pettitt	NC	-30	J	-	OIS	-	-	-	-
2503	? RECURVASTER Sp	OSSCICLE	-40	J	-	-	-	-	-	-
54	BELEMNITELLA	G	-45	J	24.1 8.5	1100520	0	1102 4	-	AN,
2170	ECHINOCORYS	NC	-45	J	-	RWU	-	-	-	-
403	BELEMNITELLA	G+A(XE)(3P)	-	J	60.0 14.0	?01860	NNNN N ALL	1101 2	CA 10 EN	AN ++
2176	C ?NORVICENSIS(JUV) Pettitt	NC	-	J	-	OIS	-	-	-	-
447	ECHINOCORYS	PS	-	J	70 40	-	-	-	-	-
2662	M CHITONIFORMIS (Schlotheim)	NC	-	J	-	-	-	-	-	-
419	BELEMNITELLA	G+A(XE)(2)	-10	K	78 0 16.6	402830	0	0	-	-
404	BELEMNITELLA	G+A(XE)(3)	-20	K	43.3 7.0	302950	1011 3	0022 4	CA DG ?N	AN BU CO
414	BELEMNITELLA	G+A(XE)	-20	K	62.5 13.2	101200	0020 ?	0001 1	CA DG	CO
424	BELEMNITELLA	G+A	-20	K	87.2 16.3	102100	0	0001 1	-	++
370	BELEMNITELLA	G+A(XE)	-	K	58.3 10.9	603040	-	-	CA	AN MO NS
425	BELEMNITELLA	G+A	-	K	56.9 10.3	2002460	0	3001 4	-	AN BU
392	?CRET Sp	FRAGS	-5	L	-	-	-	-	-	-
396	BELEMNITELLA	G+A(XE)	-5	L	42.4 13.3	403100	0032 5	0001 1	EN	AN
71	C ?NORVICENSIS(JUV) Pettitt	CS	-5	L	8.9 8.6 6.0	PVE	-	-	-	-
358	C ?NORVICENSIS(JUV) Pettitt	CS(CRU)	-5	L	8.0 8.2 6.0	-	-	-	-	-
357	CRET Sp	PS	-12	L	8.7 9.2 6.4	-	-	-	-	-
369	BELEMNITELLA	G+A	-14	L	75.6 14.1	5000000	-	-	DG	MO
381	BELEMNITELLA	G+A(XE)	-14	L	60.6 13.7	2024?0	-	-	CA DG	-
427	BELEMNITELLA	G+A(XE)	-15	L	30.3 12.2	1302900	0	0002 2	-	++
433	BELEMNITELLA	G+A(XE)	-15	L	70.1 15.5	2001600	6755 21	3010 4	CA ?N TA	BU
380	BELEMNITELLA	G+A(XE)	-16	L	63.2 14.6	402600	-	-	CA DG	AN MO
395	BELEMNITELLA	G+A	-20	L	94.5 16.2	1300300	NNNN N ALL	6313 13	CA DG TA	AN MO ww
402	BELEMNITELLA	G+A(XE)	-20	L	54.2 14.1	4200950	N32N N NE(NW	2002 4	CA DG ?N	AN ww
406	BELEMNITELLA	G+A(XE)	-20	L	48.6 16.9	2002660	0	?4?1 13	-	AP CO CT DG MB MM MT NS DG?? OS OY SA SM
397	BELEMNITELLA	G+A(XE)(3)	-	L	72.5 12.3	500000	NNNN N ALL	2201 6	CA DG	AN AP BU
413	BELEMNITELLA	G(XE)	-	L	21.1 9.4	501300	2111 5	-	CA ?N	-
376	BELEMNITELLA	G(SM)	-8	M	43.6 10.2	6902080	-	-	TA	AN, CO
377	BELEMNITELLA	A(PART)	-8	M	25.6 13.2	5602150	-	-	CG ?A	-
350	SPONGE	FRAGS	-8	M	-	-	-	-	-	-
400	SPONGE	CONICAL	-30	M	30 12	-	-	-	-	-
74	BELEMNITELLA	G+A(XE)	-35	M	81.4 14.9	1?0?4?0	0?2? ?	0111 2	CA ?A	AF AF
385	BELEMNITELLA	G	-36	M	32.4 9.4	2?0?3?0	-	-	CE	AN
365	BELEMNITELLA	G+A(XE)	-41	M	52.4 15.4	1?02360	-	-	TA	AN
371	BELEMNITELLA	G	-10	N	79.2 14.1	1502510	-	-	??	AN AP BU DA GI MO ww
382	BELEMNITELLA	G	-15	N	57.3 11.4	5??0130	-	-	-	AF AN BU GI
359	C ?NORVICENSIS(JUV) Pettitt	CS(CRU)	-24	N	10.0 9.0 5.2	-	-	-	-	-

APPENDIX SIX

List of all fossils found in the former quarry at Eaton Tunnels (TG 20870 06350). Abbreviations as in appendices 3a and 3b.

NC	NAME	DES	POS	BE	DIM	ORI	EOR	EFI	EPI	EPO
2391	BELEMNITELLA	NC	-160	1	-	2902700	-	-	-	-
2411	C NORVICENSIS JUV Pettitt	NC	-160	1	-	-	-	-	-	-
2412	GLOMERULA Sp	FRAG NC	-160		-	-	-	-	-	-
2385	BELEMNITELLA	NC	-150	1	-	201560	-	-	-	-
2552	CRET Sp	FRAGS	-150	1	-	P E	-	-	-	-
2410	C NORVICENSIS(JUV) Pettitt	FRAG NC	-140	1	-	-	-	-	-	-
2469	SPONGE	NC	-140	1	-	-	-	-	-	-
2547	BELEMNITELLA	G+A(2)	-135	1	81.6 14.5	2501620	NNNN N ALL	8	CA DB	-
2555	C NORVICENSIS(JUV) Pettitt	CS	-135	1	6.7 6.4 5.0	013	-	-	-	-
2404	CIDARID Sp	SPINE NC	-135	1	-	-	-	-	-	-
2405	CRET Sp	FRAGS NC	-135	1	-	-	-	-	-	-
2561	ECHINOCORYS	FRAGS	-135	1	-	USC	-	-	EN PO	CO MO MS PO PV VP
2565	H SEMIPLANA (J. de C. Sowerby)	FRAG	-135	1	-	-	-	-	-	-
2496	BELEMNITELLA	NC	-130	1	-	1501680	-	-	-	-
2406	SPONGE	NC	-130	1	-	-	-	-	-	-
2413	ECHINOCORYS	FRAGS NC	-125	1	-	-	-	-	-	-
2414	CRET Sp	NC	-120	1	-	-	-	-	-	-
2546	P VESICULARE (Lamarck)	PS	-126	1	15.9 15.6 13.9	-	-	-	-	-
2407	BELEMNITELLA	NC	-115	1	-	432880	-	-	-	-
2387	BELEMNITELLA	NC	-110	1	-	2203540	-	-	-	-
2550	BELEMNITELLA	G+A	-110	1	78.2 16.4	1630050	NNNN N ALL	5812 6 31	CA DB ?N PO	by PV SA ww
2388	BELEMNITELLA	sp sp NC	-95	1	-	0030000	-	-	-	-
2417	C NORVICENSIS(JUV) Pettitt	NC	-90	1	-	PVT	-	-	-	-
2416	BELEMNITELLA	NC	-50	1	-	1630470	-	-	-	-
2415	P VESICULARE (Lamarck)	FRAG NC	-40	1	-	-	-	-	-	-
2389	BELEMNITELLA	NC	-35	1	-	1031860	-	-	-	-
2392	C NORVICENSIS Pettitt	in 4) NC	-	2	-	PVT	-	-	-	-
2568	ECHINOCORYS	FRAGS	-	2	-	USG	-	-	RO	AP SA ST
2558	INOCERAMID	FRAGS	-	2	10cm+	-	-	-	-	-
2559	INOCERAMID	FRAGS	-	2	10cm+	-	-	-	-	-
2554	BELEMNITELLA	G	-	2	49.6 10.0	632200	NNFN N NE(NW)	0013 4	CA DB RO	BU fr ww
2573	M MANTELLIANA (d'Orbigny)	FRAGS(bulk samp)	-65--75	2	-	-	-	-	-	-
2395	CRET Sp	juv NC	-205	2	-	-	-	-	-	-
2399	BELEMNITELLA	NC	-180	2	-	3031740	-	-	-	-
2393	BELEMNITELLA	NC	-170	2	-	1002400	-	-	-	-
2400	BELEMNITELLA	NC	-160	2	-	420750	-	-	-	-
2401	BELEMNITELLA	NC	-160	2	-	00028	-	-	-	-
2394	C NORVICENSIS(JUV) Pettitt	FRAG NC	-155	2	-	-	-	-	-	-
2398	BELEMNITELLA	NC	-135	2	-	302600	-	-	-	-
2551	BELEMNITELLA	G+A(XE)	-135	2	45.5 13.0	432840	000N N NW	9	CA DB	-
2396	BELEMNITELLA	A NC	-125	2	-	-	-	-	-	-
2552	M CHITONIFORMIS (Schlotheim)	CS(JUV)	-115	2	5.2 3.9 1.9	-	-	-	-	-
2553	BELEMNITELLA	G(2)	-110	2	33.0 13.7	2031210	NF0F N NE	0	CA DB ?N	-
2458	C NORVICENSIS(JUV) Pettitt	NC	-55	2	-	PVT	-	-	-	-
2397	BELEMNITELLA	NC	-40	2	-	2602160	-	-	-	-
2403	C NORVICENSIS(JUV) Pettitt	NC	-35	2	-	PVT	-	-	-	-
2390	BELEMNITELLA	NC	-30	2	-	1031920	-	-	-	-
2386	CRET Sp	PS NC	-15	2	-	-	-	-	-	-
2549	C NORVICENSIS(JUV) Pettitt	CS(CR)	-10	2	16.2 9.2 5.5	PVB	-	-	-	-
2402	BELEMNITELLA	NC	-5	2	-	2030500	-	-	-	-
2435	INOCERAMID	FRAG NC	-40	3	-	-	-	-	-	-
2452	C NORVICENSIS(JUV) Pettitt	in 4) NC	-	4	-	-	-	-	-	-
2420	BELEMNITELLA	NC	-95	4	-	3900000	-	-	-	-
2562	M CRETOSA (Defrance)	FRAGS	-70	4	-	-	-	-	-	-
2419	BELEMNITELLA	NC	-60	4	-	1031650	-	-	-	-
2568	P AMPULLACEA (Sowerby)	FRAG	-30	4	-	-	-	-	-	-
2421	BELEMNITELLA	NC	-25	4	-	00182	-	-	-	-
2454	C NORVICENSIS(JUV) Pettitt	NC	-25	4	-	PVT	-	-	-	-
2571	ECHINOCORYS	FRAGS	-25	4	-	-	-	-	-	PR ST
2455-7	ECHINOCORYS	FRAGS NC	-25	4	-	?USDOIS	-	-	-	-
2422	SPONGES	sev sp NC	-25--30	5	-	-	-	-	-	-
2576	BELEMNITELLA	NC	-140	5	-	1901230	-	-	-	-
2439	BELEMNITELLA	NC	-100	5	-	00154	-	-	-	-
2426	C NORVICENSIS(JUV) Pettitt	NC	-95	5	-	PVT	-	-	-	-
2433	C NORVICENSIS(JUV) Pettitt	PV NC	-95	5	-	-	-	-	-	-
2424	BELEMNITELLA	NC	-75	5	-	1221640	-	-	-	-
2564	BELEMNITELLA	G+G	-75	5	48.4 6.0	1000900	0	0035 8	-	AN) by MO ST
2453	SPONGE	NC	-75	5	-	-	-	-	-	-
2434	ECHINOCORYS	PS NC	-65	5	-	-	-	-	-	-
2423	BELEMNITELLA	NC	-60	5	-	1.30650	-	-	-	-
2429	C NORVICENSIS(JUV) Pettitt	NC	-60	5	-	PVT	-	-	-	-
2438	SPONGE	NC	-60	5	-	-	-	-	-	-
2548	BELEMNITELLA	G+A	-55	5	81.7 12.9	2700600	0110 2	0011 2	CL	CO MO
2431	C NORVICENSIS Pettitt	PS NC	-55	5	-	-	-	-	-	-
2436	?GLOMERULA Sp	NC	-35	5	-	-	-	-	-	-
2418	BELEMNITELLA	NC	-35	5	-	5002050	-	-	-	-
2557	BELEMNITELLA	(2)(U (NC) 2only)	-35	5	34.3 13.9	2201930	NP NN NP ALL	0010 1	CA DB EN ?N TA	GG
2560	EIN	FRAGS	-35	5	-	-	-	-	-	-
2451	SPONGE	NC	-30	5	-	-	-	-	-	-
2442-5	SPONGES	NC	-30	5	-	-	-	-	-	-
2567	BELEMNITELLA	G(XE)(T NG)	-25	5	-	-	-	-	-	-
2449-50	SPONGE	NC	-25	5	-	-	-	-	-	-
2425	SPONGES	NC	-25	5	-	-	-	-	-	-
2440-1	SPONGES	NC	-25	5	-	-	-	-	-	-
2563	C NORVICENSIS(JUV) Pettitt	CS	-20	5	10.0 9.4 6.9	013	-	-	-	-
2432	SPONGE	NC	-10	5	-	-	-	-	-	-
2437	SPONGE	NC	-140	6	-	-	-	-	-	-
2619	BELEMNITELLA	G+A(2)	-135	6	58.4 5.4	1532970	FFFF F ALL	0131 5	CA DB ?N TA	ANJ 61
2430	CRET Sp	NC	-135	6	-	PVG	-	-	-	-
2428	BELEMNITELLA	NC	-115	6	-	2131800	-	-	-	-
2427	BELEMNITELLA	NC	-90	6	-	1630540	-	-	-	-
2570	?ECHINOCORYS	FRAG	-40	6	-	-	-	-	-	-
2569	ECHINOCORYS	FRAGS	-20	6	-	-	-	-	-	AF by DS HE MO
2448	BELEMNITELLA	NC	-10	6	-	1030160	-	-	-	-
2446	BELEMNITELLA	FRAG NC	-	6	-	-	-	-	-	-
2447	BELEMNITELLA	NC	-60	6	-	00356	-	-	-	-

APPENDIX SEVEN

a) List of all fossils found in the former quarry at Harford Bridges (TG 21880 05670). Abbreviations as in appendices 3a and 3b.

NO	TAX	DES	POS	FE	DIM	OFI	BOF	EPI	E(D)	E(C)
[illegible]	BELEMNITELLA	G	-	.	46.7 16.8	1481012	6FFF F	1001 2	CA DE [illegible]	CO
2599	INOCERAMID	FRAG NC	-	.	-	-	-	-	-	-
2634-5	BELEMNITELLA	G(2SPP	-	.	56.8 9.5	4520760	NFFN N NE NW	2000 2	CA DB PO TA	BU MO
[illegible]	INOCERAMID	FRAG NC	-	.	-	-	-	-	-	-
[illegible]	INOCERAMID	FRAG NC	-		-	-	-	-	-	-
[illegible]	OSTREA Sp	FRAGS	-	1	-	015	-	-	-	[illegible]
[illegible]	OSTREA Sp	FRAGS	-130	1	-	-	-	-	-	BU CO
[illegible]	BELEMNITELLA	NC	-120	1	-	2033330	-	-	-	-
[illegible]	C ARCUATA Pettitt	CS?JUV	-110	1	7.9 7.0 4..	015	-	-	-	-
2594	M CRETOSA (Defrance)	FRAG NC	-119	1	-	-	-	-	-	-
2332	C CARNEA (J. Sowerby)	FRAG NC	-105	1	-	-	-	-	-	-
2596	BELEMNITELLA	NC	-100	1	-	5933490	-	-	-	-
2336	BELEMNITELLA	NC	-90	1	-	3820790	-	-	-	-
2541	?CRINOID	?COLUMNAL	-75	1	-	-	-	-	-	-
[illegible]	BELEMNITELLA	A	-75	1	28.9 12.4	481450	FFFF F	1011 3	CA DE TA	BU CO
[illegible]	C CARNEA (J. Sowerby)	PV NC	-75	1	-	-	-	-	-	-
2597	SPONGE	NC	-70	1	-	-	-	-	-	-
2327	ECHINOCORYS	FRAGS NC	-65	1	-	RWU	-	-	-	-
2325	BELEMNITELLA	NC	-60	1	-	430900	-	-	-	-
2340	C ARCUATA Pettitt	NC	-60	1	-	PVT	-	-	-	-
2329	BELEMNITELLA	NC	-55	1	-	631100	-	-	-	-
2339	BELEMNITELLA	NC	-55	1	-	3030220	-	-	-	-
2341	C CARNEA (J. Sowerby)	NC	-55	1	-	PVT	-	-	-	-
2543	C CARNEA (J. Sowerby)	PS	-55	1	18 16 10	PVT	-	-	-	-
2334	ECHINOCORYS	FRAG NC	-55	1	-	-	-	-	-	-
2620	INOCERAMID	FRAGS	-55	1	-	-	-	-	-	CO ?PO PR
2542	C CARNEA (J. Sowerby)	FRAG	-50	1	-	-	-	-	-	-
2328	SPONGES	NC	-50	1	-	-	-	-	-	-
2535	C NORVICENSIS Pettitt	CS?JUV	-45	1	13.2 15.1 9.5	PVT	-	-	-	AF BV
2593	INOCERAMID	FRAG NC	-45	1	-	-	-	-	-	-
[illegible]	C CARNEA (J. Sowerby)	NC	-40	1	-	PVB	-	-	-	-
2537	C CARNEA (J. Sowerby)	CS	-40	1	23.4 20.5 13.1	PVB	-	-	CA	CO BW
2326	ECHINOCORYS	FRAGS NC	-40	1	-	RWU	-	-	-	-
2641	BELEMNITELLA	NC	-35	1	-	5332980	-	-	-	-
2333	CRET Sp	FRAG NC	-35	1	-	-	-	-	-	-
2536	RECURVASTER Sp	OSSICLE	-35	1	-	-	-	-	-	-
2533	C ARCUATA Pettitt	CS	-25	1	16.8 10.7 7.1	PVT	-	-	-	AF
2539	CHOMATASTER Sp	OSSICLE	-20	1	-	-	-	-	-	-
2325	ECHINOCORYS	FRAGS NC	-20	1	-	-	-	-	-	-
2540	BELEMNITELLA	G(A 2)	-15	1	46.4 7.8	1630490	0	0	-	-
2595	P VESICULARE (Lamarck)	PS NC	-15	1	-	-	-	-	-	-
2534	C CARNEA (J. Sowerby)	PS	15	1	19.2 15.7 10.2	PVT	-	-	-	-
2330	BELEMNITELLA	NC	20	1	-	5311170	-	-	-	-

b) List of all fossils found in the former quarry at Frettenham (JSS Aggregates) (TG 23700 16700). Abbreviations as in appendices 3a and 3b.

NO	TAX	DES	POS	FE	DIM	OFI	BOF	EPI	E(D)	E(D)
2522	ECHINOCORYS	FRAGS	-	1	-	RWU	-	-	-	AN PV; ST
2519	P VESICULARE (Lamarck)	PS	-	1	-	-	-	-	-	CT MO NC PO PL
[illegible]	P VESICULARE (Lamarck)	PS	-	1	-	-	-	-	-	AN
2521	P VESICULARE (Lamarck)	PS	-	1	-	-	-	-	-	BV ID OS PO PV ST
2304	P VESICULARE (Lamarck)	NC	-15	1	-	-	-	-	-	-
2303	P VESICULARE (Lamarck)	NC	-10	1	-	-	-	-	-	-
2299	OSTREA Sp	FRAG NC	-5	.	-	-	-	-	-	-
2301	ECHINOID	FRAG NC	-	2	-	-	-	-	-	-
2513	M CHITONIFORMIS (Schlotheim)	CS	-	2	9.1 9.2 5.5	PVB	-	-	-	-
2308	P VESICULARE (Lamarck)	FRAG NC	-120	2	-	-	-	-	-	-
2314	INOCERAMID	FRAG NC	-110	2	-	-	-	-	-	-
2603	INOCERAMID	NC	-100	2	-	-	-	-	-	-
2514	BELEMNITELLA	G	-95	2	57.8 15.6	3531910	0	0	-	-
2664	P VESICULARE (Lamarck)	NC	-90	2	-	-	-	-	-	-
2515	BELEMNITELLA	G(A 2)	-85	2	84.6 14.9	2202670	0	0010 1	-	NE
2300	INOCERAMID	NC	-90	2	-	-	-	-	-	-
2665	P VESICULARE (Lamarck)	NC	-80	2	-	-	-	-	-	-
2516	BELEMNITELLA	G(A 2)	-75	2	45.5 8.3	301630	NFOF N NE	0	CA DB	-
2511	H SEMIPLANA (J. de C. Sowerby)	FRAGS	-75	2	-	-	-	-	-	VT
2293	BELEMNITELLA	NC	-70	2	-	3020970	-	-	-	-
2307	BELEMNITELLA	NC	-70	2	-	7532700	-	-	-	-
2506	H SEMIPLANA (J. de C. Sowerby)	FRAGS	-70	2	-	-	-	-	-	-
2507	M CHITONIFORMIS (Schlotheim)	CS	-70	2	7.2 6.8 4.1	PVB	-	-	-	-
2517	INOCERAMID	FRAGS	-55	2	15cm+	-	-	-	-	-
2316	P VESICULARE (Lamarck)	FRAGS NC	-55	2	-	-	-	-	-	-
2315	INOCERAMID	FRAGS NC	-45	2	10cm+	-	-	-	-	-
2294	P VESICULARE (Lamarck)	FRAG NC	-45	2	-	-	-	-	-	-
2297	SPONGE	NC	-45	2	-	-	-	-	-	-
2302	P VESICULARE (Lamarck)	NC	-35	2	-	-	-	-	-	-
2512	M CHITONIFORMIS (Schlotheim)	CS	-30	2	-	PVB	-	-	-	-
2310	BELEMNITELLA	NC	-35	2	-	180640	-	-	-	-
2305	CIDARID Sp	SPINE NC	-25	2	-	-	-	-	-	-
2510	P SUBTORQUATA (Munster)	FRAGS	-25	2	-	-	-	-	-	-
2312	P VESICULARE (Lamarck)	NC	-25	2	-	-	-	-	-	-
2518	P PENTANGULATA S. Woodward	CS(FB)	-20	2	5 6 2	PVT	-	-	-	-
2313	P VESICULARE (Lamarck)	FRAG NC	-20	2	-	-	-	-	-	-
2509	BELEMNITELLA	NC	-15	2	-	5432730	-	-	-	-
2311	P VESICULARE (Lamarck)	FRAG NC	-10	2	-	-	-	-	-	-
2306	BELEMNITELLA	NC	-5	2	-	3232290	-	-	-	-
2295	P VESICULARE (Lamarck)	NC	-5	2	-	-	-	-	-	-
2653	OSTREA Sp	FRAGS	-115	3	-	-	-	-	-	?CA ?NE
2654	ECHINOID	FRAGS	-50	3	-	-	-	-	-	-
2296	BELEMNITELLA	SM NC	-35	3	-	03165	-	-	-	-
2295	BELEMNITELLA	NC	-30	3	-	3041330	-	-	-	-

APPENDIX EIGHT

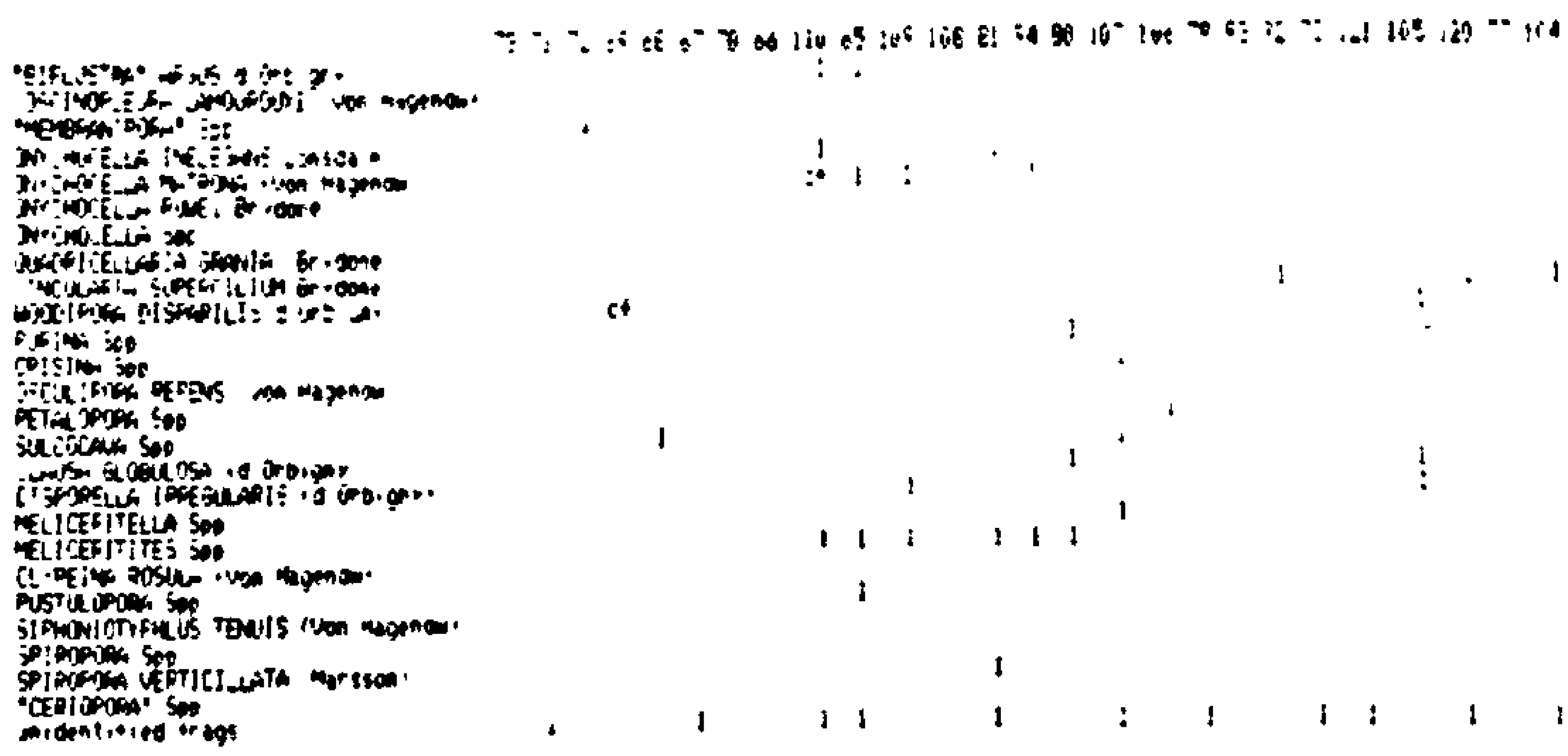
a) Occurrence of non-bryozoan faunal elements in the borehole samples obtained from Wymondham. Abbreviations: 1 = taxon present in that borehole sample; a/c = crinoid arm ossicles /columnals; aff = affinity to; cf = comparable with; w/wn = worn specimen; nuf = numerous fragments; g = gerontic specimen.

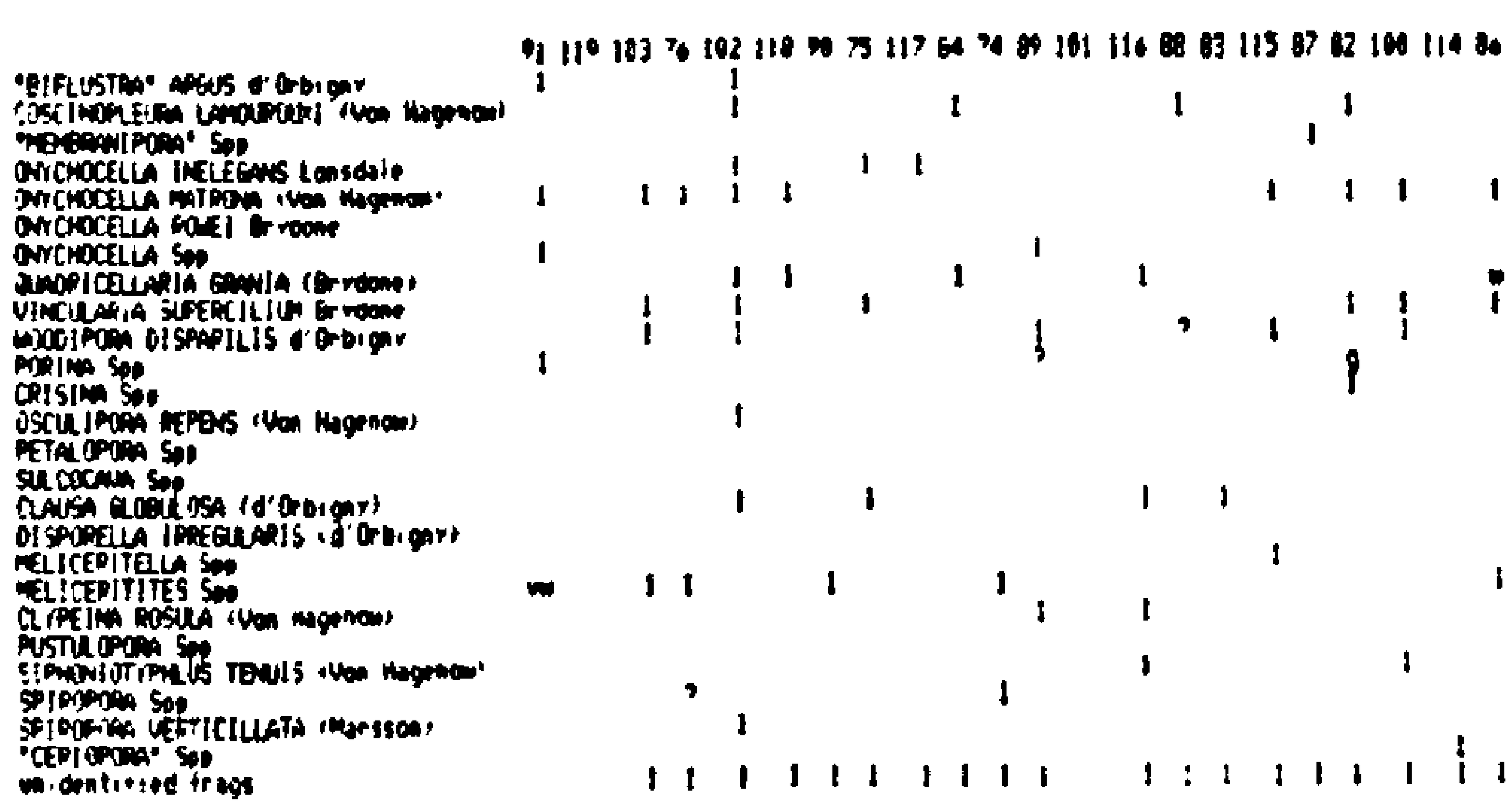
	73	71	72	69	66	67	70	68	110	65	109	108	61	94	80	107	106	79	95	92	78	121
CRETIRHYNCHIA Spp		1																			1	
KINGENA PENTANGULATA S. Woodward		1															1					
TEREBRATULINA Spp				1																		
INOCERAMID Spp	nu*		1	1						1	1											
MIMACHLAMYS CRETOSA (Defrance)			1						1													
NEITHEA SEXCOSTATA (S Woodward)												1										
OSTREA Spp	1	1							1	?								1				
SPONDYLUS Sp																						
SPONDYLUS SPINOSUS (J. Sowerby)									1													
Biv/brach frags		1				1				1	1		1			1			1		1	
FILOGRANULA CINCTA (Goldfuss)																						
GLOMERULA GORDIALIS (Schlotheim)																						
G (var ILIUM) (Goldfuss)																	1			1		
HAMULUS SEXANGULARIS (Munster)									1													
NEOMICRORBIS CRENATOSTRIATUS (Munster)																						
PENTADITRUPA SUBTORQUATA (Munster)			1	1							1		1	1		1		1				
VERMILIOPSIS FLUCTUATA (Sowerby)																						
unid worm tube rems	1					1								1								
POROSPHAERA (fusiform)								1		1				1				1	1			
POROSPHAERA GLOBULARIS (Phillips)				1				1			1			1		1	1		1			
POROSPHAERA SESSILIS Brydone				1						1	1		1	1			1	1				
BOURGUETICRINUS Spp	a	c	ca			ca				c	c		c	c	c	c		c			c	
ASTROPECTEN Spp				?																		
ASTROPECTENIDAE																						
CHOMATASTER Spp									?													
NYMPHASTER Spp																						
OPHRYASTER Spp											?						?					
RECURVASTER Spp																			?			
TEICHASTER Spp													?									
unidentified asteroid frags	1		1	1				1						1		1	1		1	1	1	
CIDARID SPINE BOSSES		1													1							
CIDARID SPINES FORM A													1				1					
CIDARID SPINES FORM B										1					1				1			
CIDARID SPINES FORM C			1												1	1				1	1	
CIDARID SPINES FORM E									1													
ECHINOCORYS	1			1	1	1		1					1		1		1				1	
Echinoid																						
HAGENOWIA Spp																		1				
OPHIOMUSIUM GRANULOSUM (Roemer)															aff						1	aff
OPHIURA HAGENOWI Rasmussen					aff																	
OPHIURA Spp	1			1		1			1	1								?				
CRETISCALPELLUM Spp			1																			
SCALPELLUM Spp																			?			
aseptate corals			1								1		1						1			
DENTALINA Spp																						
FRONDICULARIA Spp			1													?	?					
GAVELINELLA Spp	1	1	1					1		1						1	1		1	1	1	
GLOBIGERINELLOIDINAE																						1
OSTRACODS								1	1				1			1						1
unidentified frags	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

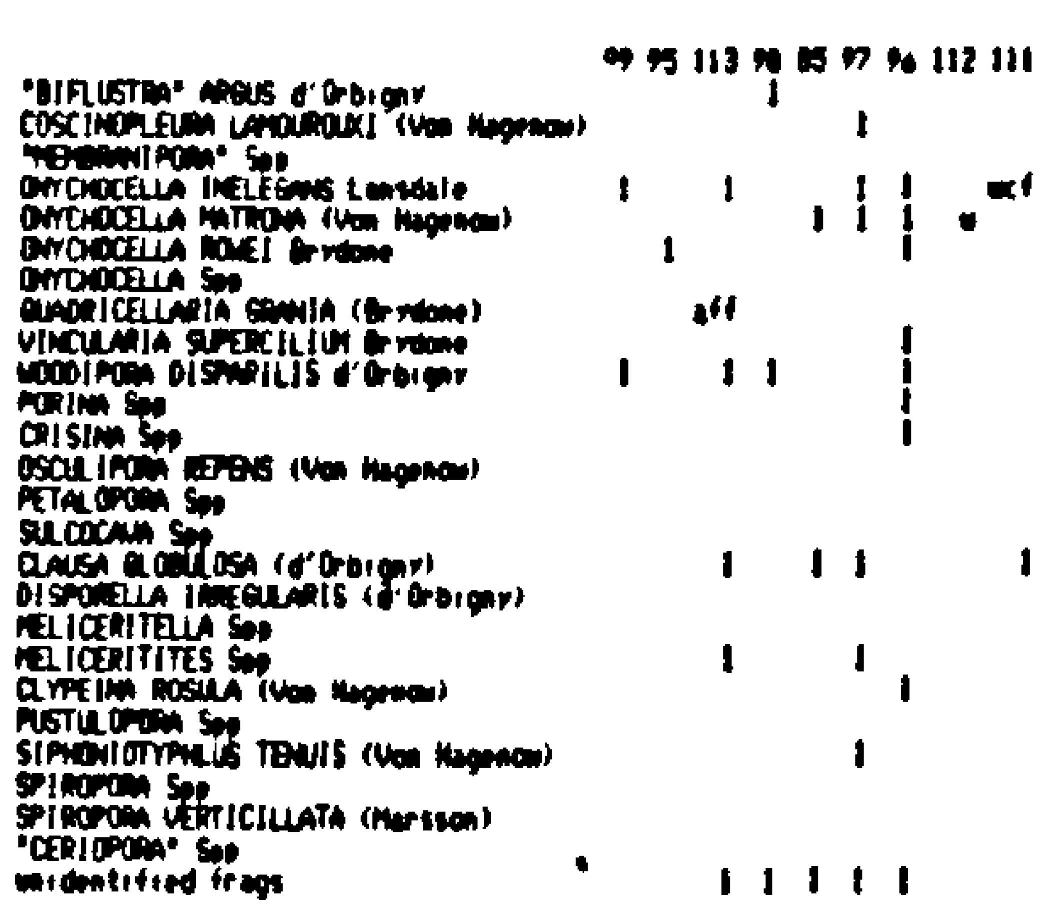
	105	120	77	104	91	119	103	76	102	118	90	75	117	84	74	89	101	116	88	83	115
CRETIRHYNCHIA Spp													1								
KINGENA PENTANGULATA S. Woodward																					
TEREBRATULINA Spp				1									1	1				1	1		1
INOCERAMID Spp					1	1					1				1						1
MIMACHLAMYS CRETOSA (Defrance)																					
NEITHEA SEXCOSTATA (S Woodward)														1							
OSTREA Spp									?			1	1				1				
SPONDYLUS Sp						?						?								?	
SPONDYLUS SPINOSUS (J. Sowerby)																					
Biv/brach frags			1	1			1					1	1			1				1	
FILOGRANULA CINCTA (Goldfuss)																		1			
GLOMERULA GORDIALIS (Schlotheim)	1									1			1								
G (var ILIUM) (Goldfuss)		1		1	1		1	1			1		1	1		1	1	1	1		
HAMULUS SEXANGULARIS (Munster)																					
NEOMICRORBIS CRENATOSTRIATUS (Munster)																					
PENTADITRUPA SUBTORQUATA (Munster)																					
VERMILIOPSIS FLUCTUATA (Sowerby)																					
unid worm tube rems		1										1									
POROSPHAERA (fusiform)				1			1		1				1	1					1		
POROSPHAERA GLOBULARIS (Phillips)						1	1		1	1										1	
POROSPHAERA SESSILIS Brydone							1		1	1	1										
BOURGUETICRINUS Spp	c	c		c					c		c				c						
ASTROPECTEN Spp	1																				
ASTROPECTENIDAE														?							
CHOMATASTER Spp																					
NYMPHASTER Spp					?														1		
OPHRYASTER Spp													?								
RECURVASTER Spp																					
TEICHASTER Spp																					
unidentified asteroid frags	1	1	1		1	1			1	1	1		1		1		1	1		1	1
CIDARID SPINE BOSSES				1			1					1						1			
CIDARID SPINES FORM A										1								1			
CIDARID SPINES FORM B						1		1					1								
CIDARID SPINES FORM C	1		1	1	1		1					1		1	1				1	1	1
CIDARID SPINES FORM E				1																	
ECHINOCORYS	w				1	1		1	1	1			1		1	1		1	1	1	1
Echinoid				1			1				1						nuf				
HAGENOWIA Spp																					
OPHIOMUSIUM GRANULOSUM (Roemer)							aff	1	1												
OPHIURA HAGENOWI Rasmussen																					
OPHIURA Spp		1	wn		1		1		1			1			1				1	1	
CRETISCALPELLUM Spp				1																	
SCALPELLUM Spp												1									
aseptate corals		1					1		1												
DENTALINA Spp																					
FRONDICULARIA Spp		?												?				?			?
GAVELINELLA Spp		1	1	1		1	1		1	1	1		1	1	1		1	1	1	1	
GLOBIGERINELLOIDINAE		1	1							1						1					
OSTRACODS									1												1
unidentified frags	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

	87	32	100	114	66	90	95	113	96	85	97	92	112	111
CRETIRHYNCHIA Spp											1			
KINGENA PENTANGULATA S. Woodward														
TEREBRATULINA Spp			1					1		1	1			
INOCERAMID Spp											1	1		
MIMACHLAMYS CRETOSA (Defrance)												1		
NEITHEA SEXCOSTATA (S Woodward)												1		
OSTREA Spp	?		1	1		1								
SPONDYLUS Sp	1											1	?	
SPONDYLUS SPINOSUS (J. Sowerby)														
Biv/brach frags	1		1				1	1	1	1				
FILOGRANULA CINCTA (Goldfuss)														
GLOMERULA GORDIALIS (Schlotheim)		1							1					1
G Gvar ILIUM (Goldfuss)	1	1	1	1	1	1			1		1		1	1
HAMULUS SEXANGULARIS (Munster)														
NEOMICRORBIS CRENATOSTRIATUS (Munster)		1												
PENTADITRUPA SUBTORQUATA (Munster)														
VERMILIOPSIS FLUCTUATA (Sowerby)											1			
unid worm tube rems			1											1
POROSPHAERA (fusiform)	1	1	1	1					1	1	1	1		
POROSPHAERA GLOBULARIS (Phillips)		1	1				1	1	1	1	1	1		
POROSPHAERA SESSILIS Brydone	1	1							1		1			
BOURGUETICRINUS Spp	c			ca	c	c			c	c	c	c		
ASTROPECTEN Spp							1			1				1
ASTROPECTENIDAE														
CHOMATASTER Spp												?		
NYMPHASTER Spp			1											
OPHRYASTER Spp														
RECURVASTER Spp		1												
TEICHASTER Spp		?			1				un					
unidentified asteroid frags		1	1	1	1		1	1	1		1		1	1
CIDARID SPINE BOSSES														
CIDARID SPINES FORM A	1													
CIDARID SPINES FORM B				1				1						
CIDARID SPINES FORM C									1	1		1		
CIDARID SPINES FORM E														
ECHINOCORYS		1	1		1			1	1		1	1		1
Echinoid	1													
HAGENOWIA Spp														
OPHIOMUSIUM GRANULOSUM (Roemer)														
OPHIURA HAGENOWI Rasmussen												1		
OPHIURA Spp					1		?	??				?		
CRETISCALPELLUM Spp														
SCALPELLUM Spp											1			
aseptate corals	1	1	1											
DENTALINA Spp		1	1											
FRONDICULARIA Spp		?								?				?
GAVELINELLA Spp	1		1	1	1		1		1	1	1		1	1
GLOBIGERINELLOIDINAE		1												1
OSTRACODS		1	1	1			1							
unidentified frags	1	1	1	1	1	1	1	1	1	1	1	1	1	1

b) Occurrence of bryozoan remains in the borehole samples obtained from Wymondham. Abbreviations as in appendix 8a.







APPENDIX NINE

Occurrence of non-bryozoan faunal elements and bryozoan remains in the bulk samples collected from miscellaneous localities. Abbreviations as in appendices 2 and 8a.

	WLS	WLS	WLS	WLS	WLS	WLS	GU	SP	SP	STF	STF	MF	SPF	TH	CLU	EAU	EAN	FNF	FNF	FNF
	247	244	243	245	246	242	235	229	228	248	249	236	233	237	230	36	37	33	35	32
BELEMNITELLA														I						
ARGYROTHECA Spp																	?			
CARNEITHYRIS CARNEA (J. Sowerby)																				
CRETIRHYNCHIA Spp							I							I	I				I	I
ISOCRANIA COSTATA (Sowerby)							I						I	I	?	I		I		I
ISOCRANIA EGGENBERGENSIS (Retzius)										I										
ISOCRANIA PAUCICOSTATA (Bosquet)																				
KINGENA PENTANGULATA S. Woodward					I	I														I
MAGAS CHITONIFORMIS (Schlotheim)													I							
NEOLITHYRINA OBESA Sahni																				
ORBIRHYNCHIA Spp																				
TEREBRATULINA Spp	I	I	I	I	I	I		I		I		I				I			I	I
ACUTOSTREA cf INCURVA Nilsson																				
GYROPLEURA INEQUIROSTRATA (S. Woodward)																				
INOCERAMID Spp	I	I	I	I	nuf	I	I	nuf	I				nuf		I		I			
LYROPECTEN CAMPANIENSIS (d'Orbigny)																				
LYROPECTEN Spp											I									
MIMACHLAMYS CRETOSA (Defrance)																				
MIMACHLAMYS MANTELLIANA (d'Orbigny)																				
NEITHEA SEXCOSTATA (S. Woodward)			I													I				
NEITHEA STRIATOCOSTATUS Goldfuss																				
OSTREA Spp	I	I	I			I	I	I	I				I			I	I	?		I
PLAGIOSTOMA CRETACEUM Woods																				
PSEUDOLIMEA GRANULATA (Nilsson)																		I		
PYCNODONTE VESICULARE (Lamarck)																			I	
SPONDYLUS DUTEMPLEANUS d'Orbigny									?				I							
SPONDYLUS SPINOSUS (J. Sowerby)													I							
SPONDYLUS Spp																				
Bivalve/brach frags										I										
EOPLACOSTEGUS PUSILLUS (Sowerby)														cf						
FILOGRANULA CINCTA (Goldfuss)			I																	
GLOMERULA GORDIALIS (Schlotheim)												I				I		I	I	I
& G var ILIUM (Goldfuss)											I	I	I			I			I	I
HAMULUS SEXANGULARIS (Munster)																I	●	I		
NEOMICRORBIS CRENATOSTRIATUS (Munster)					I								I							I
NEOMICRORBIS SUBRUGOSUS (Munster)			I		I														I	I
ORTHOCONORCA TUBINELLA (Sowerby)										I										
PENTADITRUPA SUBTORQUATA (Munster)												I		I	I	I			I	I
PROLISERPULA AMPULLACEA (Sowerby)																				I
SCLEROSTYLA SERPENTARIA Regenhardt																		I		
VERMILIOPSIS FLUCTUATA (Sowerby)																				
void worm tube rems																				
Lithistid sponge																				
POROSPHAERA (fusiform)				I		I	I		I	I	I		I							
POROSPHAERA GLOBULARIS (Phillips)		I				I	I	I	I	I	I	I		I	I	I		I		I
POROSPHAERA SESSILIS Brydone			I				I	I		I	I	I			I	I	I		I	I
AUSTINOCRINUS BICORONATUS (Hagenow)																				
BOURGUETICRINUS BRYDONEI Rasmussen																				
BOURGUETICRINUS Spp	c		c	a	a	ca				c		c	c		c					
ASTROPECTEN Spp	?												I				I		I	I
ASTROPECTENIDAE																				
CHOMATASTER Spp						?		?												
METOPASTER Spp					I					I						I		cf		cf
NYMPHASTER Spp												?							?	
NYMPHASTER STUDLANDENSIS Schultz																				?
OPHRYASTER Spp																				
PYCINASTER Spp	?		?	I							?		I							
RECURVASTER Spp															I		?	?		
TEICHASTER Spp												I								
unidentified asteroid ossicles	I	I								I	I	I	I	I	I					
CIDARID SPINE BOSSES																I			I	I
CIDARID SPINES FORM A			I						I	I	I					I		I		I
CIDARID SPINES FORM B						I		I			I	I								
CIDARID SPINES FORM C		I		I		I	I					I	I	I	I	I			I	I
CIDARID SPINES FORM D										I								I		
CIDARID SPINES FORM E			I	I										I	I					
CIDARID TEST FRAGS		.																		
ECHINOCORYS				I			I	I	I		I	I	I	I	nuf					I
Echinoids																				
OPHIOMUSIUM GRANULOSUM (Roemer)		I				I		I	I		?		I						?	
OPHIOMUSIUM Spp																				
OPHIURA HAGENOWI Rasmussen	I	cf						cf	I				I						I	I
OPHIURA Spp			I				?													
OPHIURA SUBSTRIATA Rasmussen																				
BRACHYLEPAS FALLAX (Darwin)					I															
BRACHYLEPAS NAISSANTI (Hebert)																				
CRETISCALPELLUM PAUCISTRIATUM (H.Woodward)																				
CRETISCALPELLUM Spp										I										
PROVERRUCA LAURAE Withers																				
SCALPELLUM FOSSULA (Darwin)												I								
SCALPELLUM Spp	?															I				
aseptate corals					I			I			I									
COELOSMILIA GRANULATA Duncan					I															
COELOSMILIA Spp																				
DENTALINA Spp						I				I	I		I				I		I	
DENTALINOIDES Spp					I															
FRONDICULARIA Spp						?					?									
GAVELINELLA Spp	I	I				I			I	I	I		I	I	I	I	I	I	I	I
GLOBIGERINELLOIDINAE					I	I		I				I								
MOLTKIA Spp												I						I		I
NODOSARIA Spp																				
OSTRACODS			I			I		I	I	I	I	I						I	I	
STEPHANOPHYLLIA CLATHRATA (Von Hagenow)										I								I	I	
TENTIFRONS Spp		?								I										
unidentified frags	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
VAGINULINA Spp			I		I	I											I			

	WLS	WLS	WLS	WLS	WLS	WLS	GU	SP	SP	STF	STF	MF	SPF	TH	CLU	EAU	EAN	FNF	FNF	FNF	FF
	247	244	243	245	246	242	235	229	228	248	249	236	233	237	230	36	37	33	35	32	34
"BIFLUSTRA" ARGUS d'Orbigny		I	I		I	I				I	I		I	I					I		
COSCINOPLEURA LAMOUROUXI (Von Hagenow)	I										I	I	I								
ESCHARIFORA Spp																					
LATEPESCHARA GALEATA (Von Hagenow)																	I	I	I		
LUNULITES Spp												I		I		I	I				
"M" seafordensis group Brydone																					
"M" sevingtonensis group Brydone																			I		
"MEMBRANIPORA" FLABELLIFORMIS (d'Orbigny)													I					I	I	I	I
"MEMBRANIPORA" Spp			I	I						I											
"MEMBRANIPORA" VERTEBRALIS Brydone																					
ONYCHOCELLA INELEGANS Lonsdale	I					I			I	I	I		I				I	I	I		
ONYCHOCELLA MATRONA (Von Hagenow)										I		I	I		I	I		I	I	I	I
ONYCHOCELLA NYSTI (Von Hagenow)														aff			I	I	I		
ONYCHOCELLA ROWEI Brydone		cf			I	cf					cf									I	
ONYCHOCELLA Spp		I	I																		
QUADRICELLARIA GRANIA (Brydone)						I							I				I				
VINCULARIA HECAMEDE Brydone													aff								
VINCULARIA SUPERCILIUM Brydone											I										
VOLVIFLUSTRELLARIA TAVERENSIS Brydone																I	I				
WOODIPORA DISPARILIS d'Orbigny	I	I			I	I				I	I	I	I		I	I	I	I	I	I	
BERENICEA Spp					I																
BEISSELINA Spp																.					
PORINA GOLDFUSSI Brydone																		I		I	I
PORINA SOCIA Brydone																					
PORINA Spp			?								?		I								
BICAVEA Spp																	I				
CRISINA Spp	I	I							I												
EOMORNERA LANGETHALI (Von Hagenow)																			I	I	I
HOMOEOSOLEN Spp																	I				
PETALOPORA Spp																			I		I
SPARSICAVEA Spp					I									I			I		I		
SULCOCAVA Spp													I						I	I	I
CLAUSA GLOBULOSA d'Orbigny																	I				
DISPORELLA IRREGULARIS (d'Orbigny)				I	I					I		I	I	I			I				
MELICERITELLA Spp		I	I				I					?									
MELICERITITES GOTHICA Levinsen																I	I		I	I	
MELICERITITES Spp	I		I	I	I	I	I	I			I		I				I				
CLINOPORA LINEATA Beissel	I	I				I			I	I			I		I				I		
CLINOPORA Spp	I	I																			
CLYPEINA POSULA (Von Hagenow)																I		I		I	I
CRISISINA CARINATA (Roemer)																					
DIASTOPORA Spp																					
ENTALOPHORA Spp											:										
IDMIDRONEA Spp																					
PUSTULPORA BENEDIANA (Von Hagenow)																			I	I	
PUSTULOPORA Spp										I		I	I		I			I			
SIPHONIOTYPHLUS TENUIS (Von Hagenow)	I	I	I		I						I										
SPIROPORA Spp																					
SPIROPORA VERTICILLATA (Marsson)		I								I											
"CERIOPORA" Spp													I							I	
unidentified frags	I	I		I	I		I		I	I	I	I	I	I	I		I		I		

NFF WHE WHE ET KS WH ET WH ET ET WH KS KS ET ET WH WHWBR WHE WHE CS CSCBRCBRCBR CS CS CS FR FR FR FR SJH WIT WIT

34 240 241 27 7 18 29 11 64 30 12 6 9 31 28 13 14 24 231 232 1 2 41 40 42 3 4 5 39 38 26 25 234 239 238

BELEMNITELLA
ARGYROTHECA Spp
CARNEITHYRIS CARNEA (J. Sowerby)
CRETIRHYNCHIA Spp
ISOCRANIA COSTATA (Sowerby)
ISOCRANIA EGNABERGENSIS (Retzius)
ISOCRANIA PAUCICOSTATA (Bosquet)
KINGENA PENTANGULATA S. Woodward
MAGAS CHITONIFORMIS (Schlotheim)
NEOLITHYRINA OBESA Sahni
ORBIRHYNCHIA Spp
TEREBRATULINA Spp
ACUTOSTREA cf INCURVA Nilsson
GYROPLEURA INEQUIROSTRATA (S. Woodward
INOCERAMID Spp
LYROPECTEN CAMPANIENSIS (d'Orbigny
LYROPECTEN Spp
MIMACHLAMYS CRETOSA (Defrance)
MIMACHLAMYS MANTELLIANA (d'Orbigny)
NEITHEA SEXCOSTATA (S. Woodward
NEITHEA STRIATOCOSTATUS Goldfuss
OSTREA Spp
PLAGIOSTOMA CRETACEUM Woods
PSEUDOLIMEA GRANULATA (Nilsson)
PYCNODONTE VESICULARE (Lamarck)
SPONDYLUS DUTEMPLEANUS d Orbigny
SPONDYLUS SPINOSUS (J. Sowerby)
SPONDYLUS Spp
Bivalve/brach frags
EOPLACOSTEGUS PUSILLUS (Sowerby)
FILOGRANULA CINCTA (Goldfuss)
GLOMERULA GORDIALIS (Schlotheim)
G (var ILIUM) (Goldfuss)
MANULUS SEXANGULARIS (Munster)
NEOMICRORBIS CRENATOSTRIATUS (Munster)
NEOMICRORBIS SUBRUGOSUS (Munster)
ORTHOCONORCA TUBINELLA (Sowerby)
PENTADITRUPA SUBTORQUATA (Munster)
PROLISERPULA AMPULLACEA (Sowerby)
SCLEROSTYLA SERPENTARIA Regenhardt
VERMILIOPSIS FLUCTUATA (Sowerby)
unid worm tube rems
Lithistid sponge
POROSPHAERA (fusiform)
POROSPHAERA GLOBULARIS (Phillips)
POROSPHAERA SESSILIS Brydone
AUSTINOCRINUS BICORONATUS (Hagenow)
BOURGUETICRINUS BRYDONEI Rasmussen
BOURGUETICRINUS Spp
ASTROPECTEN Spp
ASTROPECTENIDAE
CHOMATASTER Spp
METOPASTER Spp
NYMPHASTER Spp
NYMPHASTER STUDLANDENSIS Schultz
OPHRYASTER Spp
PYCINASTER Spp
RECURVASTER Spp
TEICHASTER Spp
unidentified asteroid ossicles
CIDARID SPINE BOSSES
CIDARID SPINES FORM A
CIDARID SPINES FORM B
CIDARID SPINES FORM C
CIDARID SPINES FORM D
CIDARID SPINES FORM E
CIDARID TEST FRAGS
ECHINOCORYS
Echinoids
OPHIOMUSIUM GRANULOSUM (Roemer)
OPHIOMUSIUM Spp
OPHIURA HAGENOWI Rasmussen
OPHIURA Spp
OPHIURA SUBSTRIATA Rasmussen
BRACHYLEPAS FALLAX (Darwin)
BRACHYLEPAS NAISSANTI (Hebert)
CRETISCALPELLUM PAUCISTRIATUM (H.Woodward)
CRETISCALPELLUM Spp
PROVERRUCA LAURAE Withers
SCALPELLUM FOSSULA (Darwin)
SCALPELLUM Spp
aseptate corals
COELOSMILIA GRANULATA Duncan
COELOSMILIA Spp
DENTALINA Spp
DENTALINOIDES Spp
FRONDICULARIA Spp
GAVELINELLA Spp
GLOBIGERINELLOIDINAE
MOLTKIA Spp
NODOSARIA Spp
OSTRACODS
STEPHANOPHYLLIA CLATHRATA (Von Hagenow)
TENTIFRONS Spp
unidentified frags
VAGINULINA Spp

WHP WHE ET KS WH ET WH ET ET WH KS KS ET ET WH WHWBR WHE WHE CS CSCBRCBRCBR CS CS CS FR FR FR FR SJH WIT WIT

240 241 27 7 18 29 11 64 30 12 6 9 31 28 13 14 24 231 232 1 2 41 40 42 3 4 5 39 38 26 25 234 239 238

"BIFLUSTRA" ARGUS d Orbigny
COSCINOPLEURA LAMOUROUXI (Von Hagenow)
ESCHARIFORA Spp
LATEREESCHARA GALEATA Von Hagenow
LUNULITES Spp
"M" seaterdensis group Brydone
"M" sevingtonensis group Brydone
"MEMBRANIPORA" FLABELLIFORMIS (d Orbigny)
"MEMBRANIPORA" Spp
"MEMBRANIPORA" VERTEBRALIS Brydone
ONYCHOCELLA INELEGANS Lonsdale
ONYCHOCELLA MATRONA (Von Hagenow)
ONYCHOCELLA NYSTI (Von Hagenow)
ONYCHOCELLA POWEI Brydone
ONYCHOCELLA Spp
QUADRICELLARIA GRANIA (Brydone)
VINCULARIA MELAMEDE Brydone
VINCULARIA SUPERCILIUM Brydone
VOLVIFLUSTRELLARIA TAVERENSIS Brydone
WOODIPORA DISPARILIS d Orbigny
BERENICEA Spp
BEISSELINA Spp
PORINA GOLDFUSSI Brydone
PORINA SOCIA Brydone
PORINA Spp
BICAVEA Spp
CRISINA Spp
EOHORNERA LANGETHALI (Von Hagenow)
HOMOEOSOLEN Spp
PETALOPORA Spp
SPARSICAVEA Spp
SULCOCAVA Spp
CLAUSA GLOBULOSA d Orbigny
DISPORELLA IRREGULARIS (d Orbigny)
MELICERITELLA Spp
MELICERITITES GOTHICA Levinsen
MELICERITITES Spp
CLINOPORA LINEATA Beissel
CLINOPORA Spp
CLYPEINA ROSULA (Von Hagenow)
CRISISINA CARINATA (Roemer)
DIASTOPORA Spp
ENTALOPHORA Spp
IDMIDRONEA Spp
PUSTULPORA BENEDIANA (Von Hagenow)
PUSTULOPORA Spp
SIPHONIOTYPHLUS TENUIS (Von Hagenow)
SPIROPORA Spp
SPIROPORA VERTICILLATA (Harrison)
"CERIOPORA" Spp
unidentified frags

APPENDIX TEN

Occurrence of non-bryozoan faunal elements and bryozoan remains in the borehole chalk samples collected from Norwich. Abbreviations as in appendix 8a.

Taxon	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159
BELEMNITELLA	1			1	1		1	1							[illegible]			1		
ACISTOFANIA PARISIENS (Defrance)																				
CARNEITHYRIS CARNEA (J. Sowerby)							1													
CRETIRHYNCHIA Spp	1		1	1		1		1	1		1	1		1			1		1	1
ISOCRANIA COSTATA (Sowerby)																				
ISOCRANIA EGNABERGENSIS (Retzius)																				
KINGENA PENTANGULATA (S. Woodward)								1			1		1	1					1	1
MAGAS CHITONIFORMIS (Schlotheim)	1	1																		
NEOLIOTHYRINA Spp																				
TEREBRATULINA Spp		1		1				1		1	1	1								1
ATRETA NILSSONI (Hagenow)																				
GYROPLEURA INEQUIROSTRATA (S. Woodward)	1																			
HYOTISSA SEMIPLANA (J. de C. Sowerby)																				
INOCERAMID Spp		1	1	1	1	1	1	1	1	1	1								1	
LYROPECTEN SARUMENSIS (Woods)	1																			
MIMACHLAMYS CRETOSA (Defrance)																			1	
NEITHEA SEXCOSTATA (S. Woodward)		1	1	1	1					1										
OSTREA Spp	1	1	1		1					1		1		1	1					
PLAGIOSTOMA CRETACEUM Woods																				
PLAGIOSTOMA MARROTIANA d'Orbigny																				
PSEUDOLIMEA GRANULATA (Nilsson)	1	?	1		1	1	1					1		1						
SPONDYLUS DUTEMPLEANUS d'Orbigny	?													?						
SPONDYLUS SPINOSUS (J. Sowerby)	1																			
SPONDYLUS Spp			1																	
Biv/brach frags																				
EOPLACOSTEGUS PUSILLUS (Sowerby)				1	1					1		1				1		1		
GLOMERULA GORDIALIS (Schlotheim)			1	1	1	1			1		1	1	1	1		?	1	1		1
G G var ILIUM (Goldfuss)				1						1										
HAMULUS SEXANGULARIS (Munster)																				
NEOMICRORBIS CRENATOSTRIATUS (Munster)		1	1		1									1						
NEOMICRORBIS SUBRUGOSUS (Munster)																				
PENTACITRUPA SUBTORQUATA (Munster)				1	1	1	1			1	■									
PROLISERPULA AMPULLACEA (Sowerby)					1															
VERMILIOPSIS FLUCTUATA (Sowerby)																				
unident worm tube frags								1												
POROSPHAERA (fusiform)		1																		
POROSPHAERA GLOBULARIS (Phillips)		1	1								1		1					1	1	
POROSPHAERA SESSILIS Brydone											1			1						1
POROSPHAERA Spp																				
BOURGUETICRINUS Spp		ca	c	ca	ca							ca			c		cw	a	a	
NIELSENICRINUS AGASSIZI (Hagenow)		1																		
ASTROPECTEN Spp										wn				wn					1	
CHOMATASTER Spp		1																		
METOPASTER Spp										1						1	1			1
NYMPHASTER Spp																				
NYMPHASTER STUDLANDENSIS Schultz										aff								1		
OPHRYASTER Spp			?																	
RECURVASTER Spp																				
STAURANDERASTER Spp																				
TEICHASTER Spp																				
unidentified asteroid frags		1	1	1	1			1	1		1	1		1		1	1		1	1
CIDARID SPINE BOSSES		1												1						1
CIDARID SPINES FORM A	1	1		1			1													
CIDARID SPINES FORM B			1			1		1	1	1	1	1		1	1		1		1	
CIDARID SPINES FORM C												1								
CIDARID SPINES FORM D	1											1								
CIDARID SPINES FORM E	1									1		1		1						
CIDARID TEST FRAGS						1														
ECHINOCORYS	1	1	1	1	1	1	1		1		1		1	1	1	1	1		1	1
Echinoid frags	1									1				?			?	?	1	
OPHIOMUSIUM GRANULOSUM (Roemer)	1	1	1		cf															
OPHIOMUSIUM Spp											1									
OPHIURA HAGENOWI Rasmussen	1	1	aff							aff										1
OPHIURA Spp	1			1	1				1		wn	1								?
OPHIURA SUBSTRIATA Rasmussen																				
BRACHYLEPAS NAISSANTI (Hebert)				1						1										
CRETISCALPELLUM PAUCISTRIATUM (H. Woodward)																				
CRETISCALPELLUM Spp												1								
CRETISCALPELLUM STRIATUM (Darwin)																?				
PROVERRUCA LAURAE Withers				■																
SCALPELLUM FOSSULA (Darwin)												1								
SCALPELLUM MAX. v sulcatum (J. de C. Sowerby)										1							?			
SCALPELLUM Spp																				
aseptate corals																				
COELOSMILIA GRANULATA Duncan					1															
COELOSMILIA Spp																	1			1
DENTALINA Spp	1	1																		
DENTALINOIDES Spp																				
FRONDICULARIA Spp																				
GAVELINELLA Spp	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1
GLOBIGERINELLOIDINAE	1	1	1	1	1	1		1	1	1	1	1		1	1		1			1
MOLTKIA Spp												1					1			
OSTRACODS								1												
STEPHANOPHYLLIA CLATHRATA (Von Hagenow)		1		1																
unidentified frags	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
VAGINULINA Spp		1	1		1			1				1				1	1	1		

Taxon	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159
"BIFLUSTRA" ARGUS d'Orbigny	1	1	1		1				1		1			1					1	
COSCINOPLEURA LAMOUROUXI (Von Hagenow)			1	1																1
LATERESCHARA GALEATA Von Hagenow		1	1				■							1			1			
LUNULITES Sp	1									1										1
"MEMBRANIPORA" FLABELLIFORMIS (d'Orbigny)												1						1		
"MEMBRANIPORA" Spp																				
ONYCHOCELLA INELEGANS Lonsdale	1	1	1	1	1			1			1	1		1			1	1	1	1
ONYCHOCELLA MATRONA (Von Hagenow)	1	1	1	1	1		1				1	1	1	1			1		1	?
ONYCHOCELLA NYSTI (Von Hagenow)	1											1								
ONYCHOCELLA ROWEI Brydone	1																			
ONYCHOCELLA Spp																				
QUADRICELLARIA GRANIA (Brydone)																				1
TRICEPHALOPORA Sp																				
VINCULARIA ALLAS Brydone																			cf	
VOLVIFLUSTRELLARIA TAVERENSIS (Brydone)																				
WOODIPORA DISPARILIS d'Orbigny	1	1	1							■	1	1		1			1	1	1	1
BEISSELINA Sp		1								1		1								
PORINA GOLDFUSSI Brydone																				
PORINA Spp																				
BICAVEA Spp																	1			
CRISINA Spp	1	1	1										1						1	1
EOHORNERA LANGETHALI (Von Hagenow)	1	1			1															
HOMOEOSOLEN Spp								?												
HORNERA Spp											1	1	1							
OSCULIPORA Spp																				
OSCULIPORA TRUNCATA (Goldfuss)			1																	
PETALOPORA Spp				1					1			1								1
SPARSICAVEA Spp				1									1	1			1		?	1
SULCOCAVA Spp				?			1									1				
CLAUSA GLOBULOSA (d'Orbigny)				1						1										
DISPORELLA IRREGULARIS (d'Orbigny)			1									1								1
DISPORELLA Spp																				
TROCHILIOPORA Spp		1																		
MELICERITELLA Spp												1								
MELICERITITES GOTHICA Levinsen																				
MELICERITITES Spp		1	1				1	1			1			■			1		1	
CLINOPORA LINEATA (Beissel)	1		1						1	1		Sp					1	1		
CLYPEINA ROSULA (Von Hagenow)	1	1	1							1										1
CRISISINA CARINATA (Roemer)			1															Sp		
DIASTOPORA Spp																				
ENTALOPHORA MADREPORACEA (Goldfuss)																				
ENTALOPHORA Spp	1																			1
PUSTULOPORA ?BENEDIANA (Von Hagenow)	1	1																		
PUSTULOPORA Spp	1	1										1	1						1	
RETECAVA Spp		1																		
SIPHONIOTYPHLUS TENUIS (Von Hagenow)																				
SPIROPORA VERTICILLATA (Marsson)																		1		1
SPIROPORA/SPIROENTEILOPORA Spp								1												
unidentified fragments	1	1	1	1	1				1		1	1	1	1		1	1	1	1	1

Taxon	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178
BELEMNITELLA		1	1	1	1	1	1	1		1				1				1	1
ANCISTROCRANIA PARISIENSIS (Defrance)				1															
CARNEITHYRIS CARNEA (J. Sowerby)										1	1	1	1		1		1	1	1
CRETIRHYNCHIA Spp		1	1	1	1	1	1					1	1	1				1	
ISOCRANIA COSTATA (Sowerby)													1						
ISOCRANIA EGNABERGENSIS (Retzius)											1							1	
KINGENA PENTANGULATA S. Woodward	1						1				1	1				1		1	
MAGAS CHITONIFORMIS (Schlotheim)				1	1														
NEOLITHYRINA Spp														1	1	1	1		1
TEREBRATULINA Spp	1	1	1			1										1			
ATRETA NILSSONI (Hagenow)																			
GYROPLEURA INEQUIROSTRATA S. Woodward																			
?MYOTISSA SEMIPLANA (J. de C. Sowerby)																			
INOCERAMID Spp		1	1	1	1	1													
LYROPECTEN SARUMENSIS (Woods)																			
MIMACHLAMYS CRETOSA (Defrance)			1				1								1		1	1	1
NEITHEA SEXCOSTATA (S. Woodward)						1			1	1	1	1							
OSTREA Spp																			
PLAGIOSTOMA CRETACEUM Woods																		1	
PLAGIOSTOMA MARROTIANA d'Orbigny				1															
PSEUDOLIMEA GRANULATA (Nilsson)							1									1 ?			
SPONDYLUS DUTEMPLEANUS d'Orbigny	1																		
SPONDYLUS SPINOSUS (J. Sowerby)															1				
SPONDYLUS Spp					1													1	
Biv/brach frags																			
EOPLACOSTEGUS PUSILLUS (Sowerby)									1	1	1	1	1 auf		1	1	1	1	1
GLOMERULA GORDIALIS (Schlotheim)	auf		1	1	1	1	1			1	1	1	1	1	1	1	1	1	
G. G. var ILIUM (Goldfuss)	1		1		1						1			1		1		1	
HAMULUS SEXANGULARIS (Munster)																			
NEOMICRORBIS CRENATOSTRIATUS (Munster)																	1		
NEOMICRORBIS SUBRUGOSUS (Munster)		1	1	1	1		1			1		1			1	1		1	
PENTADITRUPA SUBTORQUATA (Munster)																			
PROLISERPULA AMPULLACEA (Sowerby)	1																		
VERMILIOPSIS FLUCTUATA (Sowerby)																			
unident worm tube rems					1								1			1			1
POROSPHAERA (fusiform)	1					1			1			1	1	1	1	1	1		
POROSPHAERA GLOBULARIS (Phillips)	1	1						1		1	1	1		1		1	1		1
POROSPHAERA SESSILIS Brydone	1	1		1				1				1							
POROSPHAERA Spp											a				a		c	c	
BOURGUETICRINUS Spp		a																	
NEILSENICRINUS AGASSIZI (Hagenow)				?	1			1			wn				?		1		
ASTROPECTEN Spp																			
CHOMATASTER Spp																			
METOPASTER Spp																			
NYMPHASTER Spp											cf							1	
NYMPHASTER STUDLANDENSIS Schultz							1	1											
OPHRYASTER Spp									wn						?				
RECURVASTER Spp																			
STAURANDERASTER Spp			?																
TEICHASTER Spp		1	1	1	1				1	1	1	1	1	1	1	1	1	1	1
unidentified asteroid frags	1									1	1	1			1		1		1
CIDARID SPINE BOSSES	1			1							1				1		1		
CIDARID SPINES FORM A			1		1		1												
CIDARID SPINES FORM B				1			1	1	1	1	1		1		1	1	1		1
CIDARID SPINES FORM C	1		1									1	1		1				
CIDARID SPINES FORM D				1				1	1							1		1	
CIDARID SPINES FORM E							1												
CIDARID TEST FRAGS	1	1	1	1	1		1		auf	1	1	1	1	1	1	1	1	1	1
ECHINOCORYS							1												
Echinoid frags									1										
OPHIOMUSIUM GRANULOSUM (Roemer)																			
OPHIOMUSIUM Spp									1	1	1								
OPHIURA HAGENOWI Rasmussen												1				wn	1		
OPHIURA Spp																			
OPHIURA SUBSTRIATA Rasmussen																			
BRACHYLEPAS NAISSANTI (Hebert)																			
CRETISCALPELLUM PAUCISTRIATUM (H. Woodward)																			
CRETISCALPELLUM Spp																			
CRETISCALPELLUM STRIATUM (Darwin)																			
PROVERRUCA LAURAE Withers																			
SCALPELLUM FOSSULA (Darwin)																			
SCALPELLUM max. v. sulcatum (J. de C. Sowerby)																			
SCALPELLUM Spp								1								1			
aseptate corals																			
COELOSMILIA GRANULATA Duncan										1									
COELOSMILIA Spp			1														1	1	1
DENTALINA Spp																	?	?	
DENTALINOIDES Spp												1							
FRONDICULARIA Spp	1		1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1
GAVELINELLA Spp			1	1	1		1	1	1	1	1		1	1	1	1	1	1	1
GLOBIGERINELLOIDINAE				1							1			1					1
MOLTKIA Spp																1			
OSTRACODS																			1
STEPHANOPHYLLIA CLATHRATA (Von Hagenow)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
unidentified frags								1			1	1		1	1			1	
VAGINULINA Spp																			

Taxon	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178
"BIFLUSTRA" ARGUS d'Orbigny	1											1				1			1
COSCINOPLEURA LAMOUROUXI (Von Hagenow)							1		1					1					
LATERESCHARA GALEATA Von Hagenow					1			1			1	1		1	1	1	1		1
LUNULITES Sp														1			1		1
"MEMBRANIPORA" FLABELLIFORMIS (d'Orbigny)		1																	
"MEMBRANIPORA" Spp																			
ONYCHOCELLA INELEGANS Lonsdale	1	1		1		1	1				1	1	1	1	1	1		9	1
ONYCHOCELLA MATRONA (Von Hagenow)	1		w	1	1			1			1						1		1
ONYCHOCELLA NYSTI (Von Hagenow)																			1
ONYCHOCELLA ROWEI Brydone																		1	
ONYCHOCELLA Spp								sp									1		
QUADRICELLARIA GRANIA (Brydone)													1	1					
TRICEPHALOPORA Sp																			
VINCULARIA ALLAS Brydone																	1		1
VOLVIFLUSTRELLARIA TAVERENSIS (Brydone)										1			1	1	1				
WOODIPORA DISPARILIS d'Orbigny	1	1					1												
BEISSELINA Sp									1			1	1					1	
PORINA GOLDFUSSI Brydone						1								1					
PORINA Spp								?					?			?			
BICAVEA Spp														1		1			1
CRISINA Spp	1						1												
EOHORNERA LANGETHALI (Von Hagenow)																			
HOMOEOSOLEN Spp																			
HORNERA Spp																			
OSCULIPORA Spp																			
OSCULIPORA TRUNCATA (Goldfuss)																			
PETALOPORA Spp	1											1		1			1		1
SPARSICAVEA Spp				1		1	?	1			?								
SULCOCAVA Spp														1			1		1
CLAUSA GLOBULOSA (d'Orbigny)								1											
DISPORELLA IRREGULARIS (d'Orbigny)	1			1								1	1						
DISPORELLA Spp			1																
TROCHILIOPORA Spp																			
MELICERITELLA Spp															1				
MELICERITITES GOTHICA Levinsen														1				1	1
MELICERITITES Spp	1	1			1				1										
CLINOPORA LINEATA Beissel																			
CLYPEINA ROSULA (Von Hagenow)	1		1	1	1			1					1	1		1		1	
CRISISINA CARINATA (Roemer)																			
DIASTOPORA Spp								1											
ENTALOPHORA MADREPORACEA (Goldfuss)						cf											1		
ENTALOPHORA Spp																			
PUSTULOPORA ?BENEDIANA (Von Hagenow)																			
PUSTULOPORA Spp				1		1		1	1		1	1	1	1	1	1	1	1	1
RETECAVA Spp																			
SIPHONIOTYPHLUS TENUIS (Von Hagenow)								1											
SPIROPORA VERTICILLATA (Marsson)												1			?				
SPIROPORA/SPIROENTEILOPORA Spp						1												1	
unidentified fragments	1		1		1	1	1	1	1		1		1	1		1		1	1

	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209
BELEMNITELLA					1	.			1	vm				1	1		1	1	1
ANCISTROCRANIA PARISIENSIS (Defrance)																			
CARNEITHYRIS CARNEA (J. Sowerby)			1																
CRETIRHYNCHIA Spp		1	.	1	1				1			1	1	1	1	1	1	.	1
ISOCRANIA COSTATA (Sowerby)				1				1					●				1		
ISOCRANIA EGNABERGENSIS (Retzius)																			
KINGENA PENTANGULATA (S. Woodward)																			
MAGAS CHITONIFORMIS (Schlotheim)				.	.							1	1			.			
NEOLITHYRINA Spp																			
TEREBRATULINA Spp	.	1								.	1	1		.					
ATRETA NILSSONI (Hagenow)																			
GYROPLEURA INEQUIROSTRATA (S. Woodward)																		1	
HYOTISSA SEMIPLANA (J. de C. Sowerby)				.															
INOCERAMID Spp	.	1							.	1	1								
LYROPECTEN SARUMENSIS Woods																			
MIMACHLAMYS CRETOSA (Defrance)																.			
NEITHEA SEXCOSTATA (S. Woodward)	.						1												
OSTREA Spp	1		agg				.	.	1	n.s.	1	1				1 agg		1	
PLAGIOSTOMA CRETACEUM Woods								.	1										
PLAGIOSTOMA HOPERIANA d'Orbigny															●				
PSEUDOLIMEA GRANULATA (Nilsson)												1	1						
SPONDYLUS DUTEMPLEANUS d'Orbigny							.												
SPONDYLUS SPINOSUS (J. Sowerby)							1												
SPONDYLUS Spp							1											.	
Bry/brach frags			1		1									1			1	1	
EOPLACOSTEGUS FUSILLUS (Sowerby)																			
GLOMERULA GORDIALIS (Schlotheim)	1											1			1		1		
G. var ILIUM (Goldfuss)		.	1	1	1	1				1	1	1	.			1			1
HAMULUS SEXANGULARIS (Munster)	1															●			
NEOMICRORBIS CRENATOSTRIATUS (Munster)																			
NEOMICRORBIS SUBRUGOSUS (Munster)									1							cf			
PENTADITRUPA SUBTORQUATA (Munster)								1			1		1			?			?
PROLISERPULA AMPULLACEA (Sowerby)				.														?	
VERMILIOPSIS FLUCTUATA (Sowerby)							1											1	1
unident worm tube rems		1																	
POROSPHAERA (fusiform)			1	1							1	1					1		
POROSPHAERA GLOBULARIS (Phillips)			1	1							1								
POROSPHAERA SESSILIS Brydone												1			1		1	1	
POROSPHAERA Spp																			
BOURGUETICRINUS Spp		a									c	ca							c
NIELSENICRINUS AGASSIZI (Hagenow)																			
ASTROPECTEN Spp				1							1								
CHOMATASTER Spp																			
METOPASTER Spp									?			-					?		?
NYMPHASTER Spp																			
NYMPHASTER STUGLANDENSIS Schulz																			
OPHRYASTER Spp																			
RECURVASTER Spp				1															
STAURANDERASTER Spp																			
TEICHASTER Spp												?							
unidentified asteroid frags		1	1			1									1	1	1		
CIDARID SPINE BOSSES	1			1								1	1					1	
CIDARID SPINES FORM A	1			1								1		1			1		
CIDARID SPINES FORM B	1			1									1		1	1	1	1	
CIDARID SPINES FORM C	1		1	1		1	1			1	1	1						1	1
CIDARID SPINES FORM D							1		1						1				1
CIDARID SPINES FORM E	1	?					1						1			1			
CIDARID TEST FRAGS																			
ECHINOCORYS	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1 auf	
Echinoid frags																	:		
OPHIOMUSIUM GRANULOSUM (Roemer)				1															
OPHIOMUSIUM Spp			wm	1															
OPHIURA HAGENOWI Rasmussen																			
OPHIURA Spp		:	wm						?										
OPHIURA SUBSTRIATA Rasmussen																			
BRACHYLEPAS NAISSANTI (Hebert)																			
CRETISCALPELLUM PAUC.STRIATUM (H. Woodward)				cf						cf									
CRETISCALPELLUM Spp												1							
CRETISCALPELLUM STRIATUM (Darwin)																			
PROVERRUCA LAURAE Withers																		1	
SCALPELLUM FOSSULA (Darwin)				1						1									
SCALPELLUM MAX v sulcatum (J. de C. Sowerby)												aff							
SCALPELLUM Spp																			
aseptate corals												1							
COELOSMILIA GRANULATA Duncan																			
COELOSMILIA Spp																			
DENTALINA Spp							1												
DENTALINOIDES Spp								1											
FRONDICULARIA Spp																			
GAVELINELLA Spp																			
GLOBIGERINELLOIDINAE	1				1		1	1	1	1	1	1		1	1	1	1	1	
MOLTKIA Spp	1		1	1	1	1	1			1	1	1		1	1	1	1	1	
OSTRACODS																			
STEPHANOPHYLLIA CLATHRATA (Von Hagenow)										1									
unidentified frags																			
VAGINULINA Spp	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209
"BIFLUSTRA" ARGUS d'Orbigny																			
COSCINOPLEURA LAMOUROUXI (Von Hagenow)	1									1	1	1							
LATERESCHARA GALEATA Von Hagenow											1								
LUNULITES Sp					1													1	1
"MEMBRANIPORA" FLABELLIFORMIS (d'Orbigny)																	cf	1	
"MEMBRANIPORA" Spp																			
ONYCHOCELLA INELEGANS Lonsdale			1																
ONYCHOCELLA MATRONA (Von Hagenow)	1			1		1	1	1	1			1			1				
ONYCHOCELLA NYSTI (Von Hagenow)	1		1	1		1		1				1				1	1	1	1
ONYCHOCELLA ROWEI Brydone						w													
ONYCHOCELLA Spp											aff								
QUADRICELLARIA GRANIA (Brydone)									1										
TRICEPHALOPORA Sp																			
VINCULARIA ALLAS Brydone																			
VOLVIFLUSTRELLARIA TAVERENSIS (Brydone)																			
WOODIPORA DISPARILIS d'Orbigny						1	1			1								1	1
BEISSELINA Sp																			
PORINA GOLDFUSSI Brydone			1																
PORINA Spp												1							
BICAVEA Spp	1																		
CRISINA Spp																			
EOHORNERA LANGETHALI (Von Hagenow)					1														1
HOMOEOSOLEN Spp	1																		
HORNERA Spp												1							
OSCULIPORA Spp				1											1				1
OSCULIPORA TRUNCATA (Goldfuss)																			
PETALOPORA Spp			1		1	1		w			1	1	?	?				1	
SPARSICAVEA Spp	1		1		1						1		1				1	1	
SULCOCAVA Spp	1																		
CLAUSA GLOBULOSA (d'Orbigny)																			
DISPORELLA IRREGULARIS (d'Orbigny)				1															
DISPORELLA Spp																			
TROCHILIOPORA Spp																			
MELICERITELLA Spp				1															
MELICERITITES GOTHICA Levinsen																	1		
MELICERITITES Spp		1		1	1					1		1							
CLINOPORA LINEATA Beissel			1	sp								1							
CLYPEINA ROSULA (Von Hagenow)			1	1												1	1		
CRISISINA CARINATA (Roemer)																			
DIASTOPORA Spp																			
ENTALOPHORA MADREPORACEA (Goldfuss)																			
ENTALOPHORA Spp																			
PUSTULOPORA ?BENEDIANA (Von Hagenow)																			
PUSTULOPORA Spp						1					1	1			1	1	1	1	
RETECAVA Spp									1										
SIPHONIOTYPHLUS TENUIS (Von Hagenow)																			
SPIROPORA VERTICILLATA (Marsson)																			
SPIROPORA/SPIROENTEILOPORA Spp			1								1								
unidentified fragments	1		1		1	1		1	1	1		1	1	1	1	1	1	1	1

	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227
BELEMNITELLA		1	1	1	1	1			1	1		1	1	1	1			1
ANCISTOCRANIA PARISIENS (Defrance)																		
CARNEITHYRIS CARNEA (J. Sowerby)																		
CRETIRHYNCHIA Spp					1	1				1		1	1	1				
ISOCRANIA COSTATA (Sowerby)		?						1	1		1			1	1	1		
ISOCRANIA EGNABERGENSIS (Retzius)																		
KINGENA PENTANGULATA S. Woodward																		
MAGAS CHITONIFORMIS (Schlotheim)				1				1										
NEOLITHYRINA Spp				cf														
TEREBRATULINA Spp			1									1						
ATRETA NILSSONI (Hagenow)																		
GYROPLEURA INEQUIROSTRATA (S. Woodward)																		
PHYOTISSA SEMIPLANA (J. de C. Sowerby)																		
INOCERAMID Spp							1							1	1			
LYROPECTEN SARUMENSIS (Woods)																		
MIMACHLAMYS CRETOSA (Defrance)														1				
NEITHEA SEXCOSTATA (S.Woodward)	1																	
OSTREA Spp	1	1				1	1				1	1		1	1	1		1
PLAGIOSTOMA CRETACEUM Woods																		
PLAGIOSTOMA MARROTIANA d'Orbigny												1						
PSEUDOLIMEA GRANULATA (Nilsson)							1											
SPONDYLUS DUTEMPLEANUS d'Orbigny	1				1													
SPONDYLUS SPINOSUS (J. Sowerby)																		
SPONDYLUS Spp																		
Biv/brach frags			1										1	1		1		
EOPLACOSTEGUS PUSILLUS (Sowerby)																		
GLOMERULA GORDIALIS (Schlotheim)	1				1	1	1	1	1 nuf		nuf			1	1	1	1	1
G G(var ILIUM) (Goldfuss)	1	1	1	1	1	1	1 nuf		1 nuf		1 nuf		1	1	1	1	1	1
HAMULUS SEXANGULARIS (Munster)			1		1			1										
NEOMICRORBIS CRENATOSTRIATUS (Munster)														1				1
NEOMICRORBIS SUBRUGOSUS (Munster)																		
PENTADITRUPA SUBTORQUATA (Munster)		w	?				1			1	1	1		1	1		1	1
PROLISERPULA AMPULLACEA (Sowerby)					cf													
VERMILIOPSIS FLUCTUATA (Sowerby)								1										
unident worm tube rems												1						
POROSPHAERA (fusiform)		1							1		1	1	1	1	1			1
POROSPHAERA GLOBULARIS (Phillips)					1					1	1				1	1		1
POROSPHAERA SESSILIS Brydone	1	1			cf			1	1	1	1	1	1			1		1
POROSPHAERA Spp					1			1										
BOURGUETICRINUS Spp		c	a				c	c				a		a				a
NEILSENICRINUS AGASSIZI (Hagenow)													?					
ASTROPECTEN Spp					1													
CHOMATASTER Spp														1				
METOPASTER Spp																		?
NYMPHASTER Spp									1									
NYMPHASTER STUDLANDENSIS Schultz																		
OPHRYASTER Spp																		
RECURVASTER Spp					1	?		1			1							
STAURANDERASTER Spp																		
TEICHASTER Spp																		
unidentified asteroid frags		1	1						1		1	1						
CIDARID SPINE BOSSES			1															
CIDARID SPINES FORM A				1			1				1			1	1	1		1
CIDARID SPINES FORM B					1	1							1	1				
CIDARID SPINES FORM C	1		1	1		1	1		1		1					1	1	
CIDARID SPINES FORM D	1						1	1		1	1							
CIDARID SPINES FORM E				1									1				1	1
CIDARID TEST FRAGS												1					1	
ECHINOCORYS	1		1	1	1	1			1	1	1	1	1	1	1		1	1
Echinoid frags																		
OPHIOMUSIUM GRANULOSUM (Roemer)						1				1								
OPHIOMUSIUM Spp																		
OPHIURA HAGENOWI Rasmussen				1														
OPHIURA Spp		1																
OPHIURA SUBSTRIATA Rasmussen																		
BRACHYLEPAS NAISSANTI (Hebert)								w										
CRETISCALPELLUM PAUCISTRIATUM (H. Woodward)																		
CRETISCALPELLUM Spp																		
CRETISCALPELLUM STRIATUM (Darwin)						cf												
PROVERRUCA LAURAE Withers																		
SCALPELLUM FOSSULA (Darwin)																		
SCALPELLUM MAX = sulcatum (J. de C. Sowerby)																		
SCALPELLUM Spp																		
aseptate corals																		
COELOSMILIA GRANULATA Duncan																		
COELOSMILIA Spp		1																
DENTALINA Spp				1	1							1		1		1		
DENTALINOIDES Spp																		
FRONDICULARIA Spp																		
GAVELINELLA Spp								1	1		1	1	1	1	1		1	
GLOBIGERINELLOIDINAE	1	1	1	1		1		1	1		1	1		1	1	1	1	1
MOLTKIA Spp	1	1	1	1		1	1											
OSTRACODS								1										
STEPHANOPHYLLIA CLATHRATA (Von Hagenow)						1					1							
unidentified frags			1				1			1	1	1			1			1
VAGINULINA Spp	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227
"BIFLUSTRA" ARGUS d'Orbigny																		
COSCINOPLEURA LAMOUROUXI (Von Hagenow)					1		1											
LATEPESCHARA GALEATA Von Hagenow											1		w					1
LUNULITES Sp		1							1		1	1		1	1			1
"MEMBRANIPORA" FLABELLIFORMIS (d'Orbigny)											1			1				
"MEMBRANIPORA" Spp									aff		1	cf		1	1			
ONYCHOCELLA INELEGANS Lonsdale														1	1			
ONYCHOCELLA MATRONA (Von Hagenow)	1				1	1					1	w						1
ONYCHOCELLA NYSTI (Von Hagenow)		+	1	1		1		1	1		1	1		1				1
ONYCHOCELLA ROWEI Brydone																		
ONYCHOCELLA Spp																		
QUADRICELLARIA GRANIA (Brydone)		w							1	1					1			
TRICEPHALOPORA Sp													1					1
VINCULARIA ALLAS Brydone																		
VOLVIFLUSTRELLARIA TAVERENSIS (Brydone)											1			1				
WOODIPORA DISPARILIS d'Orbigny	1		1			1	1	1				?		1	1			1
BEISSELINA Sp																		
PORINA GOLDFUSSI Brydone												1						
PURINA Spp																		
BICAVEA Spp											1							
CRISINA Spp																		
EOHORNERA LANGETHALI (Von Hagenow)							nuf											
HOMOEOSOLEN Spp															1			
HORNERA Spp																		
OSCULIPORA Spp																		
OSCULIPORA TRUNCATA (Goldfuss)																		
PETALOPORA Spp			1		1	1			1					1				1
SPARSICAVEA Spp			1			?						1	1	1	1			1
SULCOCAVA Spp		1						1	1	1								
CLAUSA GLOBULOSA (d'Orbigny)											1							1
DISPORELLA IRREGULARIS (d'Orbigny)					1		1					1		1		1		
DISPORELLA Spp																		
TROCHILIOPORA Spp																		
MELICERITELLA Spp																		
MELICERITITES GOTHICA Levinsen			aff	1							1				1			
MELICERITITES Spp					1		1	1		1				1	1	1		
CLINOPORA LINEATA Beissel	sp			sp											1			
CLYPEINA ROSULA (Von Hagenow)	1	1		1			1				1							
CRISISINA CARINATA (Roemer)																		
DIASTOPORA Spp																		
ENTALOPHORA MADREPORACEA (Goldfuss)																		
ENTALOPHORA Spp																		
PUSTULOPORA PRENEDIANA (Von Hagenow)										1								
PUSTULOPORA Spp	1	1	1	1				w			1	1		1			1	
RETECAVA Spp																		
SIPHONIOTYPHLUS TENUIS (Von Hagenow)																		
SPIROPORA VERTICILLATA (Marsson)																		
SPIROPORA/SPIROENTEILOPORA Spp											1						1	
unidentified fragments	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

APPENDIX ELEVEN

Occurrence of non-bryozoan faunal elements and bryozoan remains in the borehole samples collected from Mayton Wood. Abbreviations as in appendix 8a.

	MW 56	MW 16	MW 15	MW 23	MW 55	MW 21	MW 22	MW 19	MW 20
BELEMNITELLA		I		I		I			
ARGIROTHECA Spp							I		
CARNEITHYRIS CARNEA (J. Sowerby)		I		I	I	I	I	I	I
CRETIRHYNCHIA Spp		I		I		I	.	I	I
KINGENA PENTANGULATA (S. Woodward)	.		.		I				.
MAGAS CHITONIFORMIS (Schlotheim)		I			I	I			
TEREBRATULINA Spp	I	I	I		I		I	I	I
INOCERAMID Spp		I		I	I	I	I	I	I
LYROPECTEN Spp			I	.					
MIMACHLAMYS CRETOSA (Defrance)	I	I	?		I				I
MIMACHLAMYS MANTELLIANA (d'Orbigny)						I			
NEITHEA STRIATOCOSTATUS Goldfuss		I			I				
OSTREA Spp	I						I		I
PSEUDOLIMEA GRANULATA (Nilsson)			I		I		I		
PYCNODONTE VESICULARE (Lamarck)		I						I	
SPONDYLUS DUTEMPLEANUS d'Orbigny						?			
SPONDYLUS Spp		I			I		?		
Bivalve/brach frags		?							I
EOPLACOSTEGUS PUSILLIS (Sowerby)	I			I	I			?	
FILOGRANULA CINCTA (Goldfuss)									I
GLOMERULA GORDIALIS (Schlotheim)					I			I	I
NEOMICRORBIS CRENATOSTRIATUS (Munster)	I		I						
NEOMICRORBIS SUBRUGOSUS (Munster)		I							
PENTADITRUPA SUBTORQUATA (Munster)	I	I		?				I	
PROLISERPULA AMPULLACEA (Sowerby)		I		I					
VEPRECULINA TUBERCULIFERA (Nielsen)	I	I							
VERMILIOPSIS FLUCTUATA (Sowerby)					I				
unid worm tube rems					I				
POROSPHAERA (fusiform)						I			
POROSPHAERA SESSILIS Brydone	I				I		I		I
BOURGUETICRINUS BRYDONEI Rasmussen				cf				cf	
BOURGUETICRINUS Spp		c					c		c
NIELSENOCRINUS AGASSIZI (Hagenow)	I								
ASTROPECTEN Spp		I		?	I		I		
CHOMATASTER Spp		?					?		
METOPASTER Spp		I	?						cf
METOPASTER UNDULATAUS Spencer	I								
RECURVASTER Spp					I				
unidentified asteroid ossicles				I		I			
CIDARID SPINE BOSSES				I		I	I		I
CIDARID SPINES FORM A			I	I					
CIDARID SPINES FORM B						I			
CIDARID SPINES FORM C		I					I		
CIDARID TEST FRAGS	I			I					
HAGENOWIA Spp					I				
OPHIOMUSIUM GRANULOSUM (Roemer)		I		I	I		I	I	I
OPHIURA HAGENOWI Rasmussen		I		I	I		I		I
OPHIURA Spp								I	
OPHIURA SUBSTRIATA Rasmussen	af								
BRACHYLEPAS FALLAX (Darwin)		I	I					??	
CRETISCALPELLUM PAUCISTRIATUM (H.Woodward)									I
DENTALINA Spp	I	I		I	I			I	
FRONDICULARIA Spp		I					?		I
GAVELINELLA Spp	I	I	I		I		I	I	I
GLOBIGERINELLOIDINAE	I	I	I		I		I	I	I
MOLTKIA Spp		I		I					
NODOSARIA Spp		I							
STEPHANOPHYLLIA CLATHRATA (Von Hagenow)		I							
TENTIFRONS Spp					I		?		
unidentified frags	I	I	I	I	I	I	I	I	I
VAGINULINA Spp	I	I	I	I				I	I

	MW 56	MW 16	MW 15	MW 23	MW 55	MW 21	MW 22	MW 19	MW 20
"BIFLUSTRA" ARGUS d'Orbigny	I	I	I	I	I		I	I	I
COSCINOPLEURA LAMOUROUXI (Von Hagenow)		I			I				I
CATEPESCHARA GALEATA Von Hagenow					I				
LUNULITES Spp		I		.	I			I	I
"M" sevingtonensis group Brydone									I
"MEMBRANIPORA" FLABELLIFORMIS (d'Orbigny)	I								
ONYCHOCELLA INELEGANS Lonsdale	I	I	I	I	I	I	I	I	
ONYCHOCELLA MATRONA (Von Hagenow)		I		I		I	I	I	I
ONYCHOCELLA NYSTI (Von Hagenow)		I		I	I	.	I	I	I
ONYCHOCELLA POWEI Brydone	I	I		I	.		I		I
ONYCHOCELLA Spp						I	I		
QUADRICELLARIA [illegible] (Brydone)					I				
WOODIPORA DISPARILIS d'Orbigny	I	I	I	I	I		I	I	I
POPINA GOLDFUSSI Brydone					I		?		
CRISINA Spp				I					
EOHORNERA LANGETHALI (Von Hagenow)				I					
PETALOPORA Spp		I							
SPARSICAVEA Spp	I	I					I		
SULCOCAVA Spp				?					
CLAUSA GLOBULOSA d'Orbigny					I				
MELICERITITES GOTHICA Levinsen	I	I	I	I	I	I	I	I	I
MELICERITITES Spp			I					I	I
CLINOPORA LINEATA Beissel		I			I		I	I	I
CLINOPORA Spp							.	I	
CLYPEINA ROSULA (Von Hagenow)		I	I		I		I	I	I
CRISISINA CARINATA (Roemer)				I					
PUSTULPORA BENEDIANA (Von Hagenow)	I							I	I
PUSTULOPORA Spp		I	I						
SPIROPORA VERTICILLATA (Marsson)								I	
unidentified frags		I			I				

APPENDIX TWELVE

Occurrence of non-bryozoan faunal elements and bryozoan remains in the borehole samples collected from Whitlingham. Abbreviations as in appendix 8a.

	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	179	180	181	182	183	184	185	186	187	188	189	190
BELEMNITELLA																														
CARNEITHYRIS CARNEA J. Sowerby																														
CRETIRHYNCHIA Spp																														
ISOCRANIA COSTATA Sowerby																														
KINGENA PENTANGULATA S. Woodward																														
MAGAS CHITONIFORMIS Schlotheim																														
TEREBRATULINA Spp																														
INVOTISSA SEMIPLANA J. de C. Sowerby																														
INOCERAMID Spp																														
LYROPECTEN Spp																														
MIMACHLAMYS CRETOSA (Defrance)																														
NEITHEA SEXCOSTATA (S. Woodward)																														
OSTREA Spp																														
PSEUDOLIMEA GRANULATA (Nilsson)																														
SPONDYLUS DUTEMPLEANUS d'Orbigny																														
SPONDYLUS SPINOSUS (J. Sowerby)																														
SPONDYLUS Spp																														
Biv brach frags																														
FILOGRANULA CINCTA (Goldfuss)																														
GLOMERULA GORDIALIS (Schlotheim)																														
G. Gr var ILIUM (Goldfuss)																														
HAMULUS SEXANGULARIS (Munster)																														
NEOMICRORBIS CRENATOSTRIATUS (Munster)																														
NEOMICRORBIS SUBRUGOSUS (Munster)																														
PENTADITRUPA SUBTORQUATA (Munster)																														
PROLISERPULA AMPULLACEA (Sowerby)																														
VEPRECULINA TUBERCULIFERA (Nielsen)																														
VERMILIOPSIS FLUCTUATA (Sowerby)																														
unident worm tube frags																														
POROSPHAERA (fusiform)																														
POROSPHAERA GLOBULARIS (Phillips)																														
POROSPHAERA SESSILIS Brydone																														
POROSPHAERA Spp																														
BOURGUETICRINUS BRYDONEI Rasmussen																														
BOURGUETICRINUS Spp																														
NEILSENICRINUS AGASSIZI (Hagenow)																														
ASTROPECTEN Spp																														
ASTROPECTENIDAE																														
METOPASTER Spp																														
METOPASTER UNDULATUS Spencer																														
NYMPHASTER Spp																														
OPHRYASTER Spp																														
RECURVASTER Spp																														
TEICHASTER Spp																														
unidentified asteroid frags																														
CIDARID SPINE BOSSES																														
CIDARID SPINES FORM A																														
CIDARID SPINES FORM B																														
CIDARID SPINES FORM C																														
CIDARID SPINES FORM D																														
CIDARID SPINES FORM E																														
ECHINOCORYS																														
Echinoid frags																														
HAGENOWIA Spp																														
OPHIOMUSIUM GRANULOSUM (Roemer)																														
OPHIOMUSIUM Spp																														
OPHIURA Spp																														
BRACHYLEPAS FALLAX (Darwin)																														
BRACHYLEPAS NAISSANTI (Hebert)																														
CRETISCALPELLUM Spp																														
PROVERRUCA LAURAE Withers																														
SCALPELLUM Spp																														
aseptate corals																														
DENTALINA Spp																														
DENTALINOIDES Spp																														
FRONDICULARIA Spp																														
GAVELINELLA Spp																														
GLOBIGERINELLOIDINAE																														
MULTRIA Spp																														
OSTRACODS																														
unidentified frags																														
VAGINULINA Spp																														

	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	179	180	181	182	183	184	185	186	187	188	189	190
"BIFLUSTRA" ARGUS d'Orbigny																														
COSCINOPLEURA LAMOUROUXI (Von Hagenow)																														
LUNULITES Sp																														
"MEMBRANIPORA" FLABELLIFORMIS (d'Orbigny)																														
"MEMBRANIPORA" Spp																														
ONYCHOCELLA INELEGANS Lonsdale																														
ONYCHOCELLA MATRONA (Von Hagenow)																														
ONYCHOCELLA NYSTI (Von Hagenow)																														
ONYCHOCELLA POWEI Brydone																														
PUNCTURIELLA Spp																														
QUADRICELLARIA GRANIA (Brydone)																														
TRICEPHALOPORA Sp																														
WOODIPORA DISPARILIS d'Orbigny																														
BEISSELINA Sp																														
PACHYTHECELLA Spp																														
PORINA GOLDFUSSI Brydone																														
PORINA SOCIA Brydone																														
PORINA Spp																														
ROTIPORINA Spp																														
CRISINA Spp																														
HORNERA Spp																														
OSCULIPORA Spp																														
PETALOPORA Spp																														
SPARSICAVEA Spp																														
SULCOCAVA Spp																														
MELICERITITES GOTHICA Levinsen																														
MELICERITITES Spp																														
CLINOPORA LINEATA Beissel																														
CLYPEINA ROSULA (Von Hagenow)																														
DIASTOPORA Spp																														
PUSTULOPORA "BENEDIANA (Von Hagenow)																														
PUSTULOPORA Spp																														
SIPHONIOTYPHLUS TENUIS (Von Hagenow)																														
SPIROPORA VERTICILLATA (Harsson)																														
SPIROPORA SPIRODENTEILOPORA Spp																														
TERVIA Spp																														
"CERIOPORA" NUCIFORMIS Hagenow																														
unidentified fragments																														