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Albian microbiostratigraphy (foraminifera and Ostracoda) of S.E. England and adjacent areas

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CHAPTER 6

THE DISTRIBUTION OF SELECTED SPECIES AND GENERA

6:1 Foraminifera

Reophax minutus Tappan, 1940

This species was recorded abundantly in the Lower Albian of Germany and in the Upper Albian of the southern North Sea Basin. Only a few specimens were recorded from the Albian of southern England. This species is of limited stratigraphic value and appears to be restricted in distribution to the northern 'Boreal' province.

Spiroplectinata annectens (Parker & Jones, 1863)

This species has been recorded throughout the Albian Stage of northwestern Europe where Price (1977b) regarded it as zonally significant in the *M.inflatum* Subzone because of its high abundance. Although this species does occur abundantly during this Subzone in southern England it also occurs frequently in many of the samples from the Fi to Fiii Subzones of the southern North Sea Basin. Since it ranges throughout the Albian, changes in abundance of this species can only be regarded as of limited, and very local, stratigraphic significance.

Arenobulimina Cushman, 1927 and *Flourensina* Marie, 1938

These genera have been discussed in detail by both Carter & Hart (1977) and Price (1977b). Both these authors proposed evolutionary lineages for these genera which have previously been discussed, and the 'evolutionary' sequence of Carter & Hart has largely been accepted. The present author differs from Carter & Hart in restricting the range of *A.macfadyeni* Cushman, 1936 to the Lower and Middle Albian

while A.advena (Cushman, 1936) and F.intermedia Ten Dam, 1950 were shown to occur in the topmost Albian. Although A.anglica Cushman, 1936 was not formally recognised from the Albian, many of the specimens of Arenobulimina Cushman, 1927 from the topmost Albian Subzone Fiii could be interpreted as early forms of this species.

The present author has concluded that the main plexus of this genus evolves from A.macfadyeni Cushman, 1936 to A.chapmani Cushman, 1936 at the boundary between the Middle and Upper Albian, and from A.chapmani to A.advena during the topmost Albian Subzone Fiii. During Subzones Ei, Eii, and Fi, many specimens of A.chapmani gradually become more coarsely grained. These are early forms of A.sabulosa; typical quadriserial specimens of which first appear in Subzone Fii. In the topmost part of Subzone Fii, this species becomes more triserial until, in Subzone Fiii, typical specimens of F. intermedia occur. Price (1975) showed that both A.sabulosa and F. intermedia are of geographically limited distribution while A. chapmani appears to have a geographically ubiquitous distribution.

In this study A.sp.cf.A.frankei Cushman,1936 was only recorded from the Anglo-Paris Basin where it evolves gradually from the A.chapmani plexus during the Ei, Eii and Fi Subzones, with typical specimens of this species first appearing in Subzone Fii. In the northern 'Boreal' basins A.frankei Cushman, 1936 occurs. This form is broader than the southern species and is closely related to the Middle and Upper Cenomanian species P.cenomana Carter & Hart, 1977. A. frankei, like A.sp.cf.A.frankei, also first occurs in Subzone Fii. Freig (pers.comm.,1978) regarded P.cenomana as synonymous with A. frankei and recorded it from the Upper Albian of Germany. It would thus appear that A.frankei is a 'Boreal' species that only migrates into the Anglo-Paris Basin (P.cenomana) during the Middle Cenomanian. A.sp.cf.A.truncata (Reuss, 1844) was only recorded from the S.dispar Zone (Upper Greensand) of Compton Bay. This form is small and stunted and

could be regarded as an ecophenotypic variant of the main Arenobulimina plexus.

The genus Arenobulimina is the most biostratigraphically significant of all the Albian benthonic genera.

Citharinella pinnaeformis (Chapman, 1894)

This distinctive species was recorded commonly from the M. inflatum Zone of the Anglo-Paris Basin, where it occurs in both the Gault Clay and Upper Greensand facies. Both the first and last occurrence of this species appear to be diachronous. The first appearance is generally accepted to be during the D.cristatum(Di) Subzone although it may be as late as the H.orbignyi(Dii) Subzone. The last appearanceof this species varies from early C.auritus(Ei) Subzone to early S.dispar(Fi) Zone. No specimens were recorded from the southern North Sea Basin.

Globigerinelloides bentonensis (Morrow, 1934)

This species was regarded as zonally significant by Price (1977b) who recorded it occurring abundantly in the upper part of the C.auritus Subzone and throughout the S.dispar Zone. Kemper (1973) noted that during this time interval in West Germany Aucellina coquandina suddenly appears which led Price (1977b) to conclude that the first appearance of these two species was associated with a 'Boreal' advance.

Both the present author (figs. 8:6, 8:13) and Magniez-Jannin (1975) have clearly illustrated that this species only occurs in abundance within the S.dispar Zone of northwestern Europe. More specifically it only occurs abundantly during the M.(M.)rostratum Subzone. This 'flood' appearance is marked by a complementary decrease in the abundance of H.delrionensis. G.bentonensis has been

recorded from southern England, France, Germany, and the southern North Sea Basin.

Burnhill (in press) has used this species in his zonal scheme for the northern North Sea Basin where he described it as typical of the late Albian and showed it to have a first occurrence 'downhole' in the late Albian (which is equivalent to Biohorizon 8). This biohorizon was clearly defined in the Glyndebourne borehole, at East Wear Bay, in the M.25 borehole 16/3, at Speeton, Melton and Hunstanton, and in the Shell/Esso boreholes, 49/24-1 and 49/19-1. However, this species has been recorded sporadically from the higher zones of the Gault Clay and from the Cenomanian, although, it has not been recorded 'in flood' from these horizons.

The first occurrence 'uphole' of G.bentonensis 'in flood' also appears to be consistent in the Anglo-Paris and southern North Sea Basins. At East Wear Bay bay this horizon occurs at the base of Bed XII while at Gylndebourne it occurs slightly above the base of the S.dispar Zone. It is also clearly defined in the M25 borehole 16/3, at Speeton, Melton, and Hunstanton.

The first and last appearances of this species 'in flood' have thus been interpreted as significant Biohorizons which can be correlated across northwestern Europe. Within the S.dispar Zone Biohorizon 7 is interpreted as the time equivalent of the base of the M.(M.)rostratum Subzone while Biohorizon 8 occurs near the top of this Subzone.

Robertinacea Reuss, 1850

Within the Albian Stage of northwestern Europe the genera Epistomina Terquem, 1883 and Hoeglundina Brotzen, 1942 show marked limitations in their distribution both vertically and laterally.

Price (1975) showed that the distribution of E.spinulifera

(Reuss, 1863) and E.polypioides (Eichenberg, 1933) were mutually exclusive and also recorded that Magniez-Jannin found E.polypioides in the Aube region of France. However, Magniez-Jannin (1975) assigned her specimens to E.spinulifera. E.spinulifera is here regarded as a very variable species with which E.polypioides is synonymous. Only the closely related species Epistomina sp.A. sp.nov. has been separated from this plexus.

Lambert & Scheibnerova (1974) noted the limited distribution of the genus Epistomina in the Albian which Price (1975) correctly regarded as being the result of environmental control (especially temperature and facies). This variation in distribution is illustrated by the poor robertinacean fauna of the Southern North Sea and Saxony Basins, while the Middle Albian clays of southern England contain a rich robertinacean fauna. However, a marked vertical change in the population was also recorded in the Middle and Upper Albian of southern England which is illustrated by a gradual decline in abundance of the Robertinacea (Carter & Hart, 1977) during the basal portion of the Upper Albian (fig. 8:12), and their last appearance in the H.varicosum Subzone. This gradual decline can be directly related to the increase in depth proposed (fig. 7:1), and therefore, their distribution must also be partially controlled by depth. The preservation of this group is markedly facies controlled and their preservation potential in clay appears to decrease with the increase in the amount of carbonate in the sediment. These views contrast with those of Price (1975) who regarded the distribution of these species to be largely the result of temperature control, and who regarded poorly preserved specimens to be the result of reworking. There is no evidence to suggest extensive reworking of the microfaunal populations of the Middle and Upper Albian.

6:2 Ostracoda

Cytherelloidea Alexander, 1929

The C.chapmani (Jones & Hinde, 1890) plexus exhibits variation in the degree of inflation and the distribution of ribs both geographically and stratigraphically. In southern England 'typical' specimens of C.chapmani occur in the Middle Albian. This species is replaced stratigraphically at the Middle/Upper Albian boundary by C.stricta (Jones & Hinde, 1890) which first appears in the D.cristatum Subzone. C.chapmani re-appears in the H.varicosum Subzone and basal portion of the C.auritus Subzone. C.kayei Weaver, (MS.) evolves from this species in the S.dispar Zone. Palaeoecologically, C.stricta appears to be an open marine species which only occurs rarely in more restricted marine conditions and exhibits a relatively constant morphology, while C.chapmani occurs ubiquitously in restricted marine and open marine environments but exhibits changes in degree of rib inflation and rib position.

C.globosa Kaye, 1964 occurs rarely in the Upper Albian and lowest Cenomanian and is normally found in association with sandstone.

No specimens of Cytherelloidea were recorded from the marginal Lower Albian. During the Albian species of this genus showed preference for an open marine environment.

Bairdia pseudoseptentrionalis (Mertens, 1956)

This species was only recorded abundantly from the S.dispar Zone of the Anglo-Paris Basin. It has also been recorded from the C. auritus Subzone of southern England and from the basal Upper Albian of the southern North Sea Basin. This species prefers an 'open marine' environment.

Cornicythereis Gründel, 1973

Several of the species of this genus exhibit marked variation in size during the Albian and this has already been discussed with regard to the C.cornueli/C.larivourensis plexus (Chapter 5). It was suggested that C.larivourensis occurred in the deeper water, clay facies, where it became smaller with increasing depth, and that C. cornueli was predominantly a marginal marine species. The larger, closely related form, C. sp.aff.C.cornueli, was recorded from the marginal sediments of the Upper Greensand. The Upper Albian specimens of Stchépinsky (1954) from the marginal Upper Greensand facies (Upper Albian) were recorded in the original diagnosis of C. cornueli. In this study these forms were included within C. sp.aff.C. cornueli to separate them from the typical Lower and lower Middle Albian specimens of this species.

The two species C.bonnemai and C.larivourensis have mutually exclusive geographical distributions. The former species has been recorded ubiquitously from the Upper Albian of the northern 'Boreal' province and the latter species from the upper Middle and Upper Albian of the Anglo-Paris Basin.

This genus has a relatively ubiquitous distribution both stratigraphically and geographically during the Albian and specimens have been recorded from all of the major Upper Albian sedimentary facies. The species C.cornueli and C.gatyensis are limited in distribution to the marginal clays of the Lower and lower Middle Albian of the Anglo-Paris Basin. In contrast, the species C. larivourensis and C.bonnemai both occur most abundantly in samples with a high percentage of planktonic foraminifera and may, therefore, prefer more open marine conditions.

Cythereis glabrella Triebel, 1940 and Mandocythere muelleri Gründel, 1964

Both these species have been recorded by Gründel from the Gault Clay of East Germany while in the southern North Sea Basin they were recorded from the Upper Albian (Red Chalk). These species are limited in distribution to the colder 'Boreal' province where they are of limited stratigraphic significance.

Cythereis hiruta, Damotte & Grosdidier, 1963; C.reticulata (Jones & Hinde, 1890); C.folkestonensis Kaye, 1964; C. thoerenensis Triebel, 1940

This plexus of closely related species evolved during the Albian with the most stratigraphically significant species, C. folkestonensis, only occurring in Subzones Dii to Ei of southern England. A complete spectrum of intermediate forms occur between this species and C.hirsuta from which it evolved, and a complete spectrum of intermediate forms exist between the Lower and lower Middle Albian species, C.reticulata, and the upper Middle and Upper Albian species, C.hirsuta. However, in the northern 'Boreal' province C.reticulata was recorded throughout the Albian, co-existing with C.hirsuta during the Upper Albian (Gründel, 1966). Thus, while C.reticulata appears to prefer the marginal marine environment during the Middle Albian of southern England, it occurs at various depths throughout the Albian of the northern 'Boreal' province, indicating that temperature must also be an important factor controlling the distribution of this species.

C.thoerenensis was first recorded from S.dispar Zone of southern England. This species is also closely related to C.hirsuta from which it evolves in the Eii Subzone. However, it has not been recognised by many Albian workers and its distribution in northwestern Europe is uncertain.

This plexus of species occurs more abundantly in the deeper water facies of the upper Middle and Upper Albian.

Cythereis ex.gr.C.lurmannae Triebel, 1940

This taxonomically complex species is variable in size, dimorphism, and ornamentation. In the Upper Albian it becomes smaller and shows a tendency to lose its primary surface reticulation. The extreme example of this occurs in the topmost Albian of the southern North Sea Basin (Red Chalk) where the secondary surface reticulation has also been lost. The variation of this species has previously been discussed in relation to the subspecies defined by Kemper (1971) and several conclusions regarding the ecological parameters controlling the taxonomically significant morphological features can be made. Firstly, this species becomes smaller and less strongly reticulate in deeper water. It also tends to lose the surface reticulation completely in marly or chalky facies. Secondly, the subspecies C.l.bemerodensis, which Kemper (1971) recorded from the topmost Albian of Germany, was not recorded from the Albian of southern England. However, it was recorded from the Cenomanian of southern England, indicating that this is a cooler water form which migrated into southern England during the Cenomanian Stage from the 'Boreal' northern province.

Isocythereis Triebel, 1940

Both the ornamentation and size of I.fissicostis Triebel, 1940 gradually change during the Middle and Upper Albian of southern England. This variation has also been documented by Gründel (1966) in the Gault Clay of East Germany. In southern England both these species first appear in association with the first occurrence in abundance of planktonic foraminifera and both range through to the late Albian. They appear ubiquitously across northwestern Europe but appear to prefer the Gault Clay, 'open sea', facies. The last appearance of these species is an important marker for the Albian/Cenomanian boundary.

Isocythereis sp.A.sp.nov. and Isocythereis sp.B.sp.nov. were only recorded from the marginal (Upper Greensand) facies of Seaton Bay, Devon and they obviously prefer a shallow water, high energy environment.

Platycythereis Triebel, 1940

Several species of this genus show marked variation in size during the Albian. Platycythereis sp.A.sp.nov., which is ubiquitously distributed across Europe, shows a marked decrease in size during the Middle and Upper Albian of southern England. P.gaultina (Jones, 1849), a species which appears to be stratigraphically and geographically limited in distribution to the Gault Clay facies, also shows a marked decrease in size during the Middle and Upper Albian.

In southern England P.laminata Triebel, 1940 was only recorded from the lower part of the Middle Albian before the first occurrence in abundance of planktonic foraminifera. It therefore appears to prefer a shallow, restricted, marine environment. P.chapmani Kaye, 1964, which mainly differs from P.laminata in frill morphology, was only recorded from the S.dispar Zone and rarely from the lowest Cenomanian. It occurs in association with large numbers of planktonic foraminifera and thus appears to prefer a more 'open water' marine environment.

Of these species, only Platycythereis sp.A. sp.nov, was recorded commonly from the Cenomanian of southern England (Weaver, MS.).

Protocythere lineata (Chapman & Sherborn, 1893) and

Protocythere striata (Grundel, 1966)

The distribution of these species indicates that they are closely related both geographically and stratigraphically. P.lineata becomes smaller, less inflated, and has more sharply defined ribs during the

Middle and basal Upper Albian of southern England and it evolves into P.striata during the C.auritus Subzone in southern England. In the southern North Sea Basin and in East Germany (Gründel, 1966) the evolutionary change from P.lineata to P.striata appears to occur stratigraphically earlier. In the southern North Sea Basin this transition occurs as early as the basal Upper Albian while in East Germany Gründel recorded this transition in the middle part of the Middle Albian. The transition between these two species is probably temperature controlled and P.striata is probably the colder water of the two species.

Mandocythere lapparenti Damotte & Grosdidier, 1963

This species was recorded from both the Gault Clay and Upper Greensand facies, it ranges from H.varicosum Subzone to the S.dispar Zone and only occurs commonly in association with the 'flood' of G. bentonensis during the basal part of the S.dispar Zone. It would therefore appear to prefer a cooler water environment. This species has only been recorded from southern England and the Paris Basin.

Clithrocytheridea aff. Haplocytheridea nana Triebel, 1936

This species was only recorded abundantly from the Lower and lower Middle Albian of the Anglo-Paris Basin and it thus appears to prefer a shallow, restricted, marine environment. A similar, but smaller form of this species occurs sporadically in the S.dispar Zone and in the Cenomanian.

Eucythere trigonalis (Jones & Hinde, 1890)

This species was only recorded from the Upper Albian of southern England where it first occurs in the D.cristatum Subzone. In southern England it was neither found occurring in association with E.solitaria Triebel, 1940 nor was recorded from the Cenomanian. However, previous

workers have recorded it from the southern North Sea Basin and from East Germany, normally occurring in association with E.solitaria.

Pseudobythocythere goerlichi Mertens, 1956

This species was only recorded abundantly from the Lower Albian of Germany. It was also recorded sporadically from the Speeton Clay (Lower-?Middle Albian) of the southern North Sea Basin. It has only been recorded from the northern 'Boreal' province.

6:3 Evolutionary trends

The changes in the populations of foraminifera and Ostracoda have already been discussed with respect to Albian biostratigraphy, while the 'evolution' of individual species has been discussed in the taxonomic sections.

Many genera and species exhibit drastic changes in their size and ornamentation during the Albian Stage of southern England while many species also exhibit these changes geographically. In southern England, the genera Arenobulimina and Hedbergella have been shown to increase their test size during the Albian while species of the genera Cornicythereis, Platycythereis and Protocythere generally decrease in size. With the exception of species which are limited to shallow-water, marginal marine facies, the bulk of Albian foraminifera show a significant increase in test size during the Middle and Upper Albian, while the majority of Ostracoda exhibit marked decreases in their carapace size. The increase in size of specimens of Hedbergella has already been suggested to be predominantly the result of an increase in the nutrient supply. This ecological parameter is inexorably inter-related with the general increase in depth, stratigraphically, of the Albian Sea. Indeed, the rate of increase in size of many of the species of

foraminifera, and the decrease in size of Ostracoda can be directly related to this increase in depth. Although most species of Ostracoda exhibit this decrease in size, both C.cornueli and V. florentinensis are larger in size in the marginal Upper Greensand facies. Thus, it appears that depth/temperature is the fundamental parameter controlling the size of species and that many species are larger in shallower (warmer) water. Whatley (pers.comm., 1978), stated that in non stenothermal (i.e.widely eurythermal) species, an almost inevitable increase in size with increasing latitude occurs. He also suggested that a general diminution in size in species of the genera concerned in the Albian might be related to a shift in climatic belts. Neale (pers. comm., 1979), suggested a similar control of the size of species. Thus, it appears that the major ecological parameter controlling the size of Recent ostracod species is temperature, with species increasing in size with increasing latitude (decrease in temperature). However, the decrease in size of Albian species should indicate an increase in temperature, stratigraphically, during the Albian which both the planktonic foraminifera and oxygen isotopic analysis indicate.

While the morphological change, especially in size, of the foraminifera is invariably gradual and very closely related to the change in depth, the changes in morphology of the Ostracoda are both gradual and rapid. C.larivourensis, Platycythereis sp.A.sp.nov.,and P. lineata all exhibit gradual morphological changes stratigraphically during the Albian, while the C.hirsuta/reticulata/thoerenensis plexus changes both gradually and in a series of evolutionary 'jumps' which are approximately half the value of the size ratio of instars indicated by Copes Rule. C.ex.gr.C.lurmannae exhibits a very great degree of morphological variation during the Albian and generally becomes smaller with less reticulation.

The 'evolution' of the foraminifera and Ostracoda is also discussed in the following section in relation to the change in depth (stratigraphically) of the Albian sea. This shows that the occurrence of 'dwarfed' specimens and large specimens (similarly to Recent examples) is related to the ecological tolerance of species and to the stability of the environment. Thus, many of the Middle Albian species of southern England may merely be ecophenotypic variants in restricted marine environments of species that are typically open marine.

6:4 Faunal Provincialism

Price (1975, 1977b) has already illustrated the difference between the Lower Albian faunas of the Saxony Basin and of the Aube region of France. He concluded that these marginal marine areas possessed isolated faunas because of a lack of large scale circulatory movements, and suggested that this was due to these basinal areas being semi-enclosed seas. In this study, the situation has been clarified, and it has been shown that the German basin was mainly influenced by a contact with the southern North Sea Basin and that the Paris basin was mainly influenced by the connection with the Tethys to the South. This 'Boreal' influence continued throughout the Albian in the northern province as did the 'Tethyan' influence in the Anglo-Paris Basin.

As the Albian sea deepened during the Middle Albian the clay facies became the dominant lithology in the basinal areas and the connection between the northern and southern basinal areas was greater. The presence of F.washitensis in the Middle and lower Upper Albian of the Anglo-Paris Basin and the absence of this planktonic species in the northern Boreal province indicates that, at this time, a marked barrier still existed between these two faunal provinces. However, during the basal portion of the Upper Albian there is evidence from

the hedbergellid population that there was a major connection between the two basinal areas. The major transgressive phase during the H. varicosum Subzone increased the connection between the two basins and resulted in both the planktonic and benthonic populations showing greater similarity. Indeed, by the S.dispar Zone, the stratigraphic distribution of G.bentonensis appears to be identical in the Anglo-Paris, southern North Sea, German and northern North Sea Basins. However, even in the Upper Albian, the benthonic populations still reflect the sedimentary facies, palaeolatitude and depth of habitat.

The distribution and major changes in the microfaunal populations of the Albian can be related to the depth model for the basin at this time (fig. 7:1). This schematical diagram illustrates the distribution of certain groups in relation to depth. Three depth provinces have tentatively been suggested: shallow marginal marine, restricted marine and open marine. The 'shallow marginal marine' province is typified by low specific diversity, dominance of the Lituolacea and lack of planktonic foraminifera. The 'restricted marine' province is dominated by the Robertinacea with large numbers of small Cassidulinacea and small numbers of planktonic foraminifera. In addition, many dwarfed specimens of typically 'open marine' species are present while the species S.asperula and B.textilarioides are limited to this province, and the genera Cythereis, Schuleridea and Cytherelloidea first appear. The 'open marine' province is characterised by an increase in abundance of miliolids and specimens of the genus Arenobulimina. Planktonic foraminifera form a high percentage of the population while the Nodosariacea are larger in size and also form a higher percentage of the population. B.pseudoseptentrionalis, and many small species of Ostracoda (Eucytherura, ?Loxoconcha, Orthonotacythere) first appear. This association of small species of Ostracoda with increasing depth is even more noticeable in southern England at the mid-Cenomanian

non sequence, when many of the remaining large species of Ostracoda disappeared (Weaver, MS.). This change in the ostracod population is probably related to the increase in depth across this horizon (Bailey & Hart, 1979).

Both foraminifera and Ostracoda exhibit greater species diversity in the 'open sea' province than in the marginal marine province. Also, in the open marine environment, the foraminifera appear to become larger while there is a complementary decrease in the size of many species of Ostracoda.

Sedimentary facies are also an important factor in determining the distribution of species in the Albian. The Red Chalk facies, which has already been discussed, and the Upper Greensand facies are the best examples of this. All the recorded populations from the Upper Greensand show marked differences from the stratigraphic equivalents in the Gault Clay. However, there are also markedly different faunas within the Upper Greensand facies with the populations from Compton Bay and Cauville showing greater affinity to the Gault Clay populations while those of Seaton Bay, Devon show very little affinity to either those of the Upper Greensand further to the East, or to the Gault Clay populations. A similar fauna to that recorded from Seaton was recorded from Pinhay, Devon by Kaye (1965) indicating that a distinct faunal province is present in the Upper Greensand of Devon, the fauna probably indicates a high energy, shallow, open marine environment.

Price (1975) described several Albian biogeoprovinces which he defined by utilising planktonic foraminifera. These he interpreted as indicating a mobile Tethyan/Boreal interface associated with a gradual warming during the Albian. The present author has already discussed the change in the planktonic populations and has shown that these largely indicate a change in depth, which in shallow epicontinental

shelf seas, is a major factor controlling the distribution of planktonic foraminifera. This has been clearly illustrated by Hart & Bailey (1979) and Hart (1980) whose depth interpretation models for Albian planktonic foraminifera have shown the relationship between depth habitat and the first appearance of species. This factor, in the Cretaceous shallow epicontinental seas, controls distribution of planktonic species more than temperature. However, changes in the ostracod populations could be interpreted as supporting the gradual warming which Price (1975) suggested.

The distribution of the planktonic species (based on the Glyndebourne borehole) recorded in this study have been interpreted as indicative of shallow-water forms (with the exception of G.harrisi and H.moremani which are probably slightly deeper water forms). Because of the complex relationship between depth and temperature in controlling the distribution of planktonic species only a tentative model of biogeoprovinces of planktonic foraminifera is proposed in this account. These, when defined, should not be based on information from shallow epicontinental sea sediments.

CHAPTER 7

PALAEOECOLOGY

The study of Recent microfaunal populations has indicated that many ecological parameters influence the distribution and morphology of species. Some of these parameters are discussed separately below.

7:1 Depth

Many models have been proposed which attempt to estimate the relative and absolute depth of the Albian Sea. The models for relative depth are mainly based on lithological evidence while those for absolute depth are mainly based on palaeontological evidence.

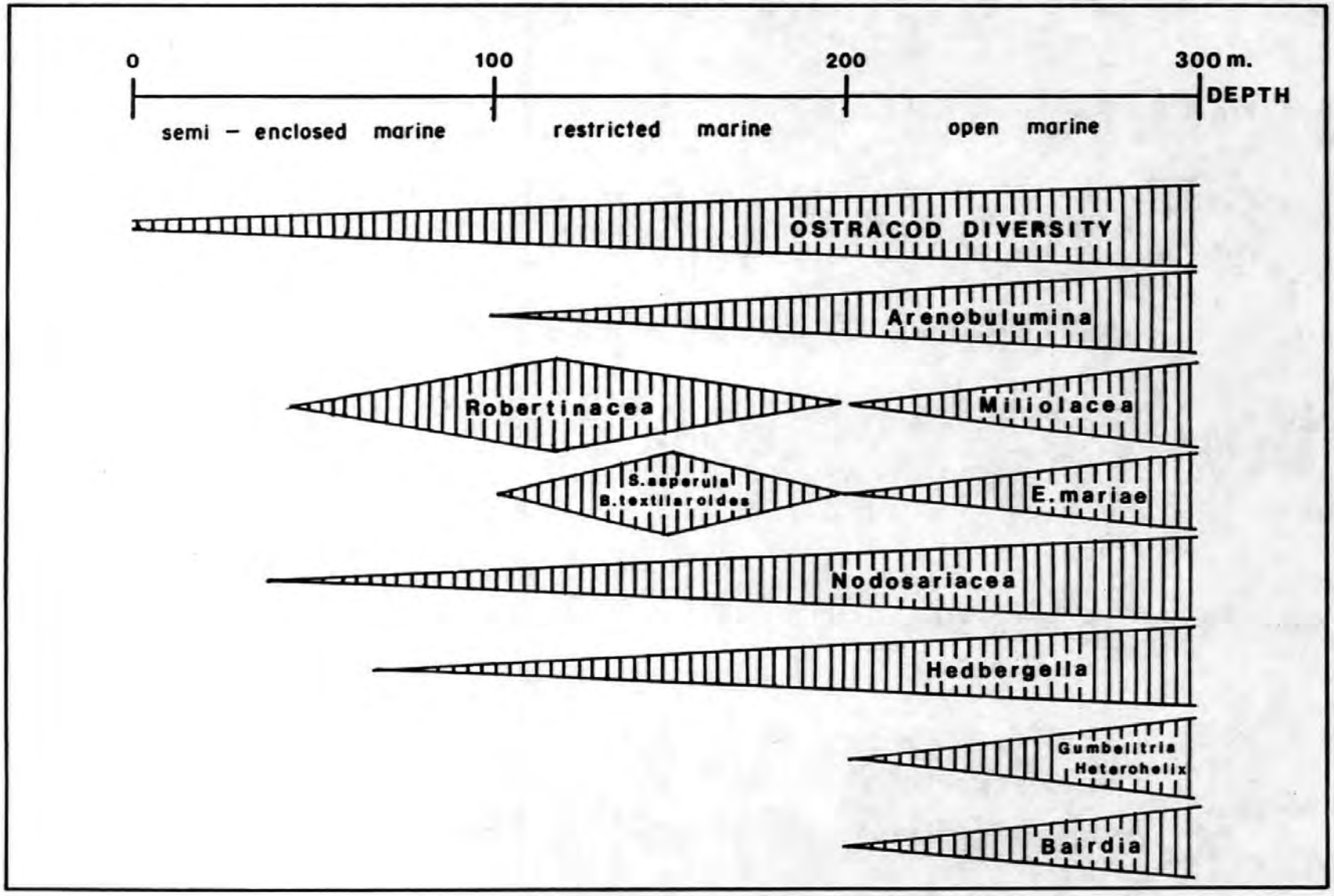
Several of the early Albian workers such as Price (1874) and Jukes-Brown & Hill (1900) appreciated the shallow marine nature of the Albian sea in southern England. They suggested depths, based on Mollusca, of 100 fathoms, and between 150 and 180 fathoms respectively. Chapman (1898) was the first to appreciate that the Upper Albian was deeper than the Middle Albian and (based on foraminifera) suggested depths of 830 fathoms for the Lower Gault and 860 fathoms for the Upper. Khan (1950), suggested a more realistic depth of 180 fathoms for the Gault Sea of southern England, he also noted that this tended to confirm the view of Jukes-Brown & Hill (1900). The most recent publication to suggest absolute depths for the Gault sea was Rosen (1977), who based his conclusions on hermatypic corals. He proposed a depth of 0-45m. for the Haldon Coral bed and a depth between 90 and 250m for the Gault Clay of Folkestone. This latter figure is shallower than the figures proposed by the early workers. In the present study, the planktonic:benthonic ratio has been utilised to propose both the absolute depth and the relative changes in depth of the Albian Sea at Glyndebourne. This is discussed more fully in the next section where depths of 100-200m for the Middle/Upper Albian and 200-300m.

for the S.dispar Zone are proposed.

The relative depth of the Cretaceous Sea has been discussed by many authors during the last decade. Hays & Pitman (1973), demonstrated the relationship (quantitatively) between plate tectonics, the volume of the mid-oceanic ridges, and the relative depth of the Cretaceous Sea. They proposed a major pulse of rapid spreading, at most of the mid-oceanic ridges between 110 and 85 M.a., to explain the gradual deepening of the sea throughout the Albian Stage. The later models of Cooper (1977) and Hancock & Kauffman (1979) proposed detailed models for Albian transgressions and regressions based essentially on sedimentological evidence, and also provided independent evidence as to the presence and the nature of these transgressions and regressions. However, Cooper and Hancock & Kauffman differ markedly in their interpretations with Cooper suggesting two major transgressive phases and three major regressive phases, while Hancock & Kauffman proposed one major transgressive phase with several minor regressive phases.

Further independent evidence indicating the transgressions and regressions of the Cretaecous has been obtained from the morphological types of planktonic foraminifera. Hart & Bailey (1979) proposed depth habitats for several of the Cretaceous planktonic foraminifera by comparison to Recent species. By comparing these depth habitats and the first occurrence of species, a depth model was proposed for the mid-Cretaceous of northwest Europe, in which they suggested that during the Albian a major deepening phase occurred at the level of the D. cristatum Subzone. This was followed by a regressive phase which continued throughout the majority of the M.inflatum Zone, a minor regression at the end of this Subzone, and a further, larger, transgressive phase in the S.dispar Zone, up to the level of the 'Glauconitic Marl'. In the present study, planktonic foraminifera have already been utilised in the definition of a number of Biohorizons

Fig. 7:1 A generalised diagram illustrating the depth distribution of some microfossils in the Gault Clay facies of southern England (based on information from the Glyndebourne borehole).



from the Glyndebourne section. These Biohorizons were defined mainly on the change in the population of hedbergellids and the variation in the planktonic/benthonic ratio. Both the morphology of individual species and the planktonic/benthonic ratio have been shown, by a succession of publications on Recent planktonic foraminifera (especially Boltovskoy & Wright, 1976; Bé, 1977), to be directly related to the environment. The planktonic/benthonic ratio in shallow marine conditions has been shown to be a direct function of depth, the larger ratios occurring in deeper water. This information has been utilised in the following interpretation of the depth of the Albian Sea which is based on the Glyndebourne borehole.

The first occurrence of planktonic foraminifera at Glyndebourne is during the middle of the A.intermedius Subzone and is thought to reflect a rise in sea level. After this horizon planktonic foraminifera were recorded throughout the section. The next major increase in the number of planktonic individuals was recorded at the base of the D.niobe Subzone, which is also interpreted as indicative of a rise in sea level. From this horizon, which has a P/B ratio of 1:10, the number of planktonic foraminifera in the population gradually increase to the top of the H.varicosum Subzone which has a P/B ratio of 1:1. At this horizon the most marked deepening occurs. There was a marked drop in the P/B ratio during the C.auritus Subzone which may indicate a lowering of sea level or a stillstand. This was closely followed (topmost C.auritus Subzone) by a large increase in the P/B ratio to 4:1. This ratio was also recorded throughout the S.dispar Zone with the exception of the M.rostratum Subzone which has a much lower P/B ratio. This drop was largely due to the cooling of the surface water and is probably not related to a change in water depth. The ratios obtained for the Middle/Upper Albian boundary and for the topmost Albian of the Glyndebourne borehole are similar to those

obtained by Carter & Hart (1977) and Price (1977b). These may indicate depths (Boltovskoy & Wright, 1976) of about 100-200m for the Middle/Upper Albian boundary and between 200 and 300 m for the topmost Albian. The Lower and Middle Albian sea in southern England was shallower than 100-200m.

If it is assumed that the planktonic/benthonic ratio for the Glyndebourne borehole is a direct reflection of the depth of the Albian Sea, then this interpretation (fig. 7:2) is very similar to that proposed by Hancock & Kauffman (1979). It differs only in dating the major Upper Albian transgressive phase as H.varicosum subzonal age, and not of H.orbignyi subzonal age as Hancock and Kauffman suggested.

During the Albian of southern England the sea gradually deepened with a minor shallowing or stillstand phase during the C.auritus Subzone. The depth of the sea changed from less than 100m in the Lower and lowest Middle Albian to a maximum of 300m in the topmost Albian.

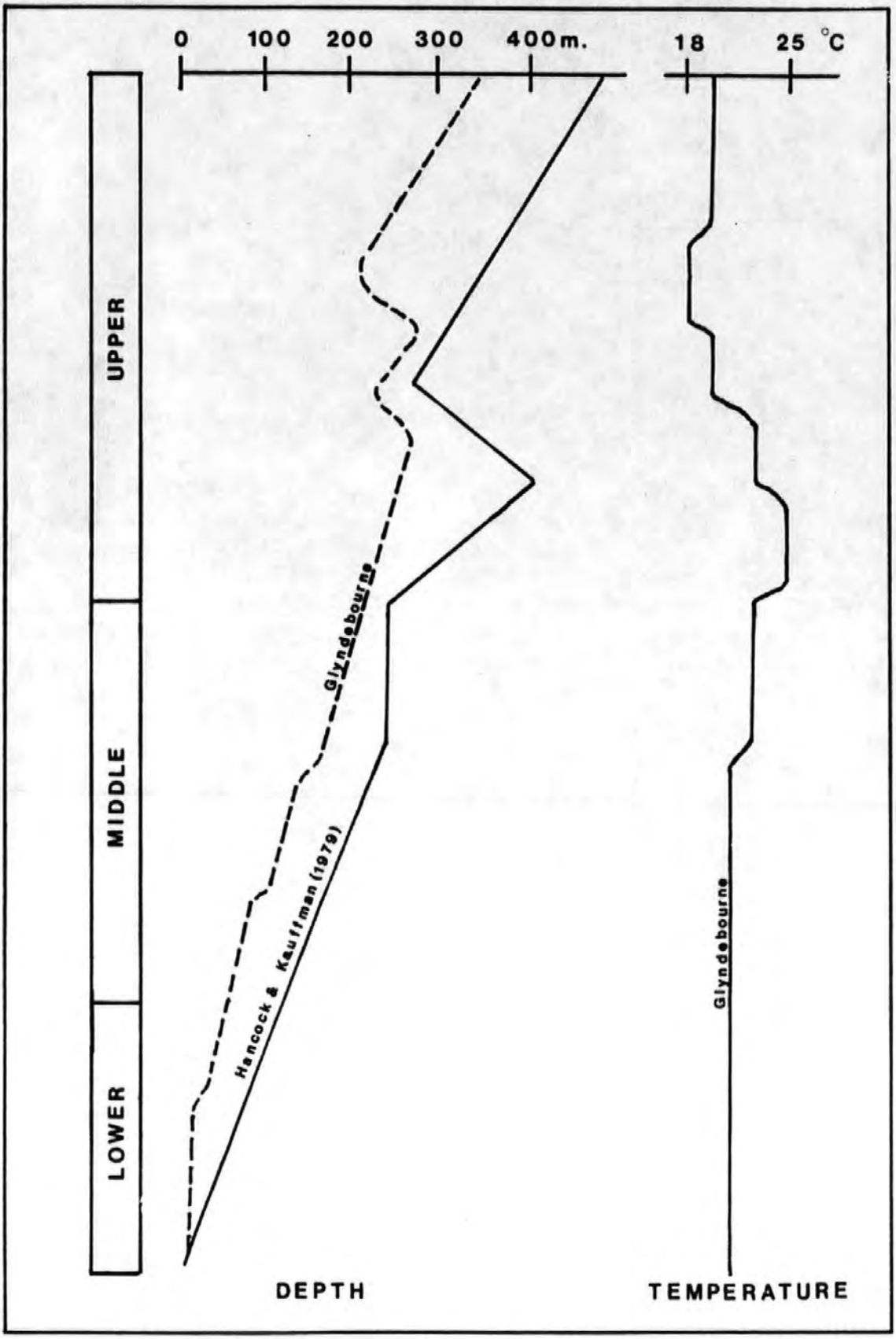
7:2 Temperature

Several attempts have been made to estimate the palaeotemperature of the Aptian, Albian, and Cenomanian Stages. These have either utilised the oxygen isotope method or have been based on a comparison of the faunas of those stages with those of the Recent.

From the oxygen isotope data (Lowenstam & Epstein, 1954; Bowen, 1961) it can be concluded that the water temperature ranged between 20 and 25°C for the Aptian and Albian Stages of northwestern Europe. This information also appears to indicate that the Cenomanian Stage was markedly cooler and that this change did not occur until after the deposition of the Cambridge Greensand (lowest Cenomanian).

Douglas & Savin (1978) applied the oxygen isotope method to Cretaceous planktonic foraminifera and proposed a depth stratification

Fig. 7:2 A generalised reconstruction of the water depth and the surface water temperature of the Albian sea of southern England.
(based on information from the Glyndebourne borehole).



of Cretaceous planktonic foraminifera. They also showed that there was a consistent relationship between the shell morphology of species and their depth habitat at least back into the Cretaceous.

During the Albian of southern England the species diversity of planktonic foraminifera gradually increases. In the Recent seas this increase in diversity has been shown to be directly related to a decrease in latitude, the higher diversity faunas occurring nearer the equatorial regions. This evidence was used by Price (1975) to propose an increase in temperature during the Albian. However, this increase in species diversity of the planktonic foraminifera during the Albian of southern England has, in the preceding section, been shown to be mainly the result of an increase in the depth of the Albian Sea. The relationship between species diversity and temperature is difficult to estimate when the depth of the shallow epicontinental seas also changes. This is especially true in the topmost Albian (C.auritus Subzone to the Cenomanian) where the increase in species diversity of the planktonic fauna is directly related to the appearance of an 'open sea' environment, which is the result of a marked increase in depth during the H.varicosum Subzone.

Two Albian planktonic species have been interpreted as indicative of changing temperature; F.washitensis and G.bentonensis. F.washitensis was recorded sporadically in the Glyndebourne section ranging from the base of the D.niobe Subzone to the H.varicosum Subzone. G.bentonensis was recorded abundantly from the M.rostratum Subzone and rarely in the higher Albian Subzones. These species have both been recorded commonly from northwestern Europe and have been used to interpret the depth of the Albian Sea. Both F.washitensis and H.delrionensis have homeomorphs in Recent oceans. The distribution of these recent species was discussed in detail by Bé (1977), and these are documented in the following table:-

Albian Species	Recent Homeomorph	Habitat
	(*Globigerina falconensis*	mainly Subtropical
H.delrionensis	(	(18-24 °C)
	(	
	(*Globigerina quinqueloba*	Subarctic, in upper
		50m. (18-0 °C)
	(*Globoquadrina dutertrei*	Subtropical/transitional;
F.washitensis	(	50-150m., 24-10 °C.
	(	
	(*Globigerina rubescens*	Tropical/Subtropical;
		top 50m. (18-30 °C)

If these four species are considered (due to their similar morphology) as functional homeomorphs of the Albian species then *F.washitensis* should be considered a Transitional to Tropical water species (0-150m. depth;10-30°C) and *H.delrionensis* should be a cooler water and more ubiquitously distributed species than *F.washitensis*.

From the stratigraphic and geographic distribution of *F. washitensis*, and a comparison to the distribution of *G.rubescens* in Recent seas, a surface water temperature between 20 and 30°C is proposed for this species in the Albian. The less reticulate specimens of *F.washitensis* are similar in their ornamentation to the modern species *G.dutertrei* and may thus be indicative of Subtropical to Transitional waters (10-24°C). Both strongly and weakly reticulate forms of *F.washitensis* occur in the Glyndebourne borehole. These forms have a distinct stratigraphic distribution with the strongly reticulate forms occurring most abundantly during the *D.cristatum* and *H.varicosum* Subzones. This increase in strongly reticulate forms of *F.washitensis* is associated with a decrease in numbers of *H.delrionensis*. Many specimens of this species have lost much of their surface ornamentation and this change in morphology of the *H.delrionensis* population is associated with an increase in the abundance of *H.planispira*.

The occurrence of the strongly reticulate specimens of F.washitensis is, therefore, regarded as indicative of a warming of the surface water during these Subzones. This temperature increase is also reflected in the abundance and morphology of H.delrionensis which, in southern England, nears its ecological limit during these Subzones and is partially replaced in the population by H.planispira, which does not appear to be effected morphologically by this increase in temperature. The last occurrence of F.washitensis in the H.varicosum Subzone is associated with a large increase in abundance of planktonic foraminifera, especially of H.delrionensis. This is associated with a marked increase in size of the H.delrionensis population.

The distribution of G.bentonensis within the S.dispar Zone has been interpreted by Hart (1973a) and Price (1977b) as indicative of a cooling period. G.bentonensis first occurs in abundance during the early part of the M.rostratum Subzone and ranges 'in flood' through much of this Subzone and sporadically through the later Subzones and into the Cenomanian. Masters (1977) showed that this species also occurred commonly in the Tethyan region. If the appearance of this species, which is also associated with the first appearance of Ticinella primula, Schackonia cenomana, and S.multispinata (see Price 1977b), and an increase in abundance of G.harrisi, and H.moremani, is considered to be directly related to this increase in diversity of the planktonic foraminiferal fauna, then a marked increase in water temperature would be indicated (Bé,1977). However, with the exception of G.bentonensis, which is here regarded as a shallow water planktonic species (e.g. the presence of this species at Melton and Hunstanton), the first appearance of these species is mainly controlled by the increase in depth during the Upper Albian and not by temperature. If only the shallow water planktonic species are considered then the following temperature model can be constructed based on the distribution of species in northwestern Europe:-

Biogeoprovince I c.24°C	Strongly reticulate specimens of F.washitensis, rare poorly hispid H.delrionensis, abundant H.planispira.
Biogeoprovince II	Poorly reticulate F.washitensis, abundant H.delrionensis and H.planispira.
Biogeoprovince III	Abundant H.delrionensis and H.planispira.
Biogeoprovince IV	Abundant H.delrionensis, rare H.planispira.
Biogeoprovince V c.18°C	Abundant G.bentonensis, moderately common H.delrionensis, rare H.planispira.

These biogeoprovinces indicate a cooling in the topmost Albian which corroborates with the oxygen isotope results of Bowen (1961). This cooling was most marked during the M.rostratum Subzone.

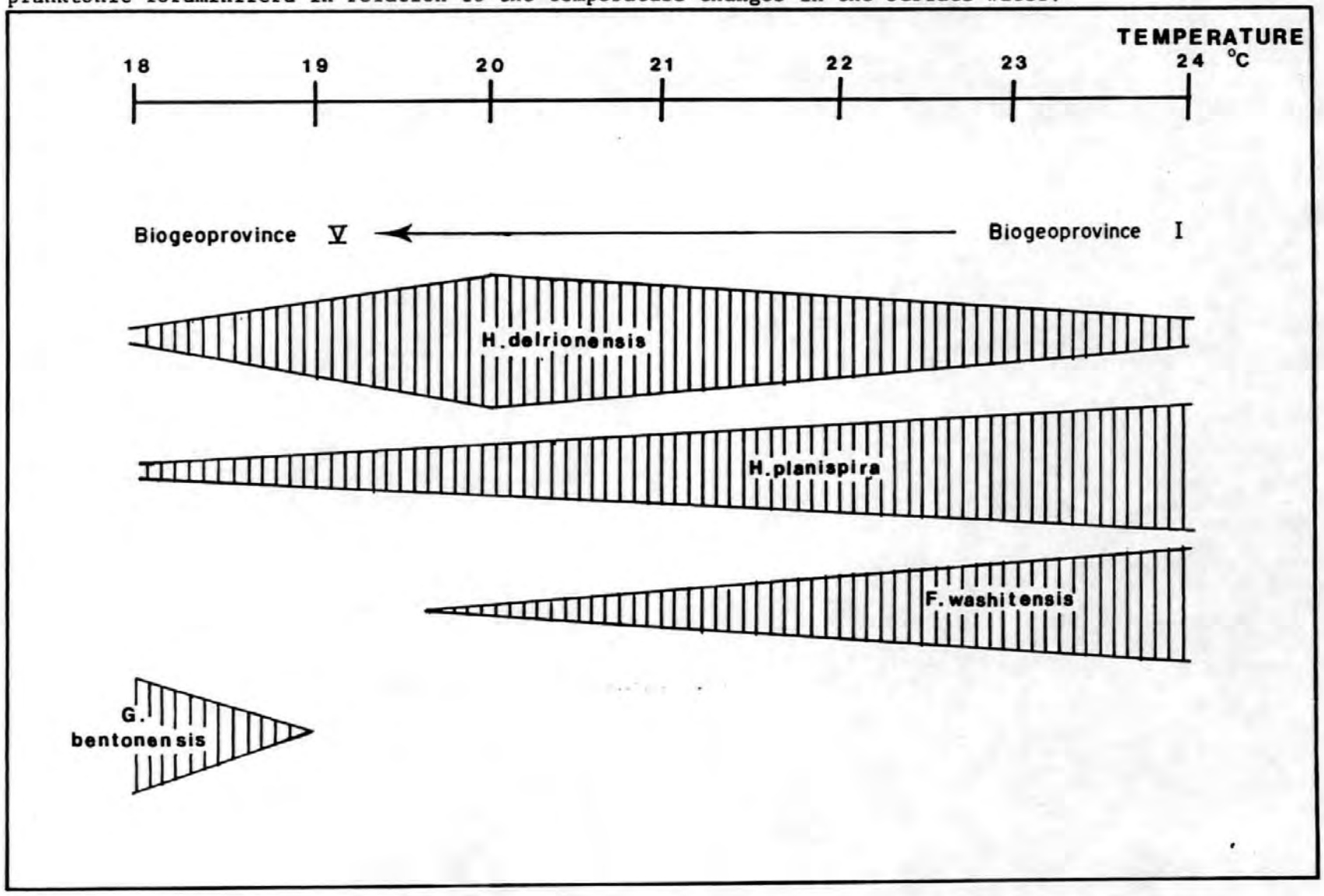
The coiling ratio of the species H.delrionensis and H.planispira was also recorded for the Glyndebourne borehole. For both species a ratio of 1:1 was recorded (fig. 8:12) throughout the Middle and Upper Albian indicating that the coiling ratio of these species during the Albian did not vary with variation in temperature.

The stratigraphic and geographic distribution of the planktonic foraminifera in the Albian of northwestern Europe indicates that there were substantial changes in the temperature of the surface water during the Albian. Both F.washitensis and G.bentonensis are important indicators of palaeotemperature.

7:3 Nutrient supply

Be (1977) showed that the test size of G. sacculiferer (Brady, 1877) is a direct function of the nutrient supply in the surface waters - the test size increasing with increasing nutrient supply. During the Albian of southern England two marked changes occur in the size of the H. delrionensis population (figs.4:4-4:7). The first occurs during the E.meandrinus and the E.nitidus Subzones, while the second occurs in the mid-H.varicosum Subzone and continues into the Cenomanian. These

Fig. 7:3 A generalised diagram which illustrates the distribution of the shallow water (0-50m.) planktonic foraminifera in relation to the temperature changes in the surface water.



may indicate an increase in the nutrient supply during these time intervals, the former representing a short term increase in nutrient supply, and the latter representing a more significant increase which is associated with the change from 'restricted marine' conditions to 'open sea' conditions. The increase of the nutrient supply in the topmost Albian may also be responsible for the increase in size of many of the benthonic foraminifera during this time interval.

The nutrient supply was a significant factor controlling the size and abundance of the populations of Albian Ostracoda and foraminifera.

7:4 Light

Bé (1977) showed that the size of the Recent planktonic foraminifera, Globigerinoides sacculiferer (Brady,1877), is related to the supply of light and that the size of the species generally increased with increasing light supply. The size changes described in the preceding section may also be partially due to an increase in the light supply in the surface waters. The high amount of water turbulence (Owen, 1971b) in the Middle and lower Upper Albian was replaced by deeper quieter depositional conditions in the topmost Albian which resulted in a decrease in the water turbulence and hence an increase in the light supply.

7:5 Carbonate

Magniez-Jannin (1975) showed that the amount of carbonate in the Gault Clay of the Aube district of France was relatively stable in the Lower and Middle Albian but increased at the top of the Middle Albian. This increase continued through the Upper Albian and reached a maximum in the Vraconian.

Price (1977b) stated that the precipitation of carbonate was probably related to temperature increase within the Albian Sea and to

the Tethyan invasion of the Boreal realm as indicated by the foraminifera.

Black (1972) stated that much of the white Chalk is formed of coccolith debris. The increase in carbonate in the deposition of organic carbonate, especially of coccoliths, towards the Chalk boundary. Thus the increase in carbonate in the Gault Clay of the Anglo-Paris Basin, which was documented by Magniez-Jannin, may also be directly related to the increase in abundance of coccoliths due to increased depth and nutrient supply.

7:6 Salinity

This ecological parameter has been particularly well documented in Recent seas. From the distribution and type of sedimentary deposit in the early Albian it is clear (Figure 1:4) that the sea was more restricted than it was in the Upper Albian.

Boltovskoy & Wright (1976,p.145) summarised research on Recent enclosed and semi-enclosed seas and showed that the specific diversity of the foraminiferal populations decreased with decreasing salinity:-

Locality	Salinity ‰	Species diversity
Black Sea	19	25 species
Caspian Sea	13	9 species
Aral Sea (enclosed)		4 species

Living planktonic foraminifera are known to be restricted in Recent seas to normal marine salinities. They first occur in the Paris Basin in the topmost Lower Albian, in southern England in the A. intermedius Subzone, and in the basal Middle Albian of Germany. Thus, the distribution of planktonic foraminifera indicates that normal marine salinities must occur in the Lower Albian. The low species diversity of the foraminiferal faunas, and the dominance of agglutinated species in the Lower Albian clays of Germany and the Aube

are associated with the presence of ammonites, which indicate normal marine salinity. These deposits probably represent very restricted marine environments of normal marine salinity. Black (1971) also recorded a coccolith fauna from the Lower Albian clays of Speeton, Yorkshire, and concluded that this indicated normal marine salinities.

Although several of the foraminiferal faunas of northwestern Europe are of low specific diversity, they still indicate normal marine salinity, but in restricted, possibly semi-enclosed seas.

7:7 Substrate

The major sedimentary facies have been discussed in an earlier chapter. Each of these facies has a different influence on the preservation potential of the fauna, these are summarised below:-

a) The Greensand fauna is generally poorly preserved due to decalcification and to the grinding action of the sand on the calcareous tests and carapaces both during the deposition of the sediment and during diagenesis.

b) The Gault Clay fauna is generally well preserved. In the Lower Albian clays of Germany many of the agglutinated specimens appear compressed. The compression is probably post-depositional. The marlier clay faunas of the uppermost Gault Clay are generally less well preserved due to the partial decalcification and recrystallisation of the fauna during diagenesis.

c) The Red Chalk fauna is generally poorly preserved due to partial decalcification and to recrystallisation which occurred during diagensis. These problems are complicated by the difficulty in processing the Red Chalk.

Although the preservation potential in the various sedimentary facies is marked the underlying effect of the various facies on the fauna is still apparent. This is most obvious within the lithological

units of the Greensand where there is marked variation of the fauna. In the Lower Greensand microfossils are invariably absent although very rare agglutinated specimens have been recorded and casts of foraminifera have been found. In contrast, although the Upper Greensand and 'Glauconitic Marl' do not contain as rich a fauna as the Gault Clay, sufficient specimens were recorded to indicate that many of the faunas were markedly different from those of the Gault Clay. Also, the fauna recorded from the topmost clay and lowest Upper Greensand of Seaton Bay showed little similarity with that recorded from the Gault facies, while the faunas from Compton Bay and Cauville showed greater similarity with the Gault Clay fauna. These differences mentioned above may be due to the sedimentary facies or to the variation in depth between the localities. Both these factors probably contribute to the characteristic Seaton Bay assemblage which has been interpreted as indicative of a shallow water, high energy environment.

In the southern North Sea Basin the fauna is markedly different to that in southern England mainly due to the presence of the 'Boreal' influence. The effect of the Red Chalk sedimentary facies on the fauna is difficult to assess. However, some intraspecific variation is due to the presence of this sedimentary facies, this includes loss of frills and reticulation by many species of the genus Cythereis, and the presence of smoother, less rugose, test surfaces in species of the genus Arenobulimina. Lateral variation was also recorded within the Red Chalk facies with greater numbers of planktonic foraminifera and fewer Ostracoda occurring in deeper offshore deposits from Block 49.

The effect of sedimentary facies on the benthonic fauna during the Albian was largely masked by more significant changes in the environment, mainly depth and temperature. Within facies, marked

lateral variations in populations have been observed which mainly reflect changes in depth.

7:8 Summary

The major controlling factors in the 'evolution' and distribution of Albian microfaunal populations are depth variation and temperature. Variations in the nutrient supply and sedimentary facies also have significant effects while no salinity variations have been detected. Many of the chronospecies and chronosubspecies that have been defined from the Albian exhibit this variation both stratigraphically and laterally. Many of the 'evolutionary changes' are the direct result of changing depth and nutrient supply and are represented by intraspecific variation. Since many of the changes in the benthonic populations are environmentally controlled they are of only very limited, local, stratigraphic significance in the Albian of northwestern Europe where most of the major ecological parameters changed drastically both stratigraphically and laterally. The environmental control of the planktonic populations was also marked, however, these changes are of much greater stratigraphic significance.

The lithologies of localities examined varied from shallow nearshore sands to offshore clays and marls, and were deposited at depths between 0-100m and 300m. Normal marine salinity prevailed and the surface water temperature varied from c.25°C to c.18°C. The change in water depth during the Albian had a profound effect on the area of landmass which was drastically reduced by the Cenomanian.

CHAPTER 8

STRATIGRAPHIC CONCLUSIONS

Introduction

Many zonal schemes have been proposed for the Albian Stage of northwestern Europe and these have been discussed in the introductory chapters. The problems relating to the definition of zonal schemes are mainly related to the inbuilt philosophical differences between authors but some are due to sampling errors. With the increase in knowledge of Recent populations of foraminifera and Ostracoda the available information for palaeoecological comparisons has increased and a thorough palaeoecological analysis may now be undertaken. This has been attempted in the preceding chapters.

The view that accurate taxonomy is essential to biostratigraphy, although partially correct, ignores, as many previous authors have done, both the stratigraphic range and the palaeoecology of species, a thorough understanding of which must also be essential to precise taxonomy. Thus all the above points must be completely interconnected and none can truly be isolated. An accurate biostratigraphy should, therefore, be defined on a thorough study of all these topics.

In the previous chapters the taxonomy and distribution of individual species have been discussed in detail and the palaeoecology of species has been interpreted in relation to the proposed palaeoecological model for the Albian. This chapter is a summary of all the information which has been used to create a multi-phyletic zonation. The zonal schemes are mainly defined on information from the Glyndebourne borehole. However, several major stratigraphic gaps are present in this section, and, therefore, information from the Folkestone sections has also been incorporated. The zonal scheme is an attempt to utilise the 'total fauna'. However, within the limits of this thesis only the foraminifera and Ostracoda could be studied in

detail. Separate zonal schemes were erected for both the foraminifera and the Ostracoda, each of which was related to the macrofaunal zonation. This study of the 'total fauna' has indicated that a number of very distinct biohorizons exist, which reflect major changes in the shallow epicontinental Albian sea, and can be correlated outside the distribution limits of the species on which the zonal schemes are defined. In this study the changes in the populations of planktonic foraminifera have been used to define these biohorizons. These have been shown to directly reflect both changes in surface water temperature and depth of the water column. They therefore indicate changes in the total marine environment.

The study of the 'total fauna' has been limited in the past by the premise that different 'groups' or different species do not necessarily evolve at similar rates. While this may be a correct assumption in a relatively stable environment, during the Albian very marked changes occurred in the environment which are reflected in fundamental changes in both the 'total fauna' and in evolutionary lineages. These changes, whilst themselves not instantaneous, are reflected by a change in the 'total fauna', which in stratigraphic terms is sufficiently rapid for the biohorizons to be recognised. This assumption is inherent in many of the previously defined zonal schemes and partially explains the coincidence of many of the macrofaunal and microfaunal zonal boundaries (figs.1:2, 8:1).

In the following sections separate zonal schemes have been proposed for the planktonic foraminifera, benthonic foraminifera, and Ostracoda. These are then compared to the macrofaunal zonal scheme and a multi-phyletic zonal scheme proposed.

8:1 PLANKTONIC FORAMINIFERA (figs. 8:1, 8:2, 8;11, 8:12)

Many authors have discussed the genus Hedbergella and its

Fig. 8:1 The proposed zonal scheme (based on information from the Glyndebourne and Folkestone sections).

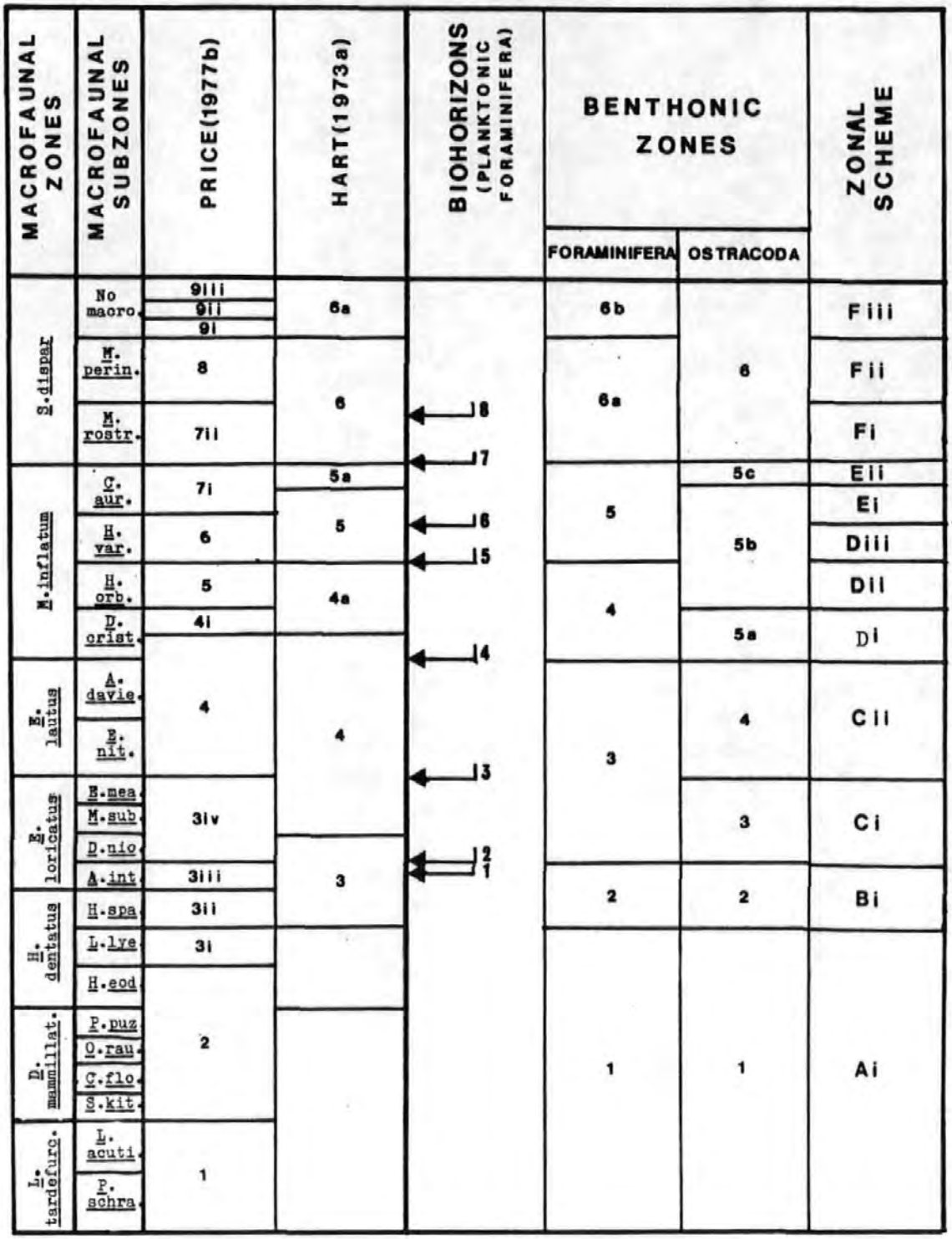


Fig. 8:2 The stratigraphic ranges of the zonally significant foraminifera (taxonomic order) based on information from the Glyndebourne and Folkestone sections.

LOWER					MIDDLE							UPPER							SUBSTAGE
L.(L.)tard-glauca		D.mammill-atum			H.(H.)dentatus			E. loricatus			E.lautus		M.(M.)inflatum				S.dispar			MACROFAUNAL ZONE
L. schran.	L. acutic.	S.kitch.	C.flor.	O.raul.	P.puzos.	H.goden.	L.lyelli	H.spathi	A.int.	D.niobe	M.subd.	E.mean.	E. nit.	A. dav.	D. crist.	H. orb.	H. var.	C. aur.	M. rostra.	M. perinf.	No macro.	MACROFAUNAL SUBZONE
																						A.cretaceus
																						G.gaultina
																						R.minutus
																						C.cylindracea
																						H.chapmani
																						H.nonioninoides
																						T.chapmani
																						T.minuta
																						Textularia sp.A.sp.nov.
																						B.textilarioides
																						F.intermedia
																						G.filiformis
																						G.gradata
																						S.annectens
																						T.pyramidata
																						U.alta
																						A.advena
																						A.chapmani
																						A.sp. cf.A.frankei
																						A.macfadyeni
																						A.sabulosa
																						D.ozawai
																						D.trochus
																						E.mariae
																						P.cretosa
																						S.papyracea
																						N.nodulosa
																						Q.antiqua
																						C.pinnaeformis
																						C.laffitei
																						F.filocinta
																						S.asperula
																						V.parva
																						V.praestans
																						P.ex.gr.P.complanata
																						G.baltica
																						G.cenomanica
																						G.intermedia
																						L.albiensis
																						L.jarzevae
																						C.lamplughi
																						E.cretosa
																						E.spinulifera
																						E.sp.A.sp.nov.
																						H.carpenteri
																						H.chapmani
																						G.harrisi
																						H.moremani
																						G.bentonensis
																						H.delrionensis
																						H.planispira
																						F.washitensis
Ai			Bi	Ci	Cii				Di	Dii	Diii	Ei	Eii	Fi		Fii		Fiii	ZONAL SCHEME

distribution in the Albian Stage of northwestern Europe, and several authors have used the morphological changes which successive populations exhibit in the shallow epicontinental sea to delimit evolutionary lineages. As this genus has been described from the Aptian of the Aube (Damotte & Jannin, 1973) and of Mexico (Longoria, 1977), the first appearance of this genus in the Albian of southern England cannot be due to evolution, but is simply the result of migration. In this study it is suggested that only two species of Hedbergella occur in the Albian of southern England. It is from this changing population that the biohorizons have been defined.

The hedbergellid population has been recorded from the O.raulinianus Subzone onwards in the Paris Basin (Price, 1977b), while its first Albian appearance in southern England is in the A.intermedius Subzone. Similarly (Price, 1977b), G.harrisi has been recorded commonly in clays of L.lyelli to A.intermedius subzonal ages in the Paris Basin while in southern England it does not occur in abundance until the S.dispar Zone. It is not until the deeper seas of the Upper Albian that planktonic species occur more ubiquitously across northwestern Europe. However, even in the Upper Albian, the planktonic population of the Paris Basin has a distinctly 'Tethyan' appearance when compared to that of southern England. The most noticeable absences in southern England being those of T. primula Luterbacher, 1963 and R.appenninica (Renz,1936), both of which occur as close to southern England as the Boulonnais (Robaszynski et.al.,1980). The only species which appears to have a relatively ubiquitous first occurrence over much of northwestern Europe is G.bentonensis. This species has been recorded from southern England and the southern North Sea Basin by the present author, by Magniez-Jannin (1975) from the Vraconian of the Aube, and by Gawor-Biedowa (1972) from the uppermost Albian of Poland. The range quoted by Hart

(1973) is based on an incorrect location of sample points, while that of Price (1977b) is based on insufficient sample points and incorrect placement of macrofaunal zonal boundaries. Both these ranges should be discounted. This species first occurs in southern England at the base of M.rostratum Subzone but only occurs in abundance in the M.rostratum Subzone. However, it does occur in the higher Albian Subzones and the Cenomanian, but only rarely (Carter & Hart, 1977).

The genus Hedbergella dominates the populations of planktonic foraminifera in the Albian of southern England and the southern North Sea Basin. The evolutionary and palaeoecological implications of changes in this population have been discussed in the previous chapters. Below, a number of Biohorizons have been defined on the basis of information form the Glyndebourne borehole. The definition of these biohorizons is based on the absolute abundance of species and the relative proportions of the species H.delrionensis and H. planispira (figs. 8:11, 8:12).

Biohorizon 1

The first occurrence of planktonic foraminifera in the Albian of southern England (mid A.intermedius Subzone).

Biohorizon 2

The first occurrence of abundant H.delrionensis and H.planispira (early D.niobe Subzone).

Biohorizon 3

The occurrence in abundance of H.delrionensis; H.planispira rare (early E.nitidus Subzone).

Biohorizon 4

H.planispira occurs abundantly; H.delrionensis occurs rarely and has a poorly hispid to smooth test surface (early D.cristatum Subzone).

Biohorizon 5

Both H.delrionensis and H.planispira occur rarely and in varying proportions (early H.varicosum Subzone).

Biohorizon 6

H.delrionensis occurs abundantly and dominates the planktonic foraminiferal fauna (mid H.varicosum Subzone).

Biohorizon 7

G.bentonensis first occurs in abundance and H.delrionensis becomes rarer (early M.rostratum Subzone).

Biohorizon 8

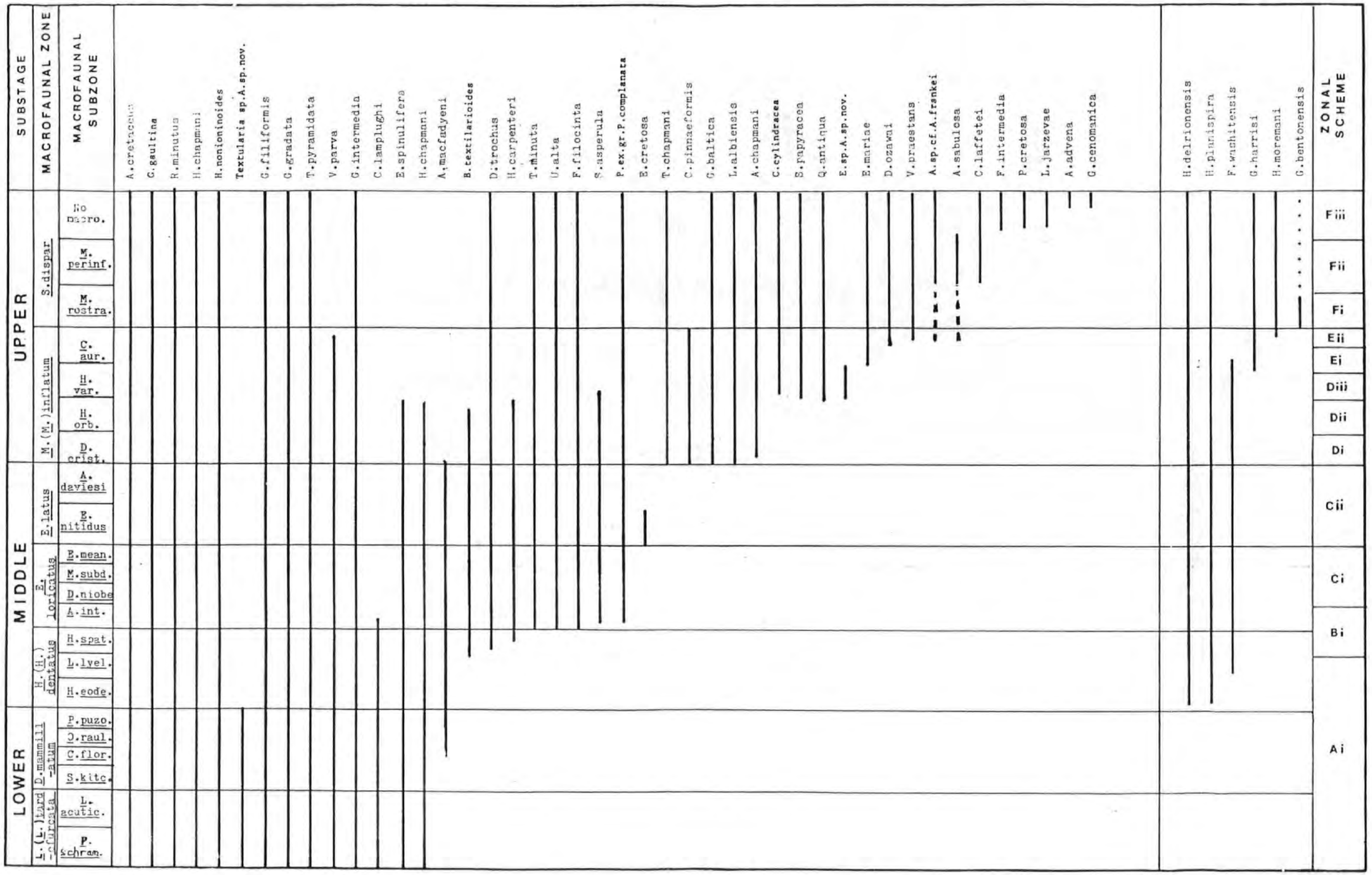
G.bentonensis last occurs in significant numbers, H.delrionensis becomes abundant once again (late M.rostratum Subzone).

All these biohorizons have been recognised at Glyndebourne and Folkestone. They can also be recognised in the M.25 sections and in the Red Chalk of the southern North Sea Basin (fig. 8:60).

8:2 BENTHONIC FORAMINIFERA (figs. 8:1, 8:2, 8:3).

This zonal scheme is a modified version of that proposed by Price (1977b). His Lower and Middle Albian zones having been broadly accepted, however, extensive modification of his Upper Albian zones (5 to 9iii) is now required. The following zones are mainly defined on the first appearance of species but they also use the total ranges of species, and their abundance, where significant.

Fig. 8:3 The stratigraphic ranges of the zonally significant foraminifera (order of first appearance) based on information from the Glyndebourne and Folkestone sections.



N.B. - Ranges in Zone Ai partly based on information from Carter and Hart (1977) and Price (1977b).

ZONE 1: Lower Albian, Type sections from Germany and France.

Assemblage zone: Textularia sp.A/C.lamplughi.

This zone is dominated by long ranging species of agglutinated foraminifera, many of which also occur in the Aptian. Rhizammina cf. dichoma Hagenmeyer; Price, 1977b and Reophax (Haplophragmium) lagenarium (Berthelin); Price, 1977b are limited in distribution to this zone. Textularia sp.A. and C.lamplughi were only recorded commonly in this zone which has been defined from both the Lower Albian clays of the Hannover area, Germany and the Aube region of France.

ZONE 2: Lower/Middle Albian (H.spathi and A.intermedius Subzones)

Type section: Glyndebourne borehole.

Assemblage zone: B.textilarioides/S.asperula.

This zone is one of the gradual appearance of species such as D.trochus, H.chapmani, B.textilarioides, S.asperula, and F.filocinta.

ZONE 3: Middle Albian (D.niobe to A.daviesi Subzones).

Type section: Copt Point, Folkestone.

Assemblage zone: N.nodulosa/E.spinulifera.

This zone is dominated by the Robertinacea and Cassidulinacea. N.nodulosa first appears in this zone. Most species range through this zone, while E.spinulifera, H.carpenteri, G.intermedia, V.parva, T.pyramidata, B.textilarioides, and S.asperula dominate the fauna.

ZONE 4: Upper Albian (D.cristatum and H.orbignyi Subzones)

Type section: Glyndebourne borehole,

Concurrent range zone: E.spinulifera/A.chapmani.

This zone is marked by a major, but gradual, transition in the fauna. T.chapmani and C.pinnaeformis first appear. Transitional

forms between A.macfadyeni and A.chapmani occur at the base of this zone. The top of this zone is marked by the extinction of E. spinulifera, H.carpenteri, H.chapmani and B.textilarioides. G.baltica and L.albiensis also make their first appearance in this zone. The dominance of the Robertinacea is gradually replaced by the dominance of the genus Arenobulimina.

SONE 5: Upper Albian (H.varicosum and C.auritus Subzones).

Type section: Glyndebourne borehole.

Assemblage zone: Q.antiqua/Epistomina sp.A.sp.nov.

This zone is marked by the appearance of A.chapmani and Q.antiqua in large numbers while S.papyracea first occurs commonly. The Robertinacea are represented by Epistomina sp.A.sp.nov., which occurs very sporadically. The upper levels of this zone are marked by the gradual appearance of early forms of A.sp.cf.A.frankei, A.sabulosa, and V. praestans. C.pinnaeformis becomes extinct at the top of this zone.

SUBZONE 6a: Upper Albian (M.rostratum and M.perinflatum Subzones).

Type section: Glyndebourne borehole.

Assemblage zone: A.sabulosa/A.sp.cf.A.frankei

This subzone is marked by the gradual appearance of species of typically Cenomanian aspect which are generally large in size. Characteristic specimens of D.ozawai, V.praestans, A.sabulosa and A.sp. cf.A.frankei appear. L.jarzevae first appears at the base of this zone.

SUBZONE 6b: Upper Albian (Subzone with no macrofaunal equivalent).

Type section: East Wear Bay, Folkestone.

Assemblage zone: G.cenomanica/A.advena.

This subzone is marked by the first appearance of typical specimens of G.cenomanica, A.advena and F.intermedia.

8:3 OSTRACODA (figs. 8:4,8:5)

This is the first detailed zonal scheme for the Albian Stage to be based on Ostracoda. It has been defined on the first appearance, total range, last occurrence, and abundance of species.

ZONE 1: Lower Albian (L.tardefurcata Zone to L.lyelli Subzone).

Type sections from Germany and France.

Assemblage zone: P.goerlichi/C.heslertonensis.

This zone is characterised by P.nodigera, P.goerlichi and several other species of the genus Protocythere. These species are typical of the 'boreal' province. Platycythereis sp.A.sp.nov.,P.albae, and C. heslertonensis range through this zone and D.rara only occurs commonly in this zone. C.cornueli, C.aff.H.nana, N.(C.)denticulata, M.harrisiana, N.(N.)vanveeni, O.fordensis and E.multituberculata first appear in this zone which is defined in the Lower Albian clays of the Hannover area, Germany and in the Aube region, France.

ZONE 2: Lower/Middle Albian (H.spathi and A.intermedius Subzones)

Type section: Glyndebourne borehole.

Assemblage zone: P.laminata/C.aff.H.nana.

This zone is characterised by the first appearance of many species. S.jonesiana, S.dimorphica, H.fragilis, M.umbonata, H.euglyphea and C.nanissimum first occur in the basal part of this zone. P.derooi and P.laminata have only been recorded from this zone. C. chapmani, D.bosquetiana, and P.harrisiana first appear within this zone.

ZONE 3: Middle Albian (D.niobe to E.meandrinus Subzones)

Type section: Glyndebourne borehole.

Assemblage zone: C.hirsuta/C.larivourensis.

The base of this zone is characterised by the first appearance

Fig. 8:4 The stratigraphic ranges of the zonally significant Ostracoda (taxonomic order) based on information from the Glyndebourne and Folkestone sections.

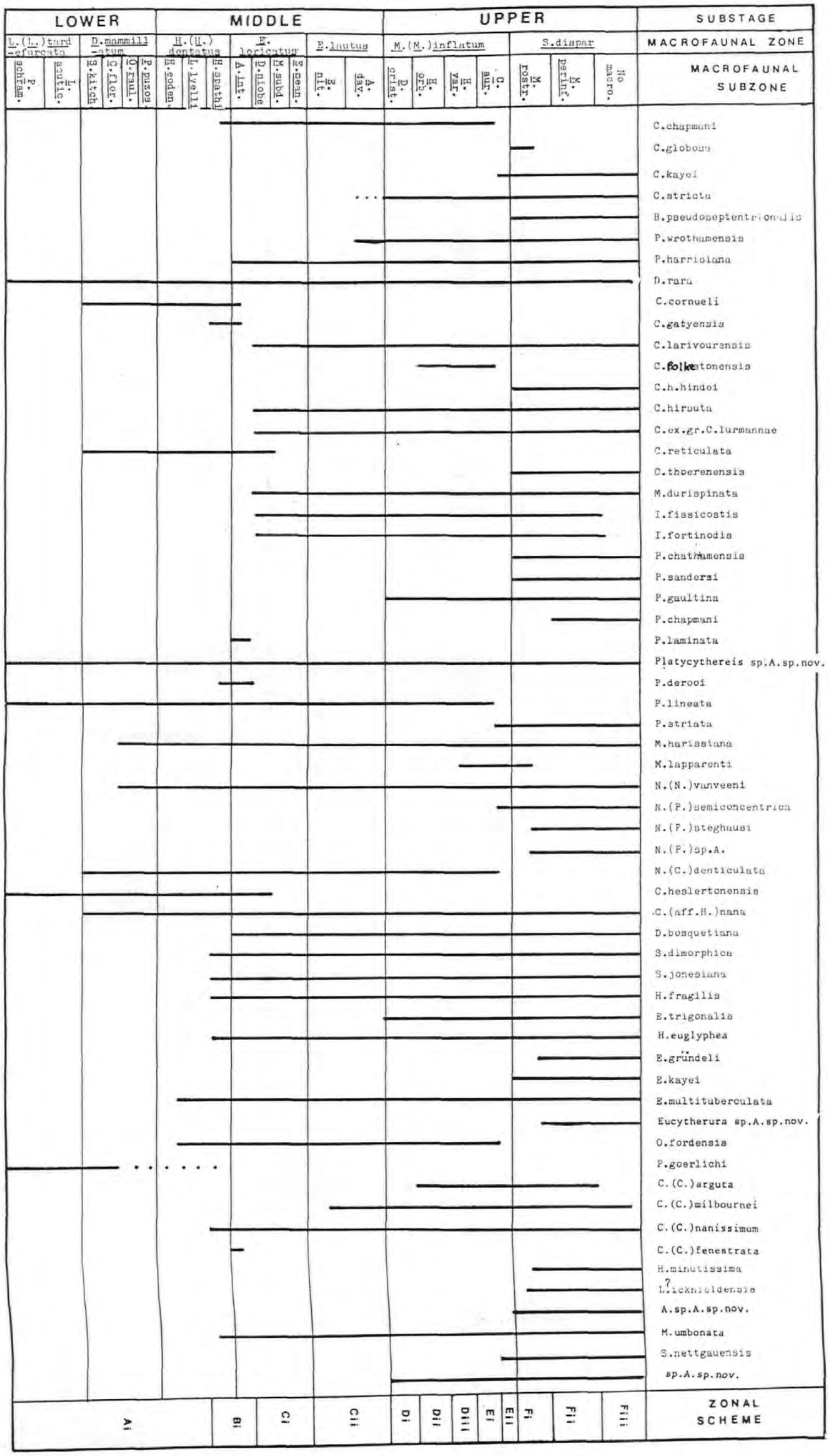
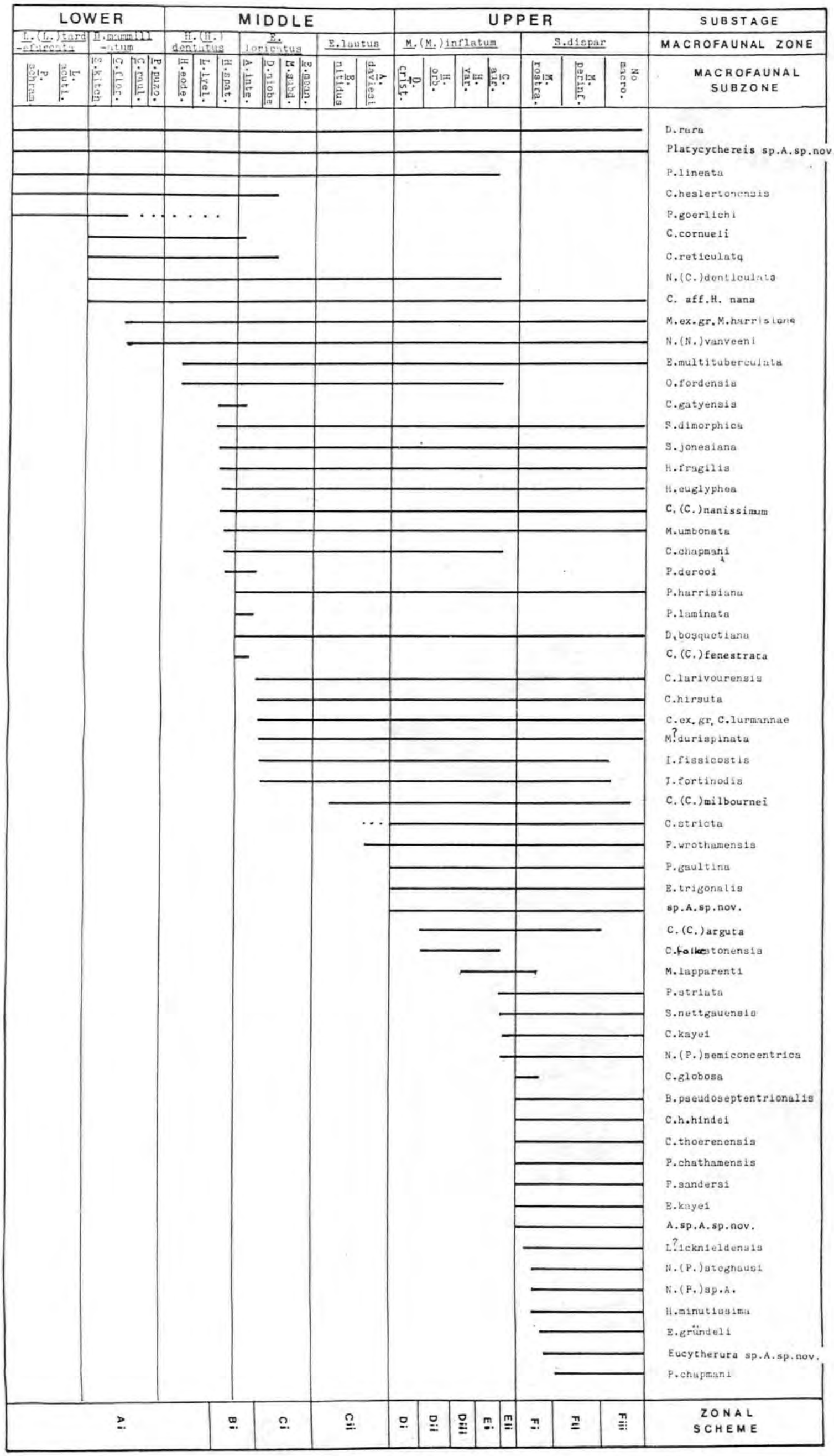


Fig. 8:5 The stratigraphic ranges of the zonally significant Ostracoda (order of first appearance) based on information from the Glyndebourne and Folkestone sections.



N.B. Ranges in Zone Ai partly based on information from Kaye (1963-1966), Gründel (1966) and Damotte (1971b).

of C.larivourensis, C.hirsuta, C.ex.gr.C.lurmannae, and M?durispinata and the last appearance in abundance of C.aff.H.nana. C. heslertonensis and C.reticulata last occur in this zone.

ZONE 4: Middle Albian (E.nitidus and A.daviesi Subzones)

Type section: Copt Point, Folkestone.

Assemblage zone: P.wrothamensis/C.milbournei.

This zone is characterised by the first appearance of P. wrothamensis and C.milbournei. Typical specimens of C.chapmani last occur at the top of this zone.

SUBZONE 5a: Upper Albian (D.cristatum Subzone)

Type section: Glyndebourne borehole.

Assemblage zone: C.stricta/E.trigonalis.

The base of this subzone is characterised by the first appearance of C.stricta, P.gaultina, E.trigonalis, and sp.A.sp.nov. C.chapmani was not recorded from this zone.

SUBZONE 5b: Upper Albian (H.orbignyi, H.varicosum, and the lower half of the C.auritus Subzone)

Type section: Glyndebourne borehole.

Taxon range zone: C.folkestonensis

The base of this subzone is defined by the first appearance of C.arguta and C.folkestonensis. M. lapparenti only occurs rarely in this Subzone. The top of this subzone is marked by the last occurrence of C.folkestonensis, P.lineata, N.(C.)denticulata, O.fordensis and C.chapmani.

SUBZONE 5c: Upper Albian (upper half of the C.auritus Subzone)

Type section: Glyndebourne borehole.

Assemblage zone: S.nettgauensis/N.(P.)semiconcentrica.

The base of this subzone is marked by the first appearance of P.striata, N.(P.)semiconcentrica and S.nettgauensis. B. pseudoseptentrionalis occurs rarely.

ZONE 6: Upper Albian (S.dispar Zone)

Type section: East Wear Bay, Folkestone.

Assemblage zone: B.pseudoseptentrionalis/P.chapmani.

This zone is marked by the gradual appearance of species of 'Cenomanian aspect'. C.thoerenensis, C.h.hindei, Alatacythere sp.A.sp.nov., E.kayei, E.gründeli, C.kayei, P.sandersi, P.chathamensis, L?icknieldensis, H.minutissima, and P.chapmani make their first appearance. M.lapparenti, and B.pseudoseptentrionalis occur in abundance. D.rara and C.aff.H. nana reappear. The upper part of this zone is marked by the gradual disappearance of E.trigonalis, D.rara, S.dimorphica, P.gaultina and M. lapparenti. None of these species appear in the Cenomanian of southern England.

8:4 ZONAL SCHEME (fig 8:1)

This zonal scheme is based on the first occurrence, last occurrence, and abundance of species (Ostracoda and foraminifera). It also uses the Biohorizons that were based on the abundance of the planktonic foraminifera and which indicate major changes in the palaeoenvironment.

This combination of zonal information has provided a much more refined stratigraphic framework than could have been achieved by the application of the individual schemes which are all relatively coarse in terms of stratigraphic resolution. It is this zonal scheme that has been used in the stratigraphic correlation of the various sections.

ASSEMBLAGE ZONE Ai

This zone is characterised by the dominance of agglutinated

foraminifera, the low diversity of the Ostracoda, and the very rare occurrence of planktonic foraminifera. Textularia sp.A., C.lamplughi, D.rara, C.heslertonensis and P.goerlichi only occur commonly in this zone. C.cornueli, C.aff.H.nana, C.reticulata, M.ex.gr.harrisiana, O. fordensis, and E.multituberculata first appear in this zone. Rhizammina sp.cf.R.dichoma and R.(H.)lagenarium are limited in distribution to this zone.

ASSEMBLAGE ZONE Bi

This zone is characterised by the gradual appearance of many species including:- D.trochus, B.textilarioides, S.asperula, C.chapmani, and H.euglyphea. P.derooi and P.laminata have only been recorded from this zone while C.aff.H.nana only occurs abundantly in this zone. S.dimorphica, M.umbonata, and C.nanissimum first occur at the base of this zone. Biohorizon 1 occurs within this zone (in southern England) while Biorhorizon 2 marks the upper limit of this zone.

ASSEMBLAGE SUBZONE Ci

This subzone is characterised by the first occurrence, in abundance, of members of the Cassidulinacea and Robertinacea. The base of this subzone is marked by Biohorizon 2 and the first occurrence of C.larivourensis, C.hirsuta, C.ex.gr.C.lurmannae, and M?durispinata. The upper limit of this subzone is marked by Biohorizon 3. C.heslertonensis and C.reticulata last occur in this subzone.

ASSEMBLAGE SUBZONE Cii

This subzone is characterised by the occurrence in abundance of members of the Robertinacea and Cassidulinacea. N.nodulosa, P.wrothamensis and C.milbournei first occur in this subzone. The lower boundary of the subzone is marked by Biohorizon 3, the upper boundary by Biohorizon 4.

ASSEMBLAGE SUBZONE Di

This subzone is characterised by the first occurrence of many species of stratigraphic significance. T.chapmani, A.chapmani, C.pinnaeformis, L.albiensis, C.stricta, P.gaultina, E.trigonalis, and sp.A. first occur. Biohorizon 4 marks the base of this subzone.

ASSEMBLAGE SUBZONE Dii

This subzone is characterised by the marked decline of the Robertinacea and the increase in abundance of the Arenobul mina plexus. The base of this subzone is marked by the first appearance of C. folkestonensis and C.arguta, the top of this subzone is marked by Biohorizon 5.

ASSEMBLAGE SUBZONE Diii

This subzone is marked by the first occurrence in abundance of the miliolids and the final occurrence of the Robertinacea. A.chapmani dominates the Lituolacea. The base of this subzone is marked by the first occurrence of Q.antiqua and S.papyracea and by Biohorizon 5, the top is marked by Biohorizon 6.

ASSEMBLAGE SUBZONE Ei

The base of this subzone is marked by Biohorizon 6 and is characterised by the occurrence of abundant, large hedbergellids. The top of this subzone is marked by the last occurrence of C.folkestonensis P.lineata, N.(C.)denticulata, O.fordensis, and C.chapmani. G.harrisi first appears in this subzone.

ASSEMBLAGE SUBZONE Eii

The base of this subzone is marked by the first occurrence of N.(P.) semiconcentrica and S.nettgauensis. The top of this subzone

is marked by Biohorizon 7. H.moremani first appears in this subzone.

ASSEMBLAGE SUBZONE Fi

This subzone is characterised by the first occurrence 'in flood' of G.bentonensis. The base of this subzone is marked by Biohorizon 7 and the first appearance of C.thoerenensis, C.h.hindei, P.chathamensis, P.sandersi, and L?icknieldensis. B.pseudoseptentrionalis and M.lapparenti first occur in abundance. The top of this subzone is marked by Biohorizon 8.

ASSEMBLAGE SUBZONE Fii

The base of this subzone is marked by Biohorizon 8 and the first appearance of typical specimens of A.sabulosa and A.sp.cf. A.frankei. This zone is characterised by the large size of many species of benthonic foraminifera.

ASSEMBLAGE SUBZONE Fiii

This subzone is typically of 'Cenomanian aspect'. The base of this subzone is marked by the first appearance of F.intermedia and G.cenomanica while A.advena first appears during this subzone and A.chapmani, E.trigonalis, S.dimorphica, P.gaultina, and M.lapparenti last appear.

The following section contains the stratigraphic correlation of the sections examined during this study.

8:5 SECTION DETAILS

Glyndebourne, Sussex

The macrofaunal zonation of this section, which was provided by I.G.S., was proposed by Morter and is directly comparable to the zonation of Owen (1971a; 1975). This section can, therefore, be

directly correlated with the Folkestone sections. This zonation is illustrated (fig. 8:6).

All of the Subzones (above the A.intermedius Subzone) of the Middle Albian have been recognised with the single exception of the A.daviesi Subzone. This may be present but there is no direct macrofaunal information to suggest this (Morter; pers.comm.1979). Within the Upper Albian the D.cristatum and H.orbignyi Subzones are clearly defined but the H.varicosum and C.auritus Subzones and the S.dispar Zone are somewhat problematical. The zonation of Morter places the H.varicosum/C.auritus subzonal boundary at about 90 m depth and the lower boundary of the S.dispar Zone at about 75m depth.

In the following section the microfauna is discussed in relation to the macrofaunal zonation. The information from this borehole has been used to propose the zonal schemes and to define the Biohorizons.

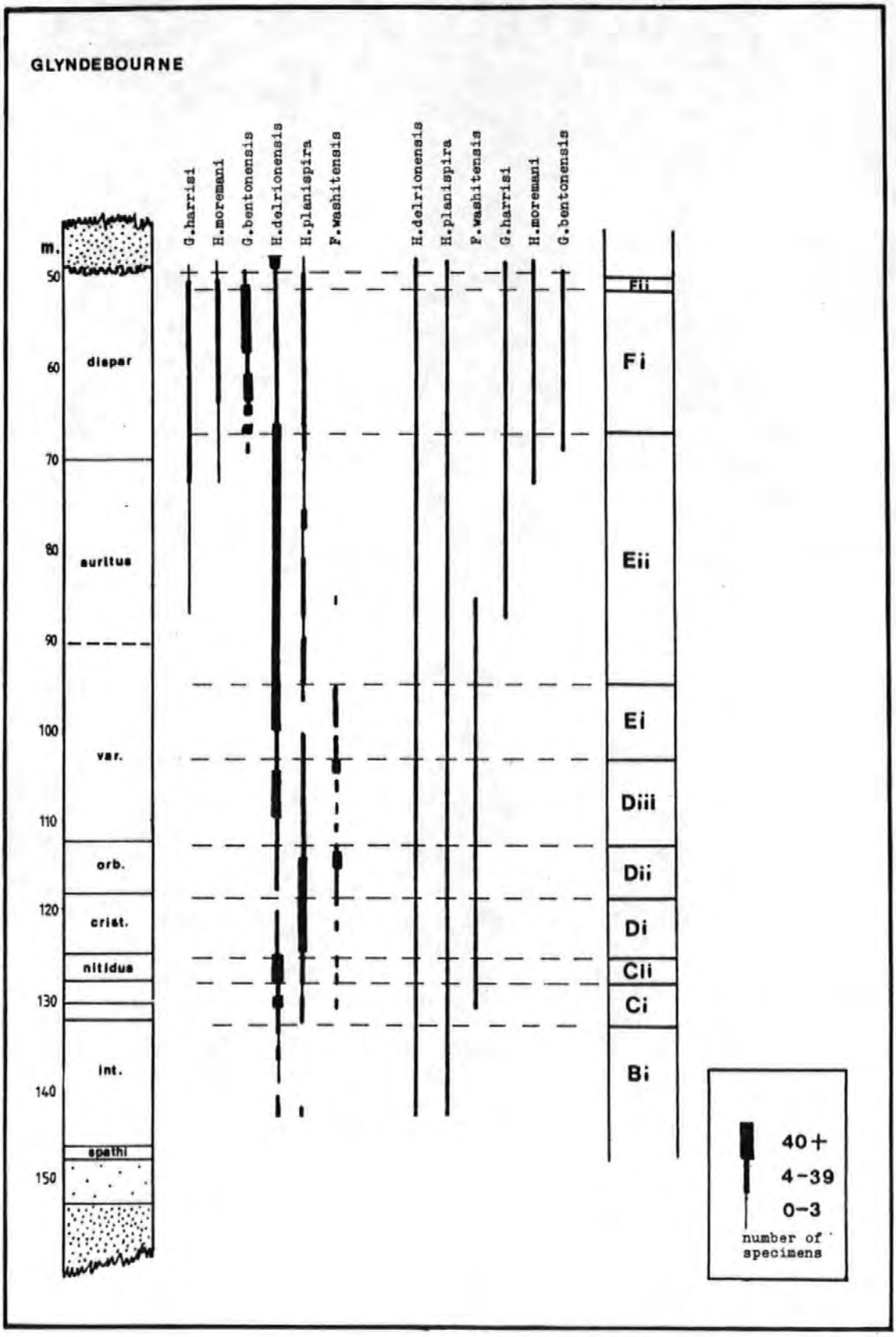
Planktonic foraminifera (figs. 8:6, 8:11, 8:12)

H.delrionensis first appears at 142m. depth (mid. A.intermedius Subzone). This species ranges through the rest of the Albian and into the Cenomanian. The changes in the populations of this species have been discussed in the taxonomic and palaeoecological chapters. H.planispira also appears first in the mid A.intermedius Subzone and ranges into the Cenomanian. The changes in the relative abundance of these two species have been used to define the Biohorizons.

F.washitensis was first recorded at 130m depth. It occurs sporadically up the succession and last occurs at 94.5m depth. In the higher part of the section first G.harrisi and then H.moremani become increasingly more abundant. At 64m. depth they are both relatively abundant.

G.bentonensis first appears at 68.5m. depth (lowest S.dispar Zone) and occurs abundantly up to 48.5m. depth.

Fig. 8:6 The distribution of planktonic foraminifera in the Glyndebourne borehole (taxonomic order and order of first occurrence).



Benthonic foraminifera (figs. 8:7,8:8).

C.lamplughi only occurs rarely in the basal clays of this section (basal A.intermedius Subzone). The Robertinacea are abundant in the Middle Albian forming up to 75% of the foraminiferal population. E.spinulifera ranges through to the topmost H.varicosum Subzone as does H.chapmani. H.carpenteri last appears in the upper part of the H.orbignyi Subzone. Epistomina sp.A. sp.nov. occurs throughout the H.varicosum Subzone. E.cretosa appears briefly in the E.nitidus Subzone.

A.macfadyeni occurs rarely in the lowest Gault Clay but becomes more abundant in the D.niobe subzonal to the D.cristatum subzonal interval. Transitional forms to A.chapmani occur in the D.cristatum Subzone. A.chapmani ranges through to the top of the S.dispar Zone where transitional forms to A.advena occur. A.sp.cf.A.frankei and A.sabulosa appear in the S.dispar Zone. F.intermedia first appears in the basal Cenomanian.

G.intermedia ranges through this section; G.baltica first appears in the mid H.varicosum Subzone and G.cenomanica does not appear until the basal Cenomanian. L.jarzevae occurs rarely between 65m. and 60m. depth.

Q.antiqua and S.papyracea first appear in the basal portion of the H.varicosum Subzone and range through into the Cenomanian.

C.pinnaeformis ranges from 124m. depth to 70m. depth

Ostracoda (figs. 8:9, 8:10)

C.gatyensis, C.cornueli, and P.laminata only occur in the basal portion of the A.intermedius Subzone. C.aff.H.nana occurs very abundantly in the A.intermedius Subzone but occurs very rarely in the higher Subzones. C.larivourensis ranges from the base of the D.niobe Subzone to the Cenomanian and M?durispinata ranges from the base of the D.niobe Subzone to the top of the S.dispar Zone. Both I.fissicostis and I.fortinodis first appear in the basal portion of the

KEY (to Figs 8:11, 8:12, 8:18, 8:27, 8:37)

Column A: The distribution of coarse sediment in the Glyndebourne borehole.

Column B: The abundance of H.delrionensis (solid line) and H.planispira (dashed line).

Column C: The variation in size of H.delrionensis in the Glyndebourne borehole (based on the ten largest specimens per sample). D 1=maximum diameter (solid line), D 2=minimum diameter (dotted line).

Column D: The planktonic/benthonic ratio for the Glyndebourne borehole (smoothed graph).

Column E: The Superfamily abundance of foraminifera in the Glyndebourne borehole.

Black = Ammodiscidae

White = Lituolacea

Diagonal stripes = Miliolacea

Large dots = Nodosariacea

Small dots = Globigerinacea

Horizontal stripes = Cassidulinacea

Column F: The species diversity of Ostracoda in the Glyndebourne borehole.

Fig. 8:7 The distribution (abundance/taxonomic order) of benthonic foraminifera in the Glyndebourne borehole.

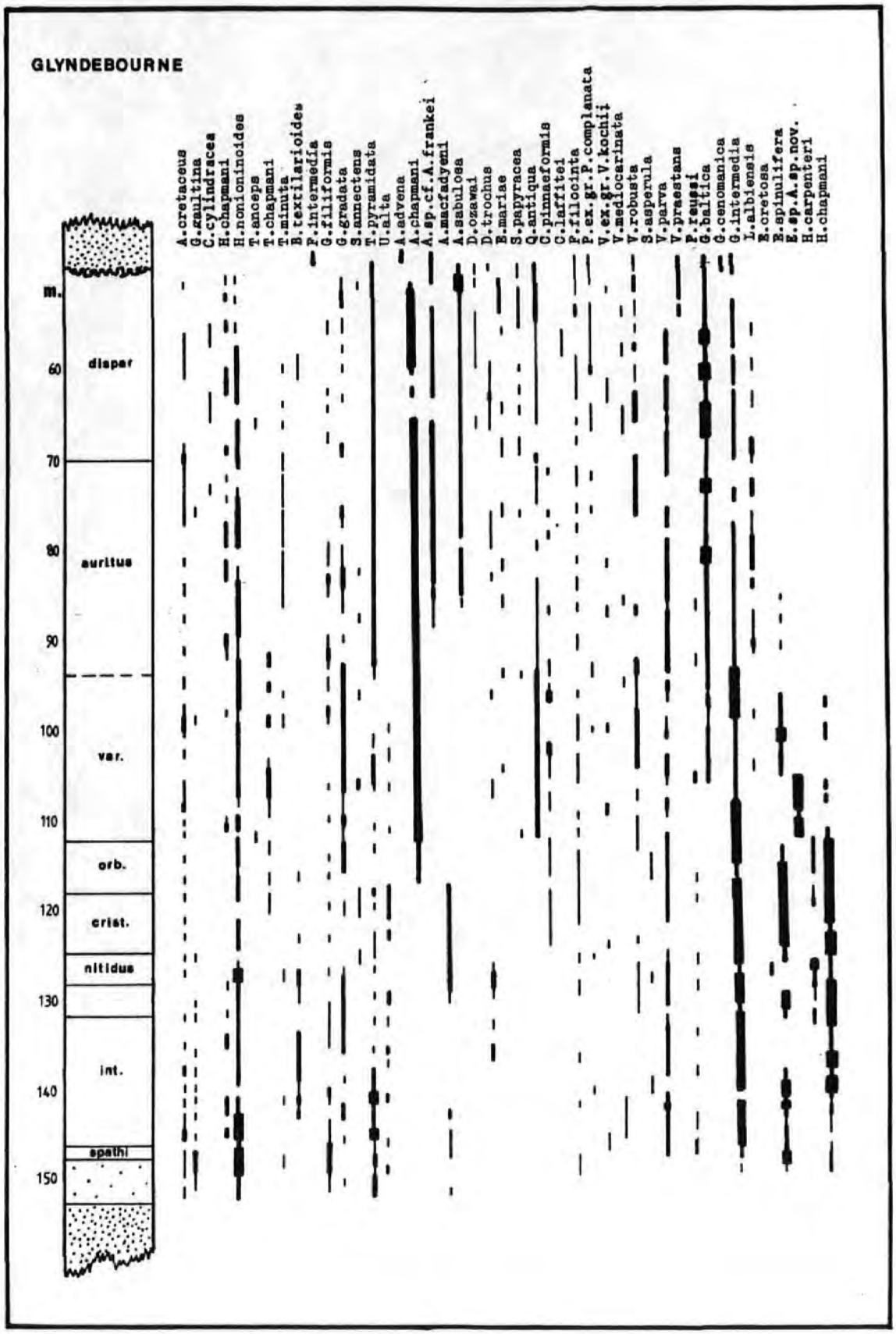


Fig. 8:8 The first occurrence of benthonic foraminifera in the Glyndebourne borehole.

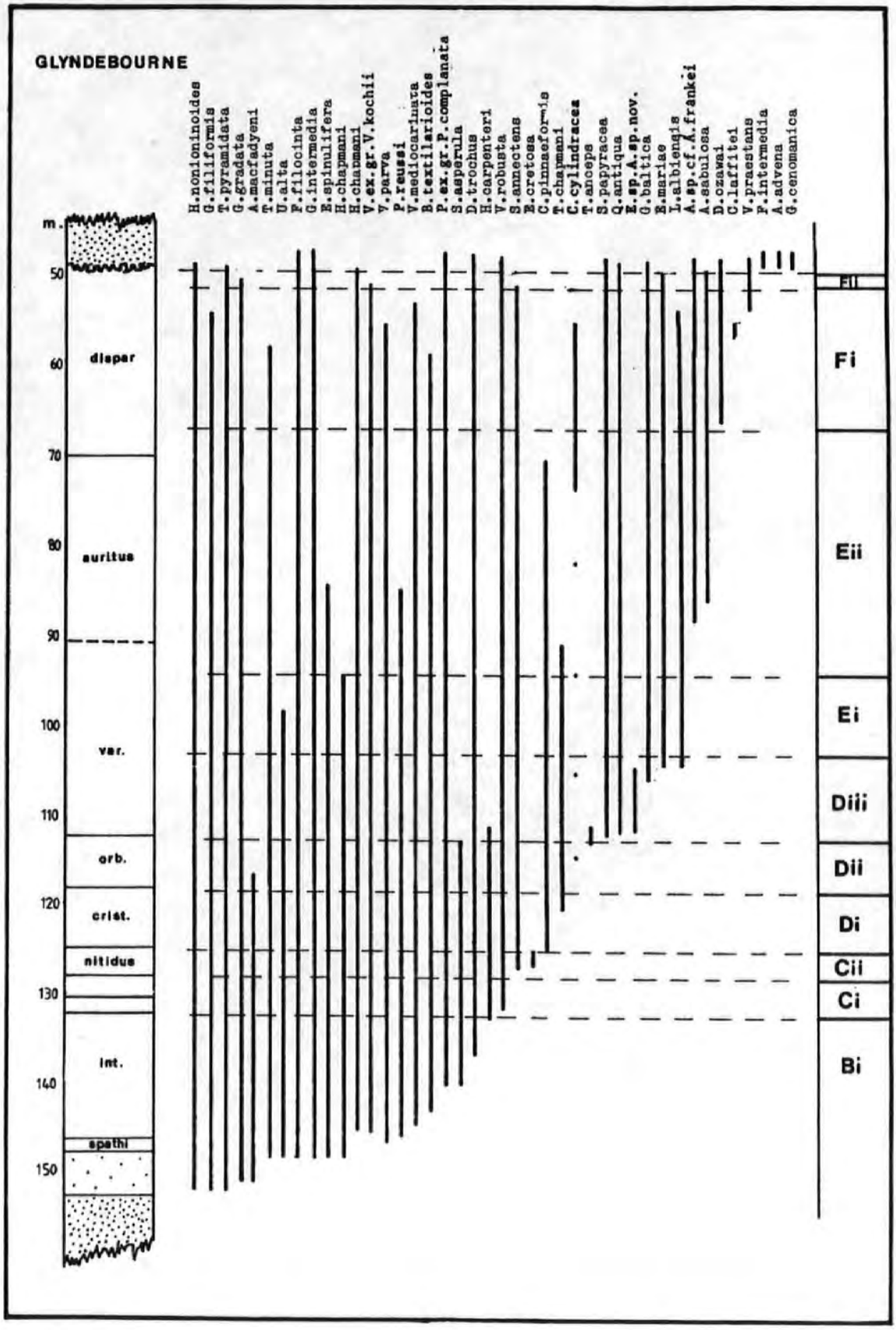


Fig. 8:10 The distribution of Ostracoda (first occurrence) in the Glyndebourne borehole.

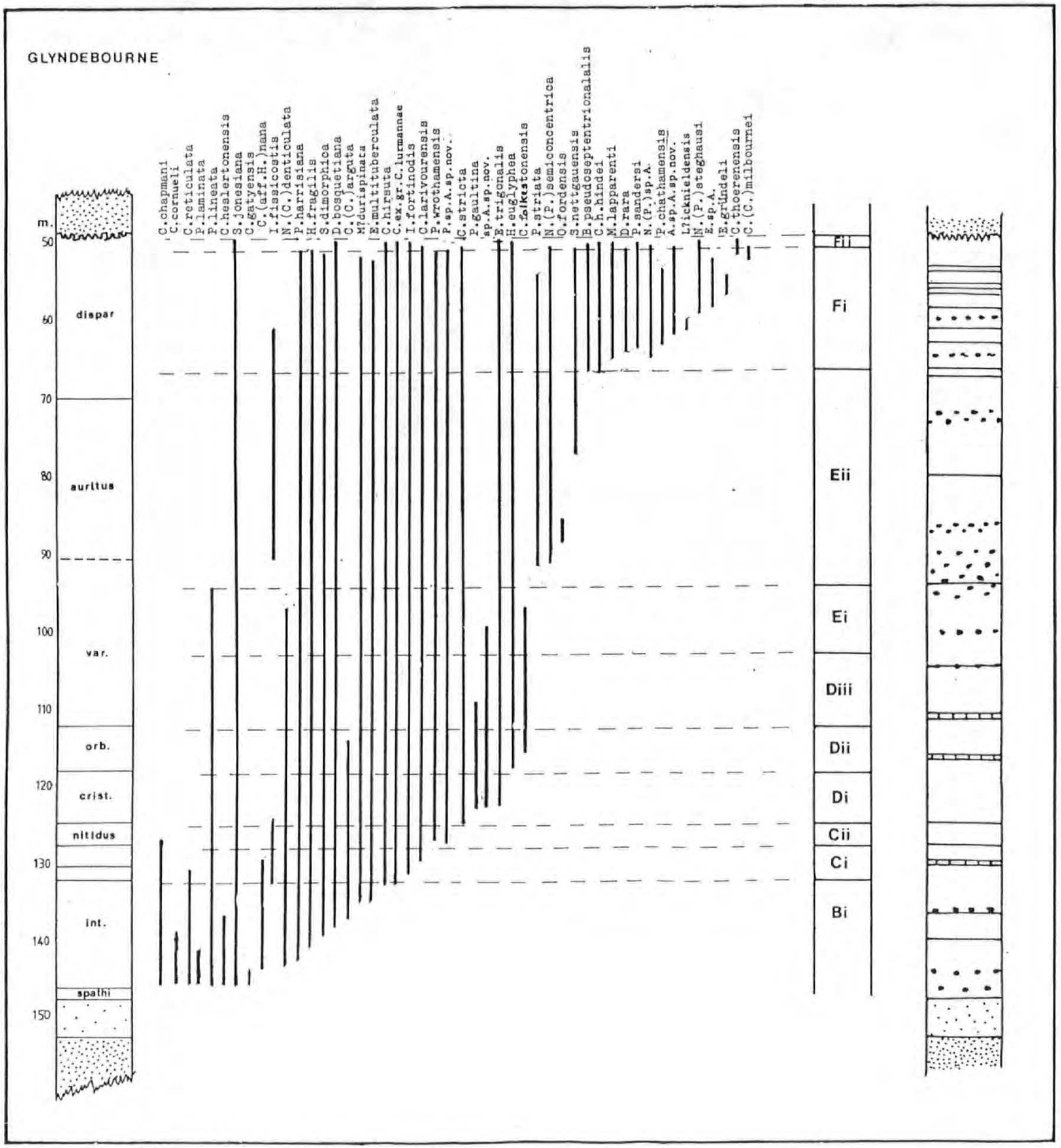


Fig. 8 :9 The distribution of Ostracoda (abundance/taxonomic order)

in the Glyndebourne borehole.

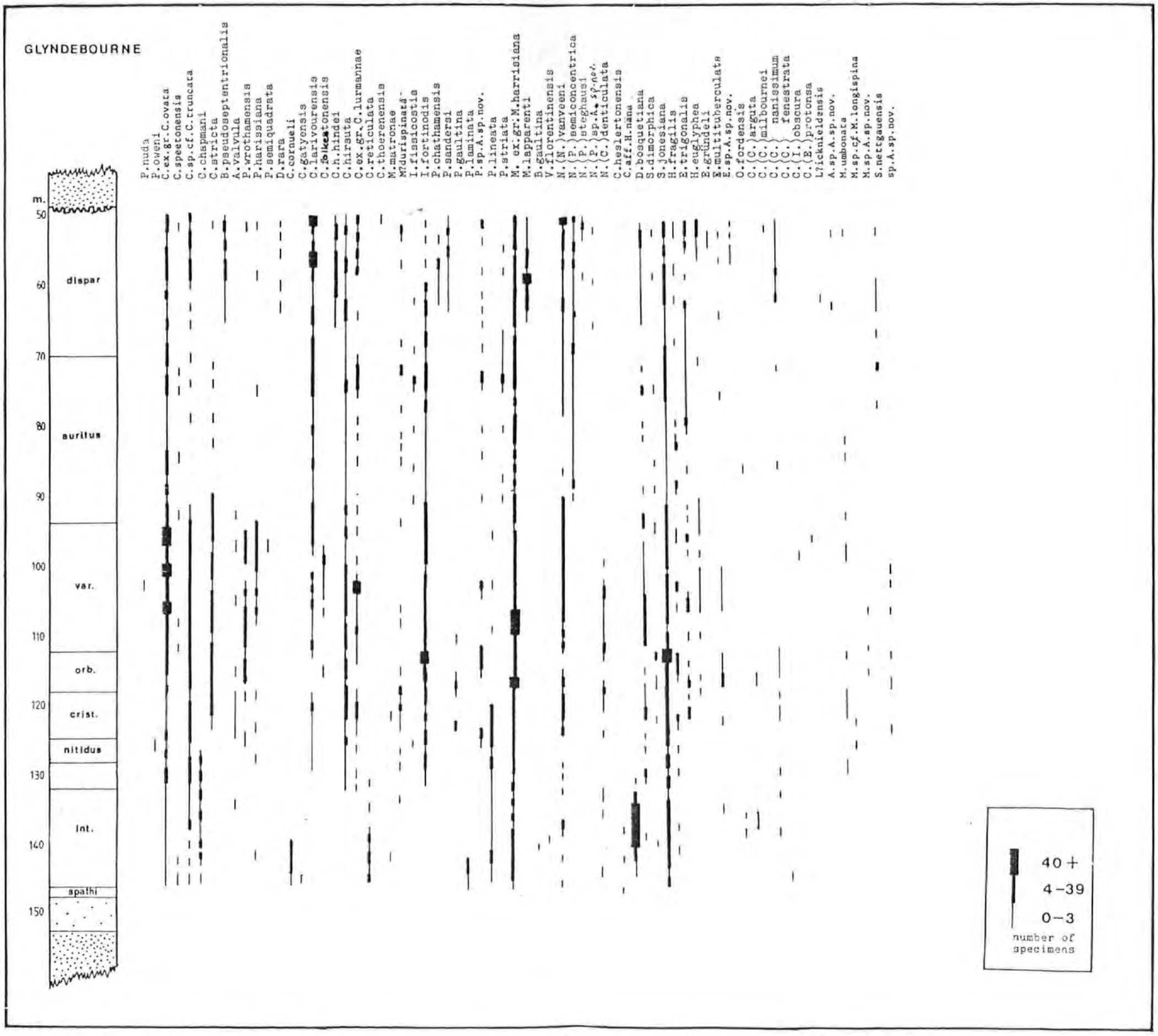


Fig. 8:11 Foraminiferal analysis of the Glyndebourne borehole.

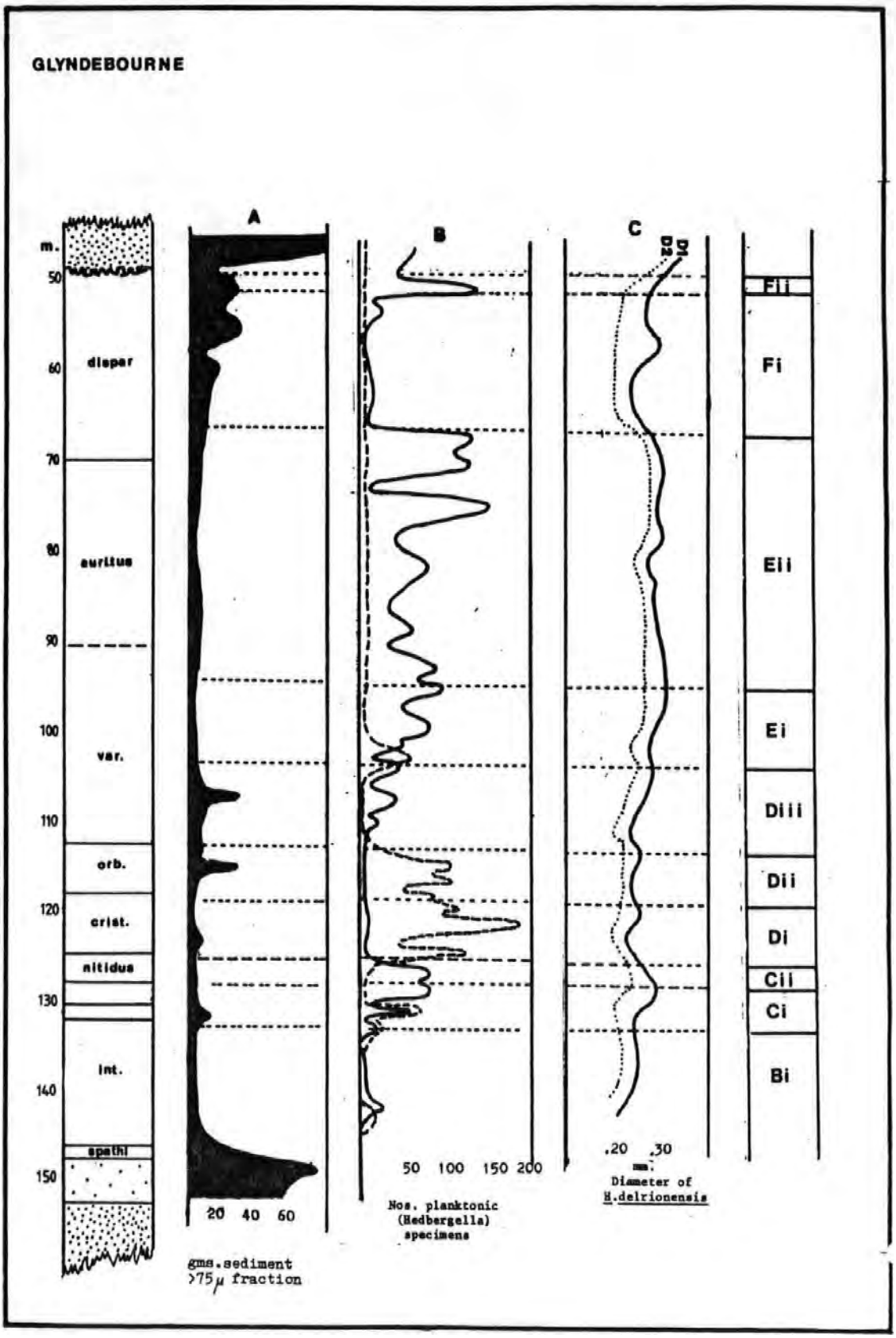
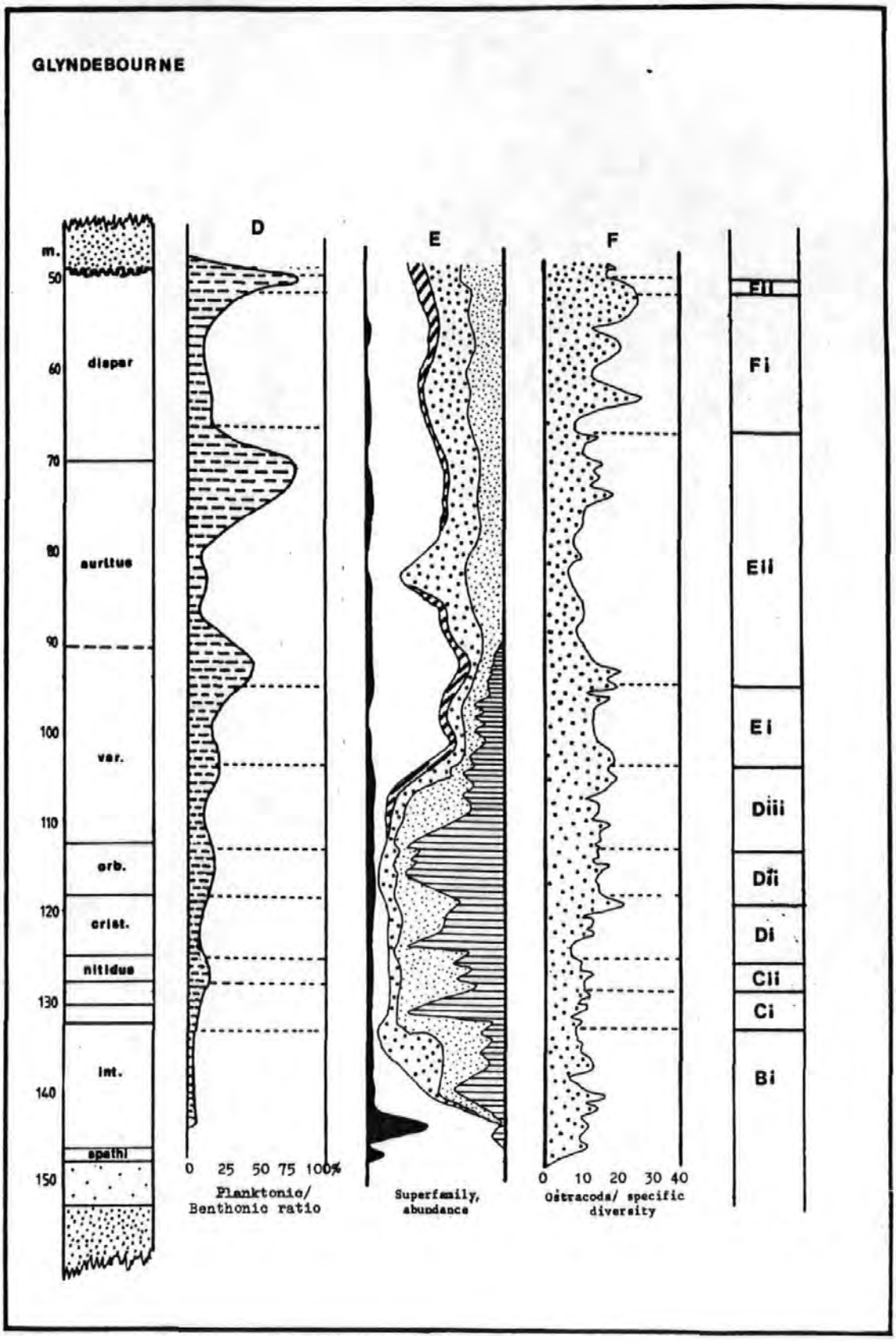


Fig. 8:12 Microfaunal analysis of the Glyndebourne borehole.



D.niobe Subzone and both become extinct in the topmost portion of the S.dispar Zone.

C.chapmani occurs in the basal Gault Clay up to the topmost portion of the E.nitidus Subzone and C.stricta ranges from the basal portion of the D.cristatum Subzone into the Cenomanian. Both E.trigonalis and sp.A.sp.nov. are restricted in occurrence to the upper Albian and C.folkestonensis ranges from the base of the H.orbignyi Subzone to the top of the H.varicosum Subzone.

S.nettgauensis, P.striata and N.(P.)semiconcentrica first appear in the middle of the C.auritus Subzone and range through the S.dispar Zone into the Cenomanian.

B.pseudoseptentrionalis, C.thoerenensis, C.h.hindei, M. lapparenti, P.sandersi, P.chathamensis, E.sp.aff.E.nuda, L?icknieldensis, E.gründeli, H.minutissima, and C.kayei all make their first appearance in the S.dispar Zone. All of these species, with the exception of M. lapparenti, occur in the Cenomanian.

Conclusions

The basal 15m of the Gault Clay at this locality is characterised by the rare occurrence of C.lamplughi, the first occurrence of planktonic foraminifera, and the last appearance of C.gatyensis, C.cornueli and P.laminata. These species indicate the presence of the Bi Subzone. The presence of Biohorizon 2 and the first occurrence of C. larivourensis, C.hirsuta and C.ex.gr.C.lurmannae at 132m. depth indicate the base of Subzone Ci. The top of this Subzone is marked by the presence of Biohorizon 3 at 128m. depth. The top of Subzone Cii is marked by the presence of Biohorizon 4 at a depth of 125m. There is no conclusive evidence to indicate the presence of the A.daviesi Subzone

within Cii.

The base of the Upper Albian is marked by Biohorizon 4 at a depth of 125m. This indicates the base of Subzone Di. Below this horizon C.chapmani occurs. Above this horizon C.stricta, E.trigonalis and sp.A. first appear. The base of Subzone Dii is marked by the first appearance of C.folkestonensis and H.euglyphea and is characterised by the decline in abundance of the Robertinacea. The top of this Subzone is marked by the presence of Biohorizon 5 at 112m depth. Epistomina sp.A.sp.nov. first occurs at this horizon. The top of Subzone Diii is marked by the presence of Biohorizon 6. By this time the Robertinacea represent only a small percentage of the total fauna which is dominated by specimens of the genus Arenobulimina.

The first occurrence of P.striata, N.(P.) semiconcentrica, and the last occurrence of C.folkestonensis indicate the upper limit of Subzone Ei at 93m depth. Eii is the thickest Subzone at this locality (26m thick). It is characterised by an abundance of the genera Hedbergella and Arenobulimina.

The presence of Biohorizon 7 (the first appearance of G. bentonensis) indicates the base of Subzone Fi at 67m depth. At this horizon there is also a marked drop in the abundance of the genus Hedbergella and an influx of species of typical 'Cenomanian aspect'. This Biohorizon is followed by Biohorizon 8 which is the last appearance of G.bentonensis 'in flood'. This Biohorizon indicates the base of Subzone Fii. At this locality Subzone Fii is very thin (approximately 2m.). The upper surface of this Subzone is a marked erosional surface. Above this horizon the 'Glauconitic Marl' is of Lower Cenomanian age. The diastem at the top of the Gault Clay represents part of the Fii Subzone and all of Subzone Fiii. Subzone Fiii (which is characterised by the presence of A.advena, F.intermedia and G.cenomanica) was not recorded at this locality.

FOLKESTONE (Copt Point and East Wear Bay sections)

Planktonic Foraminifera (figs. 8:13, 8:18)

H.delrionensis was first recorded in the A.intermedius Subzone and H.planispira in the D.niobe Subzone. Both these species range through the Albian into the Cenomanian. F.washitensis was only recorded rarely from the M.subdelaruei and E.nitidus Subzones. Both G.harrisi and H.moremani first appear in the upper part of the C.auritus Subzone. G.bentonensis first occurs at the base of Bed XII indicating the base of Subzone Fi and last occurs in abundance near the top of the M.rostratum Subzone (Owen pers.comm., 1979; Carter pers.comm., 1980). This indicates that the occurrence of G.bentonensis in flood is very sporadic within the M.rostratum Subzone. However, it is only found abundantly within this Subzone.

Benthonic Foraminifera (figs. 8:14, 8:15)

C.lamplughi was only recorded rarely in the basal portion of the A.intermedius Subzone. Both E.spinulifera and H.carpenteri range from the H.spathi Subzone to the top of the H.orbignyi Subzone while H.chapmani ranges from the A.intermedius Subzone to the top of the H.orbignyi Subzone. A.macfadyeni was found to range from the E.nitidus Subzone to the base of the D.cristatum Subzone while A.chapmani was first recorded in the basal portion of the H.orbignyi Subzone ranging through to the topmost Albian Subzone (Fiii) where A.advena was first recorded. G.baltica ranges from the D.cristatum Subzone through into the Cenomanian while primitive forms of G.cenomanica first appear in the middle of the S.dispar Zone (Fii Subzone). L.jarzevae was recorded rarely in the upper part of the S.dispar Zone. Q.antiqua and S.papyracea were first recorded in the topmost H.orbignyi Subzone and both range through into the Cenomanian. Other zonally significant species include A.sabulosa, which occurs throughout Subzones Fi and Fii, and A.sp.cf.A.frankei which was

Fig. 8:13 The distribution of planktonic foraminifera (abundance and first occurrence) in the Folkestone sections.

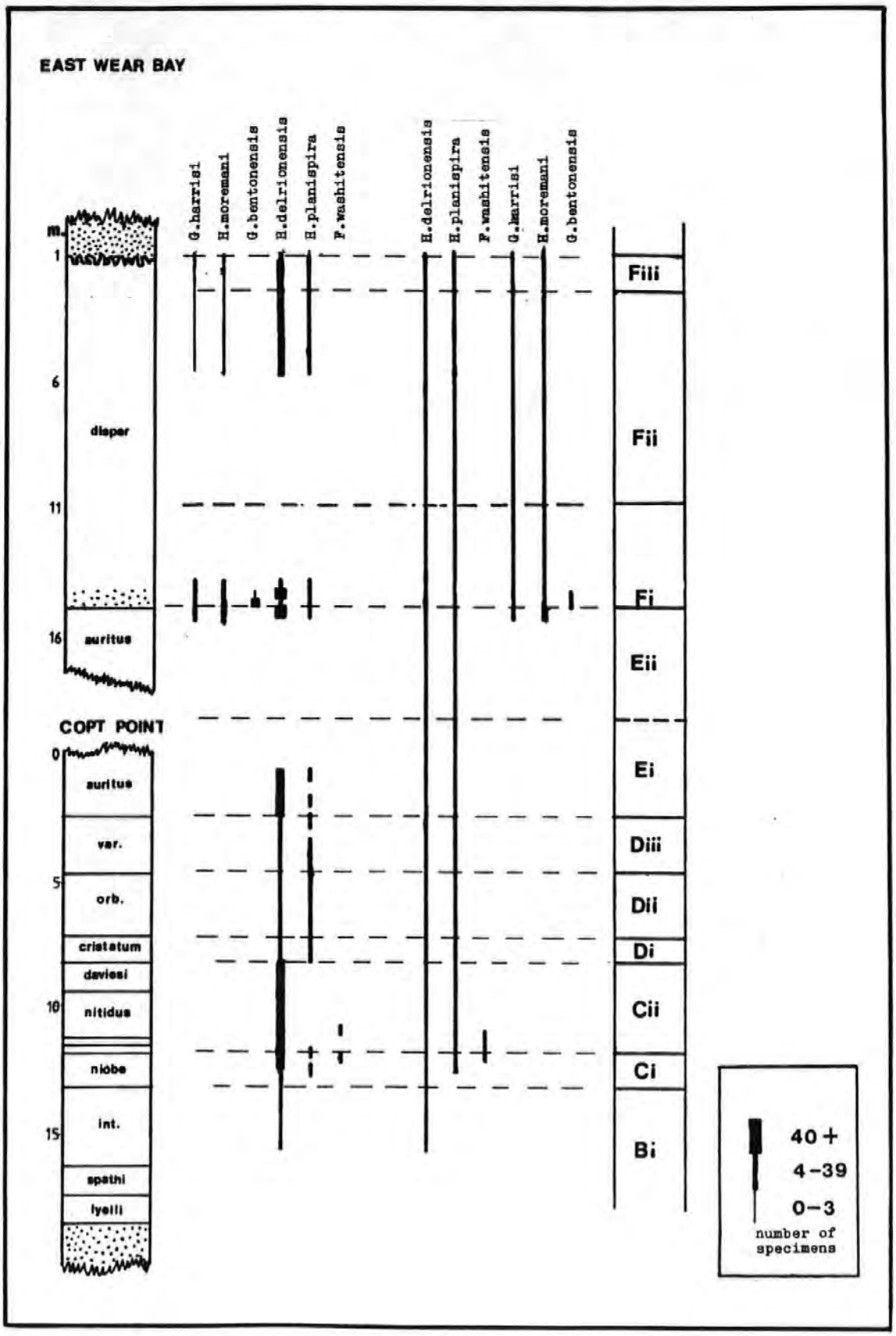


Fig. 8:14 The distribution of benthonic foraminifera (abundance/ taxonomic order) in the Folkestone sections.

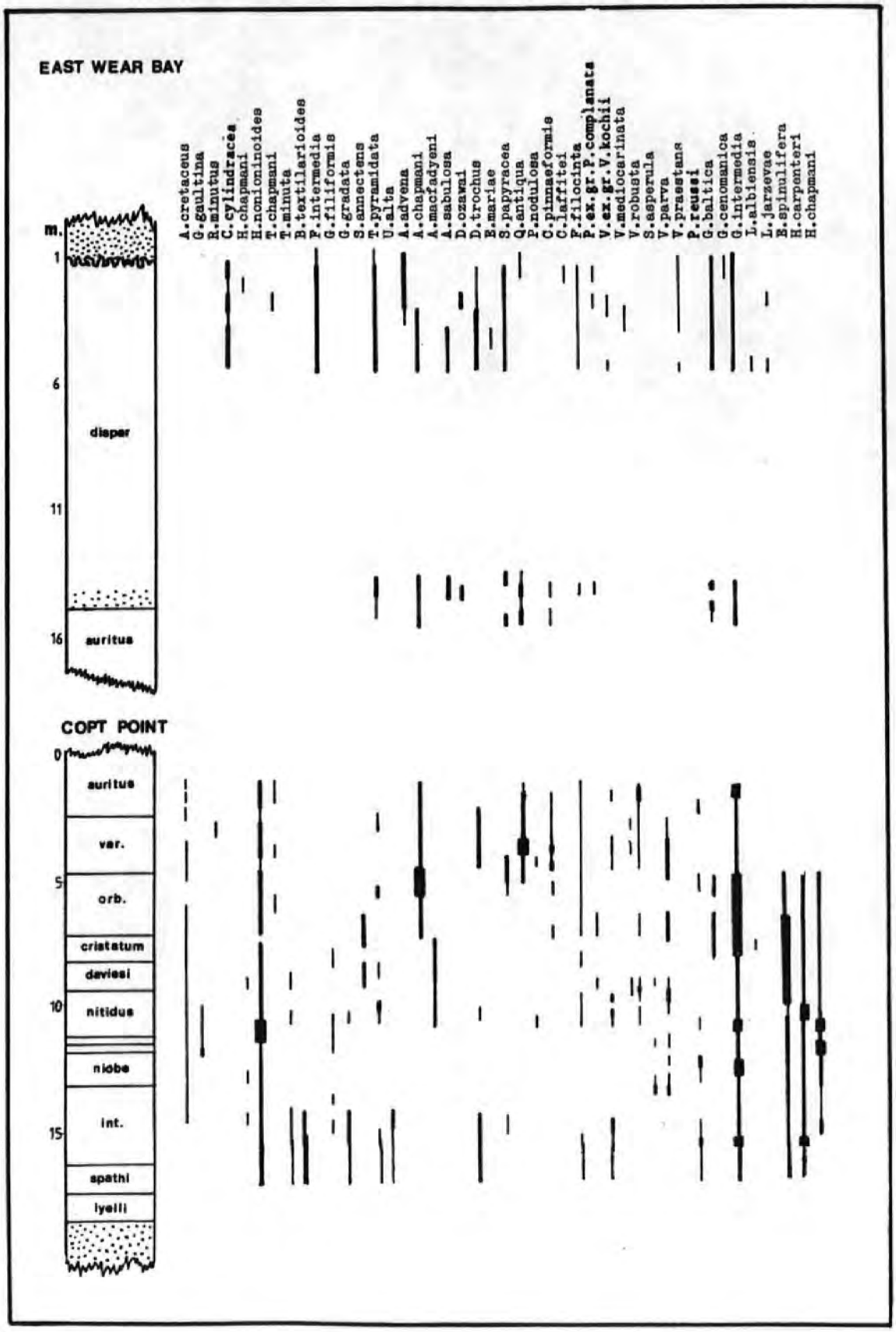
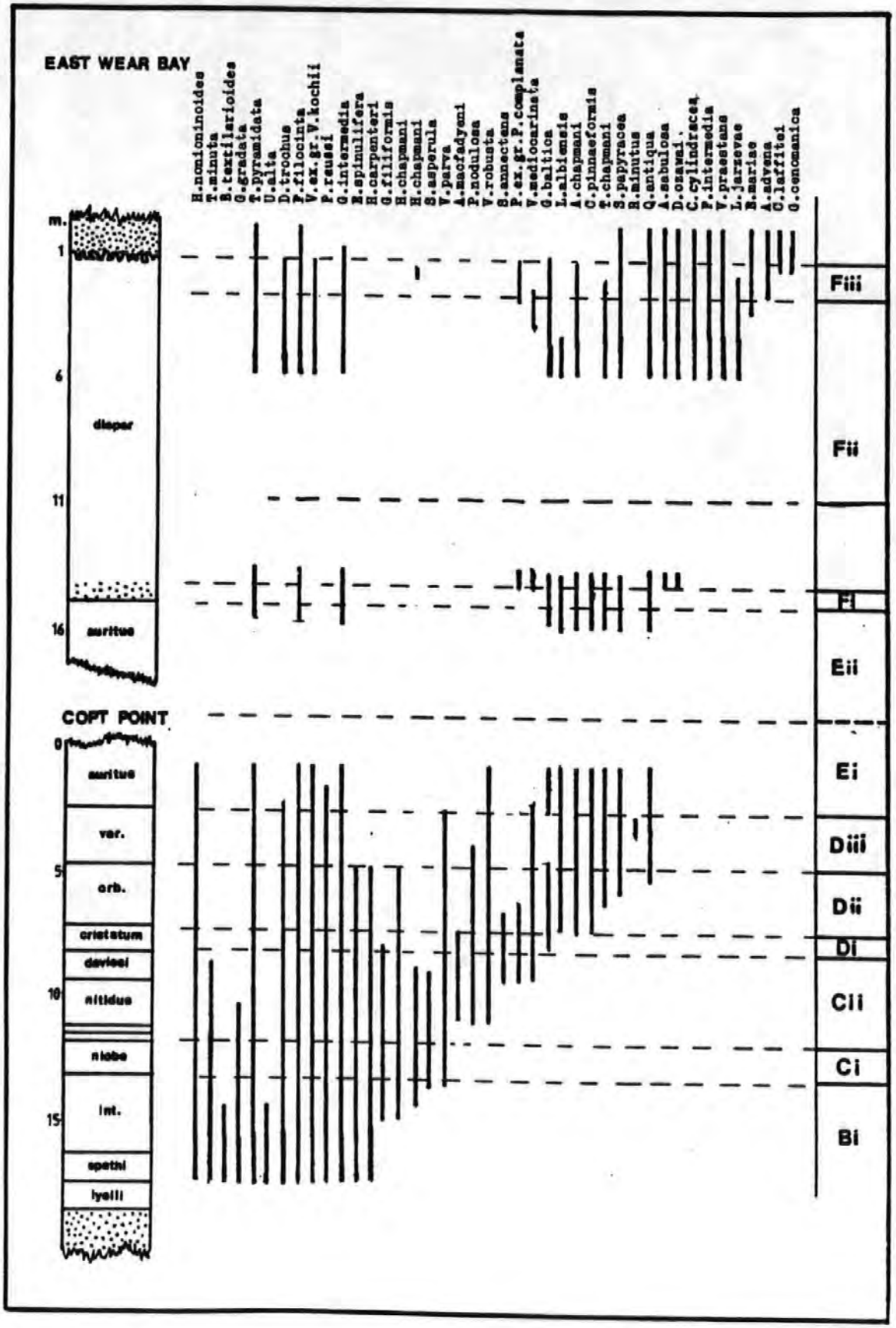


Fig. 8:15 The first occurrence of benthonic foraminifera in the Folkestone sections.



recorded from Subzones Fii and Fiii. F.intermedia was only recorded from Subzone Fiii.

Several species which were only recorded sporadically are also of zonal significance. These include S.asperula, which was only recorded from the A.intermedius and A.daviesi Subzones, C.pinnaeformis which was first recorded from the basal portion of the H.orbignyi Subzone and ranged through to the top of the C.auritus Subzone (derived specimens were recorded form Bed XII), and D.ozawai which was recorded sporadically from the topmost part of the S.dispar Zone.

Ostracoda (figs. 8:16, 8:17)

C.cornueli was only recorded in the A.intermedius Subzone while C.hirsuta, C.ex.gr.C.lurmannae, M?durispinata, and I.fortinodis were all first recorded at the base of the D.niobe Subzone and indicate the base of the Subzone Ci. C.chapmani ranges from the A.intermedius Subzone to the top of the A.daviesi Subzone. This species was again recorded higher in the succession, ranging from the middle of the H.varicosum Subzone to the lower part of the C.auritus Subzone. C.stricta was first recorded in the basal part of the A.daviesi Subzone and ranged through to the Lower Cenomanian while both E.trigonalis and P.gaultina were first recorded in the D.cristatum Subzone and were last recorded in the topmost part of the S.dispar Zone. C.folkestonensis was recorded from the topmost H.orbignyi Subzone to the basal part of the C.auritus Subzone and C.arguta was recorded from the basal H.orbignyi Subzone to the lower part of the C.auritus Subzone. N.(P.)semiconcentrica was first recorded in the topmost C.auritus Subzone ranging into the Cenomanian.

The S.dispar Zone is characterised by the appearance of many species of 'Cenomanian aspect'. These species include B. pseudoseptentrionalis, S.nettgauensis, N(P.) steghausi, C.h.hindei,

Fig. 8:16 The distribution of Ostracoda (abundance/taxonomic order)

in the Folkestone sections.

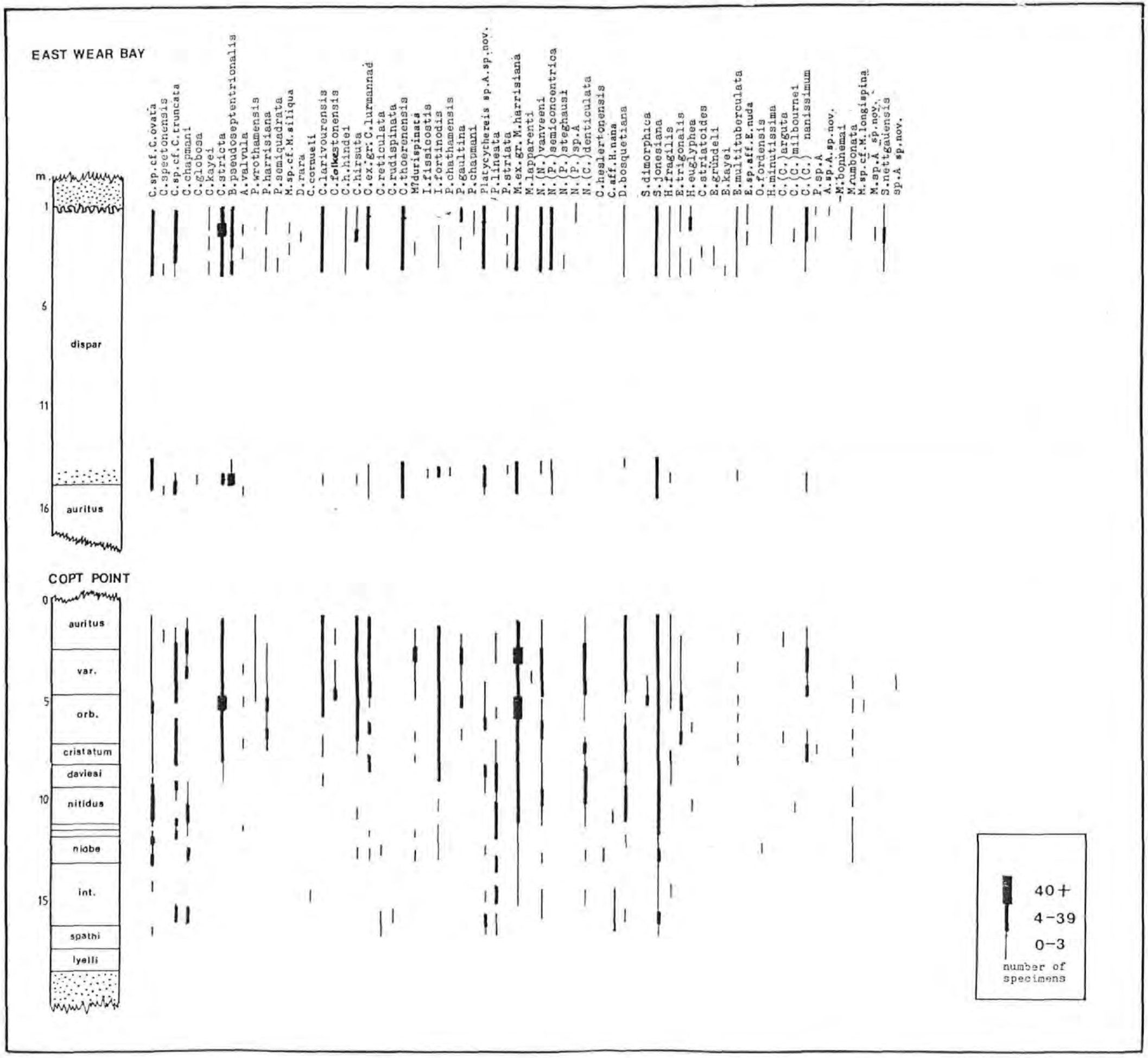


Fig. 8:17 The distribution of Ostracoda (first occurrence) in the Folkestone sections.

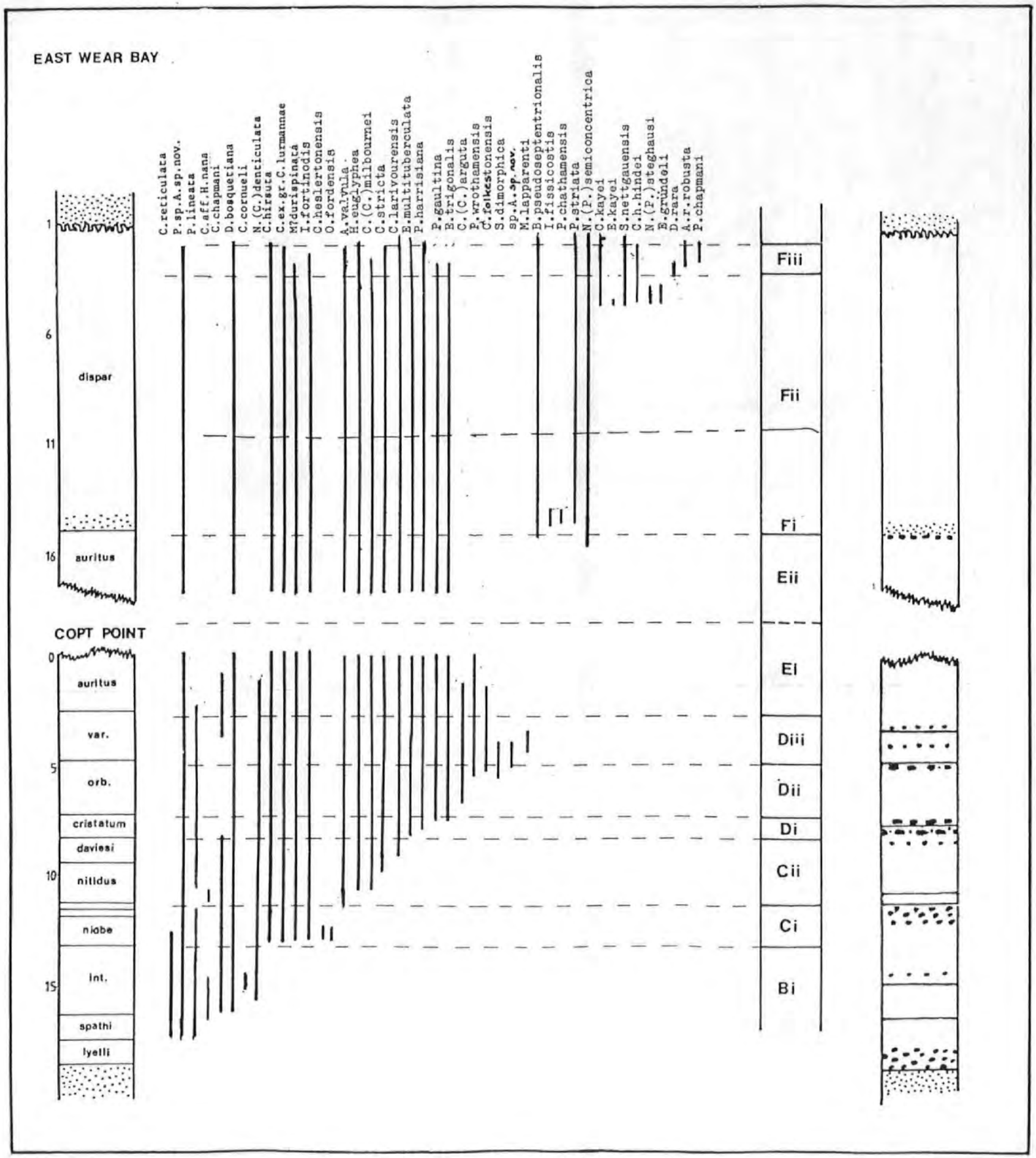
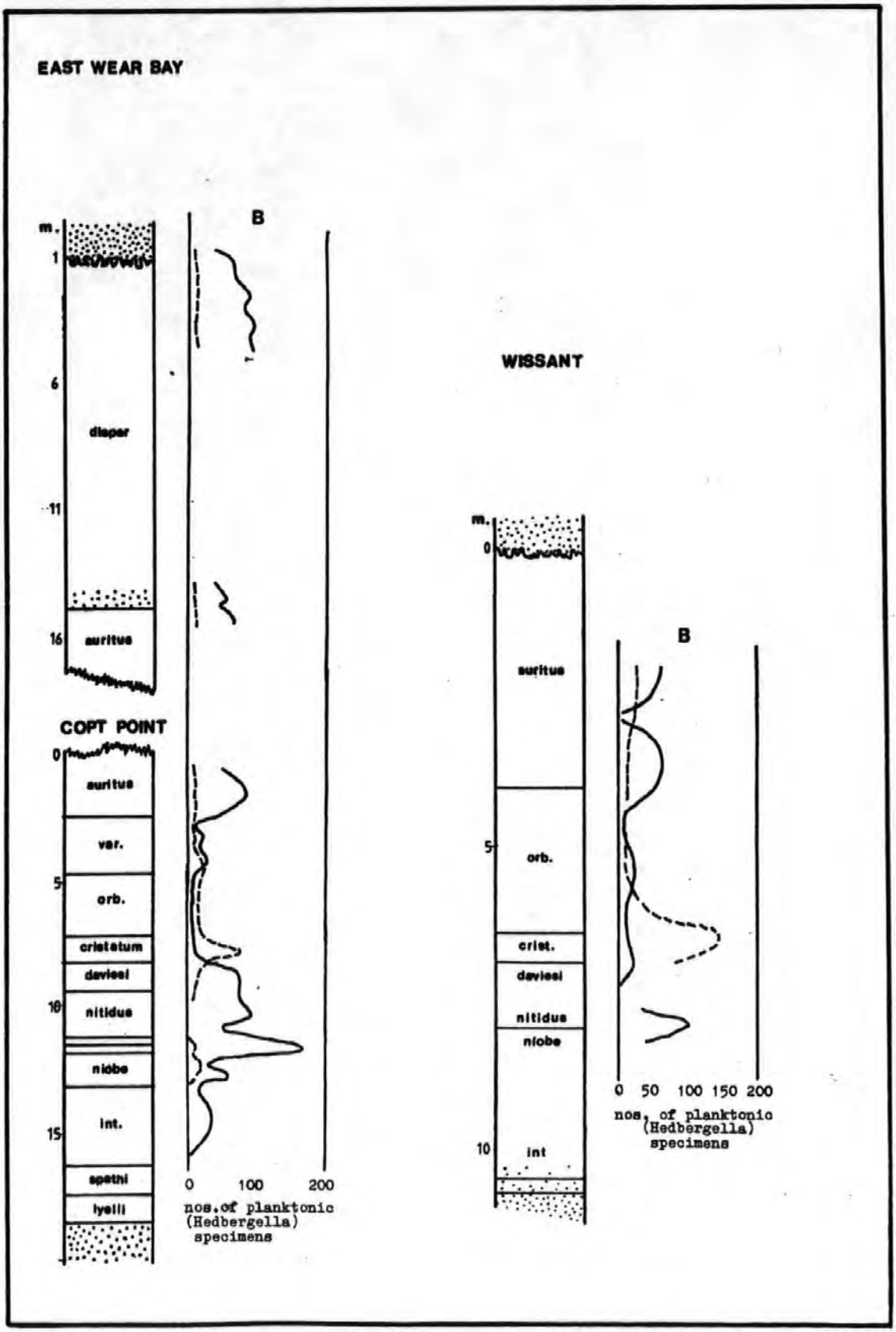


Fig. 8:18 Variations in abundance of H.delrionensis and H.planispira in the Folkestone and Wissant sections.



P.chapmani, P.chathamensis, E.kayei, E.gründeli, H.minutissima, and E.sp.aff.E.nuda. All these species range into the Cenomanian.

Conclusions

The first appearance of planktonic foraminifera together with C.lamplughi and C.cornueli indicates the presence of Subzone Bi. Biohorizon 2 is present 6.5m above the base of the Gault Clay. At this horizon C.hirsuta, C.ex.gr.C.lurmannae, M?durispinata, and I. fortinodis also appear indicating the base of the Ci Subzone. The top of this Subzone is marked by the presence of Biohorizon 3. Biohorizon 4 was recorded 8m above the base of the Gault Clay and indicates the base of the Di Subzone. The first occurrence of C.striata, E.trigonalis, and C.pinnaeformis indicate the presence of the Dii Subzone while the top of this Subzone is marked by Biohorizon 5 and the occurrence of miliolids in abundance. The presence of Biohorizon 5 at the base of the H.varicosum Subzone indicates that this is equivalent to the base of Subzone Diii, with the top of Subzone Diii being indicated by the presence of Biohorizon 6, approximately 50cm above the topmost H.varicosum nodule bed, within the basal portion of Bed XI. The boundary between Subzones Ei and Eii was not recorded due to the presence of a major gap in the section, within Bed XI, between the top of the Copt Point section and the base of the East Wear Bay section (equivalent to most of the C.auritus Subzone).

G.bentonensis was recorded 'in flood' in the basal sample from Bed XII, indicating that the boundary between Subzones Eii and Fi is represented within the basal nodule bed of Bed XII. G.bentonensis has also been recorded 'in flood' from the topmost part of the M.rostratum Subzone (Carter pers.comm., 1980). This is the last occurrence of this species 'in flood' up the section and is indicative of Biohorizon 7, and therefore, the top of Subzone Fi. The M.rostratum Subzone

is, therefore, approximately equivalent to the Fi Subzone. The presence of F.intermedia and A.advena within the topmost 2 metres of Bed XIII indicate the presence of Subzone Fiii. The overlying 'Glauconitic Marl' is of Lower Cenomanian age.

M.25 SECTIONS

These sections have no direct macrofaunal zonation, although Owen (pers.comm., 1979) has provided information from the nearest surface localities to these boreholes. The macrofaunal boundaries can also be interpreted by using the multi-phyletic zonal scheme (fig. 3:5).

BOREHOLE 3/1

Planktonic Foraminifera (figs. 8:19, 8:20, 8:37)

H.delrionensis was recorded from 48' depth ranging to the top of this borehole while H.planispira ranged from 16'6" to the top of the borehole.

Benthonic Foraminifera (figs. 8:19, 8:20)

G.intermedia was recorded at 60' depth ranging to the top of the section while E.spinulifera was recorded from 48' depth to the top of the section. Both H.carpenteri and H.chapmani were recorded from 36' depth to the top of the section. A.macfadyeni was recorded from 67' depth to 22' depth and A.chapmani ranged from 18' depth to the top of the section. S.asperula was recorded from 40' depth to the top of the section and U.alta was recorded from 60' depth to 16' depth.

Ostracoda (figs. 8:21, 8:22)

C.cornueli, P.laminata and P.derooi were all recorded between 55' and 45' depth and C. aff.H. nana was recorded commonly between 57' and 33' depth. These species indicate the presence of Subzone Bi.

Fig. 8:19 The distribution of foraminifera (abundance/taxonomic order) in the M.25 borehole 3/1.

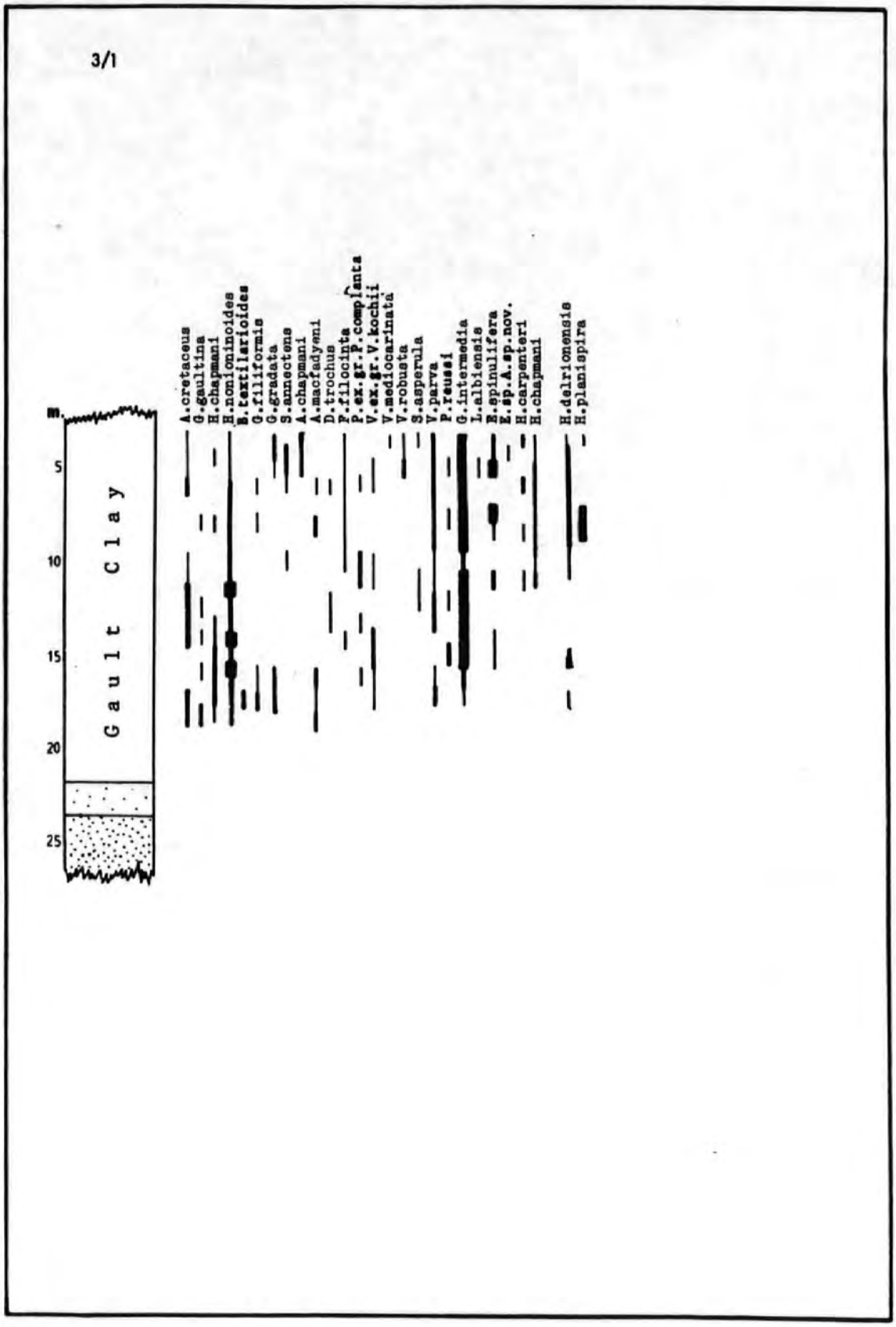


Fig. 8:20 The distribution of foraminifera (first occurrence) in the M.25 borehole 3/1.

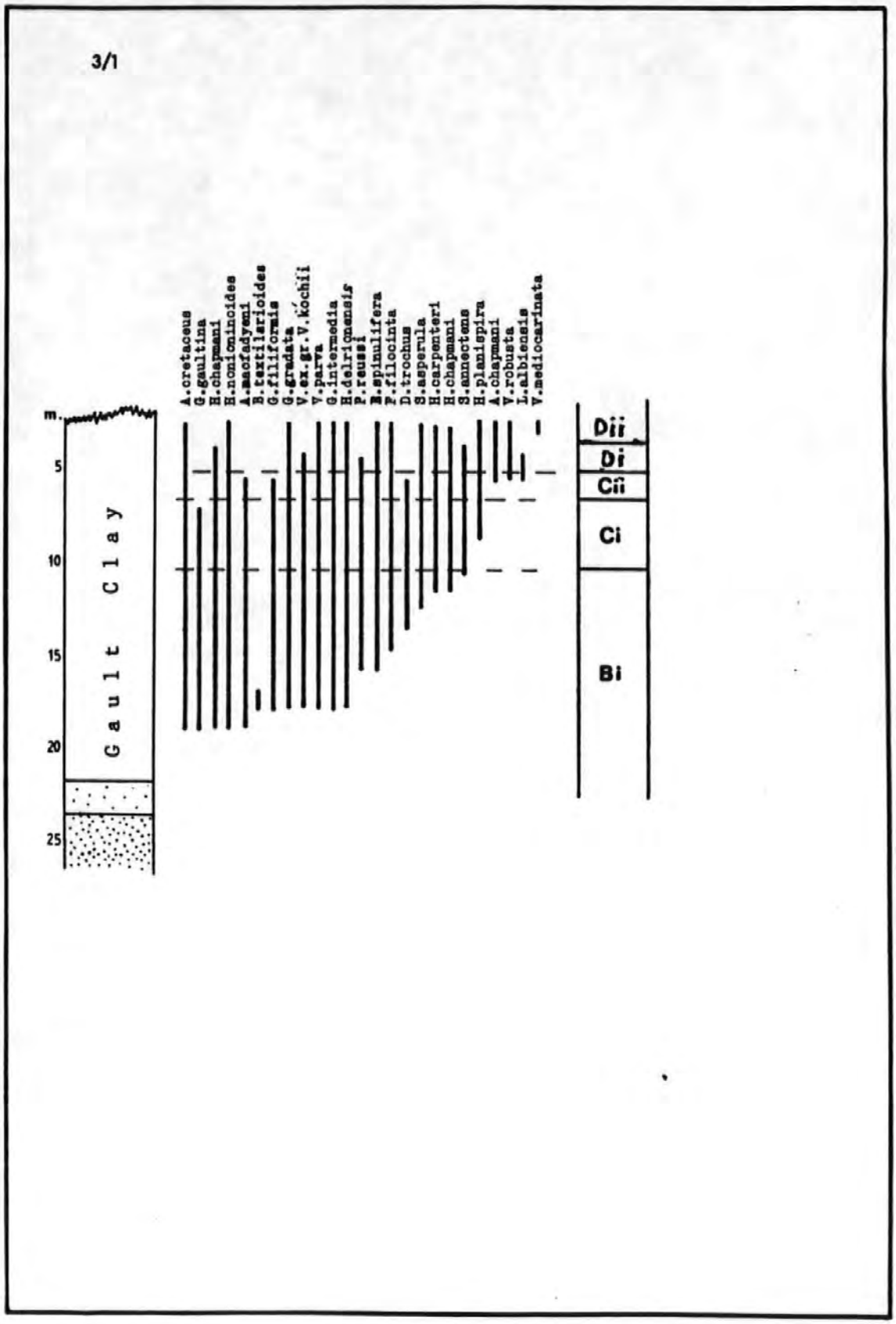


Fig. 8:21 The distribution of Ostracoda (abundance/taxonomic order) in the M.25 borehole 3/1.

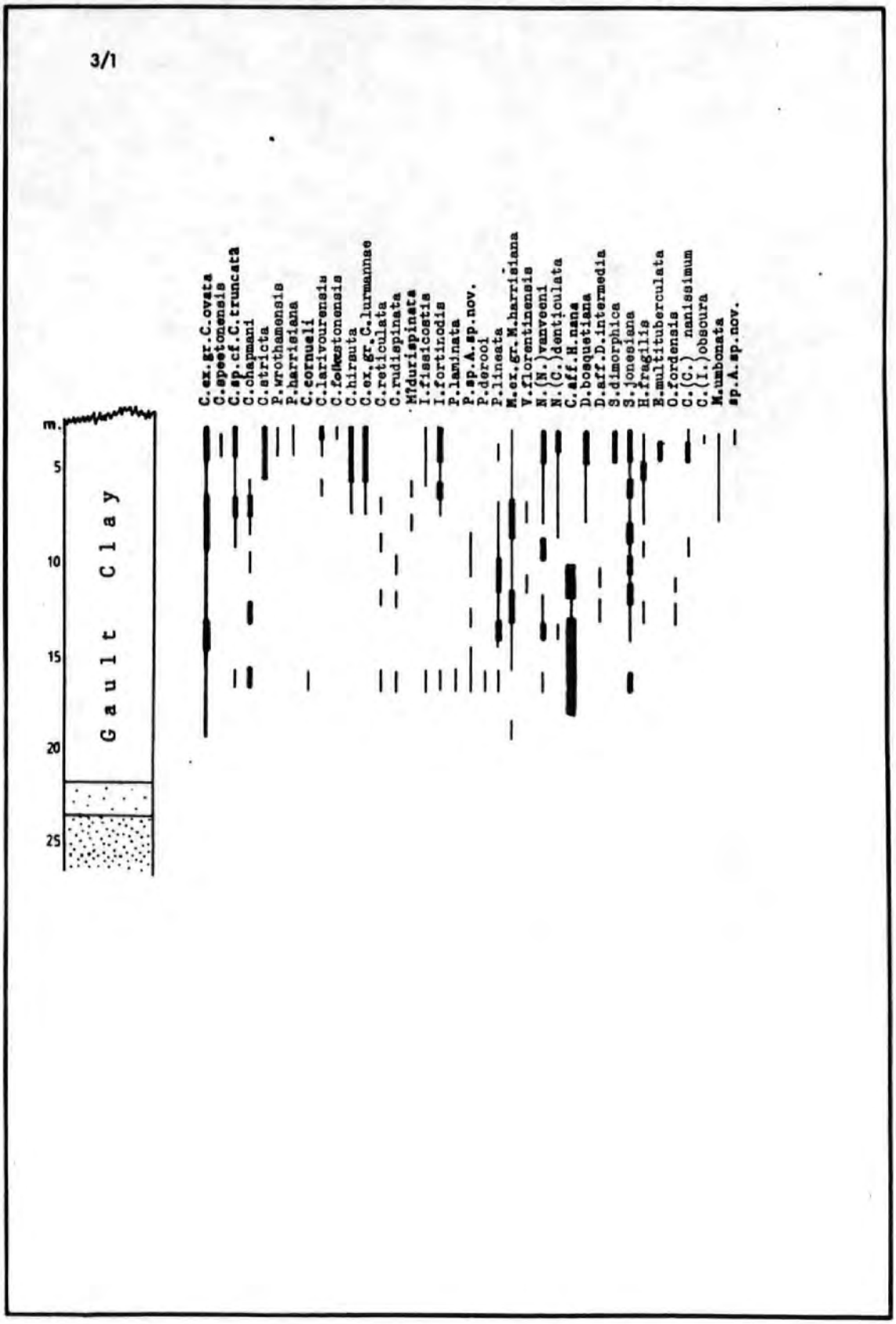
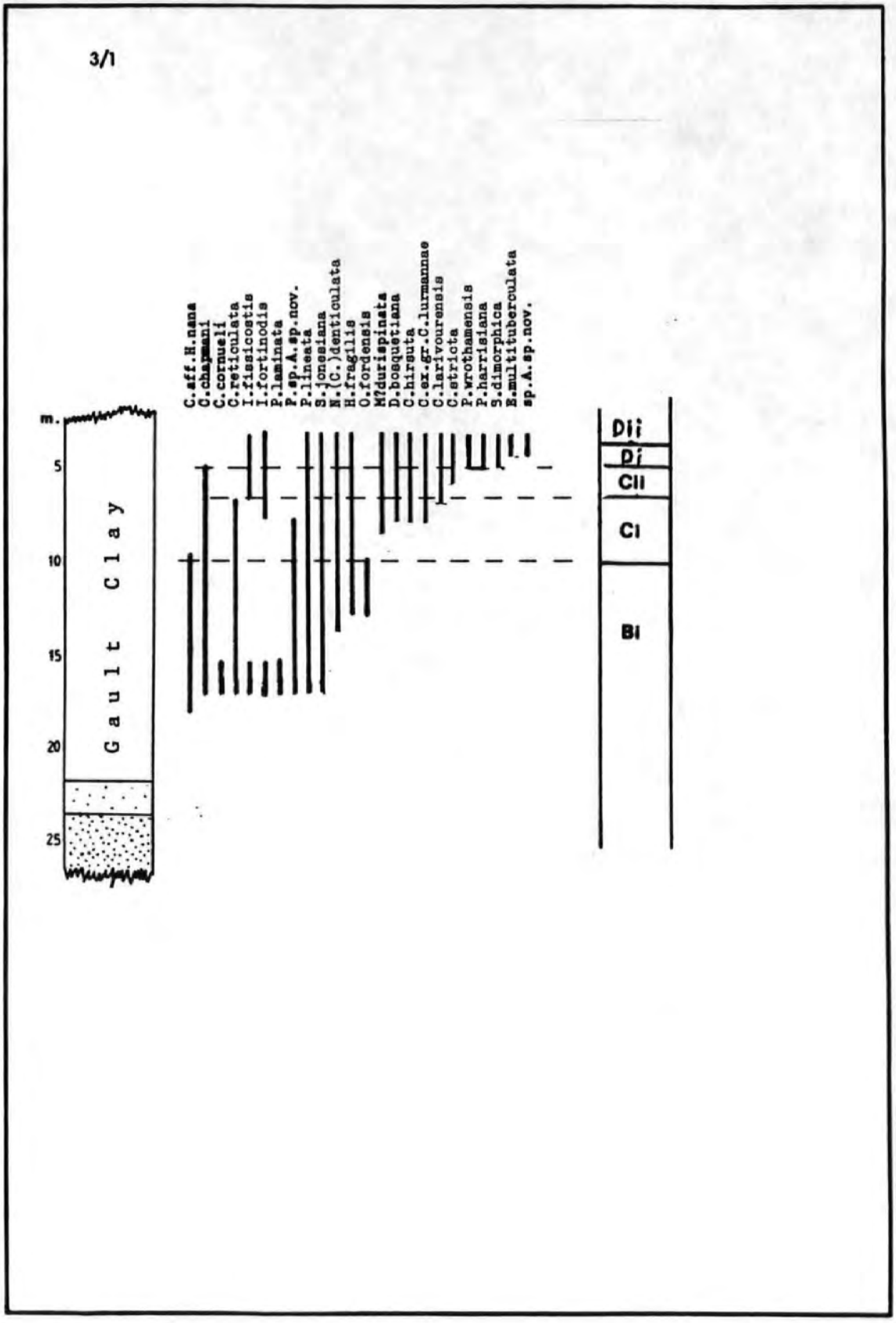


Fig. 8:22 The distribution of Ostracoda (first occurrence) in the M.25 borehole 3/1.



I.fortinodis and I.fissicostis were both recorded rarely at 53' depth and more commonly from 23' depth to the top of this section. Between 26' and 21' depth M?durispinata, C.ex.gr.C.lurmannae and C.hirsuta all make their first appearance indicating that the base of Subzone Ci is present at 33' depth. C.chapmani was recorded between 53' and 15' depth and C.stricta was recorded from 18' depth to the top of this section. E.trigonalis was recorded from 16' depth to the top of the section and C.folkestonensis was recorded from 12' depth to the top of the section.

Conclusions

The first appearance of planktonic foraminifera and the presence of C.cornueli, P.laminata and P.derooi indicate the presence of Subzone Bi in the basal 12m of the Gault Clay at this locality. Biohorizon 2 indicates the base of Subzone Ci and the presence of Biohorizon 4, associated with the first occurrence of E.trigonalis, C.stricta and A.chapmani, indicates the base of Subzone Di. This Subzone is 1.5m thick. The base of Subzone Dii is indicated by the first occurrence of C.folkestonensis. Subzone Dii is the youngest recorded from this section.

BOREHOLE 1967/1

Planktonic Foraminifera (figs. 8:23, 8:24, 8:27)

Both H.delrionensis and H.planispira were recorded throughout this section and F.washitensis was recorded between 111' and 114' depth.

Benthonic Foraminifera (figs. 8:23, 8:24)

G.intermedia was found to range through this section and G.baltica was recorded from 50' depth to the top of this section. E.spinulifera was recorded between 140' and 98' depth while H.chapmani

Fig. 8:23 The distribution of foraminifera (abundance/taxonomic order) in the M.25 borehole 1967/1

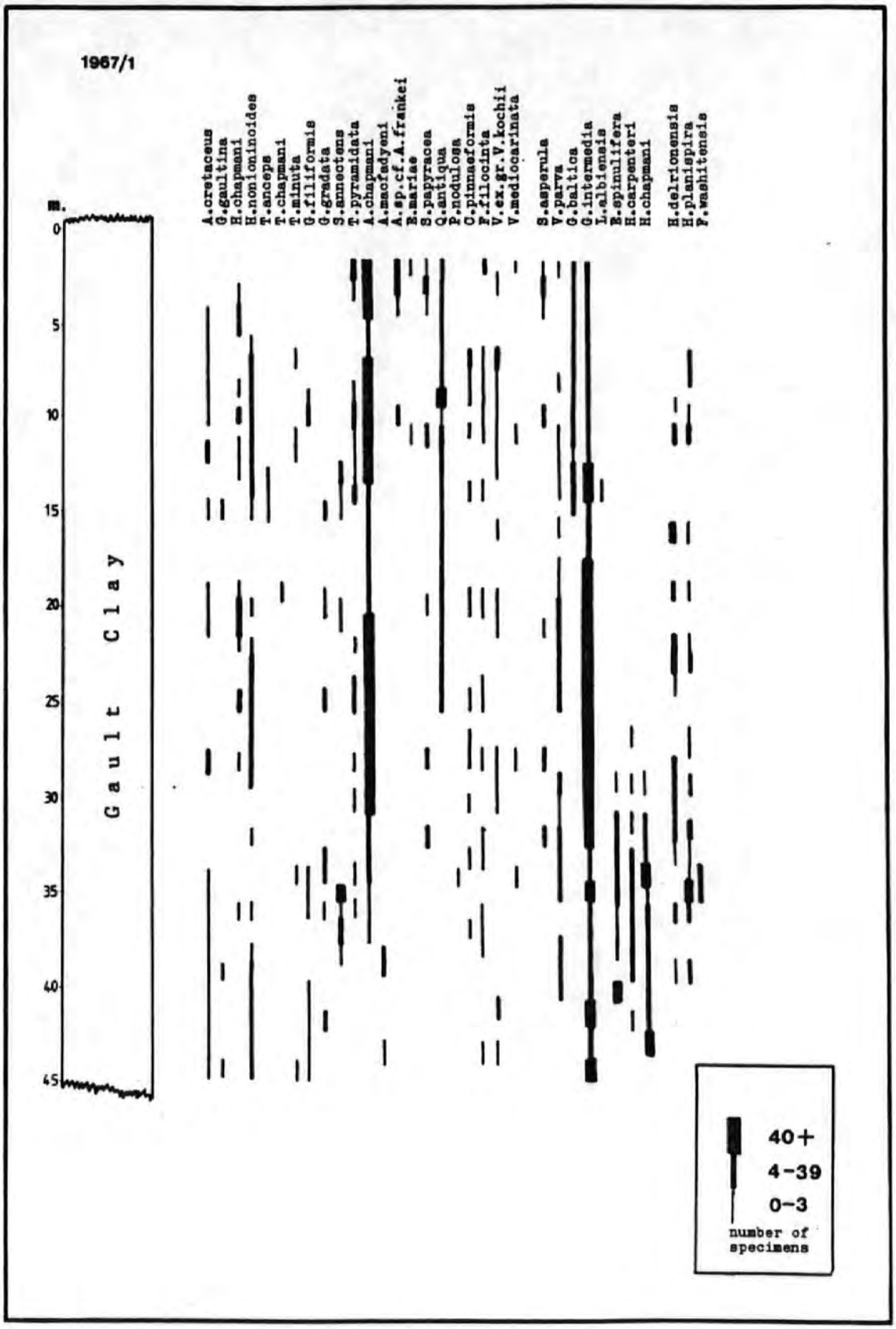
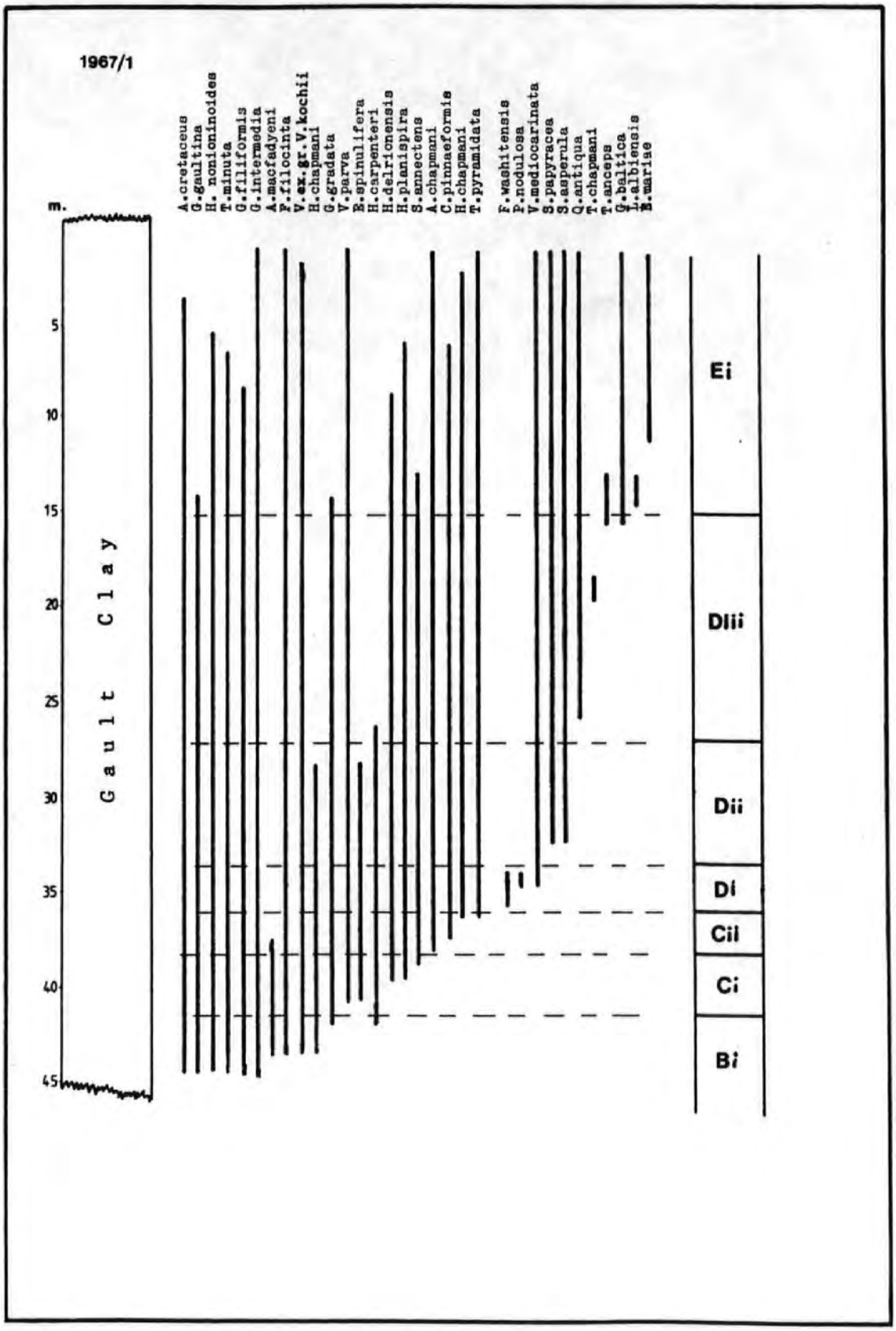


Fig. 8:24 The distribution of foraminifera (first occurrence) in the M.25 borehole 1967/1.



was recorded from 144' to 98' depth and H.carpenteri was recorded between 142' and 93' depth. Epistomina sp.A. sp.nov. was recorded commonly between 98' and 62' depth but only sporadically above 98'. A.macfadyeni was recorded from 144' to 128' depth and A.chapmani was recorded from 128' depth to the top of the section. Miliolids were first recorded in abundance at 85' depth while U.alta was recorded from 144' to 112' depth and S.asperula was recorded from 112' to 22' depth. C.pinnaeformis was recorded between 122' and 26' depth.

Ostracoda (figs. 8:25, 8:26)

C.aff.H.nana was only recorded commonly in the basal sample while M?durispinata was first recorded at 142' depth and C.hirsuta, I.fortinodis and C.larivourensis were all first recorded around 137' depth. C.ex.gr.C.lurmannae was first recorded at 130' depth and C. chapmani was last recorded at 127' depth. C.stricta and P.gaultina were first recorded at 122' depth, E.trigonalis was first recorded at 120' depth while C.folkestonensis was recorded ranging from 113' to 32' depth.

Conclusions

The presence, in abundance, of C.aff.H.nana in the basal sample of this section indicates the presence of Subzone Bi. The base of Subzone Ci is indicated by the first appearance of C.hirsuta, I.fortinodis, and C.larivourensis. Both Subzones Ci and Cii are present at this locality, the base of the latter being marked by the presence of Biohorizon 3. These two Subzones are 5.5m thick. C.stricta, which first occurs 9m above the base of this section, and the first occurrence of E.trigonalis indicate the base of the Di Subzone. The base of Subzone Dii (2m above the base of Di) is marked by the first occurrence of C.folkestonensis. The majority of this section is composed of Subzones Dii, Diii and Ei. The boundaries between these Subzones are clearly defined by the presence of Biohorizons 5 and 6.

Fig. 8:25 The distribution of Ostracoda (abundance/taxonomic order) in the M.25 borehole 1967/1.

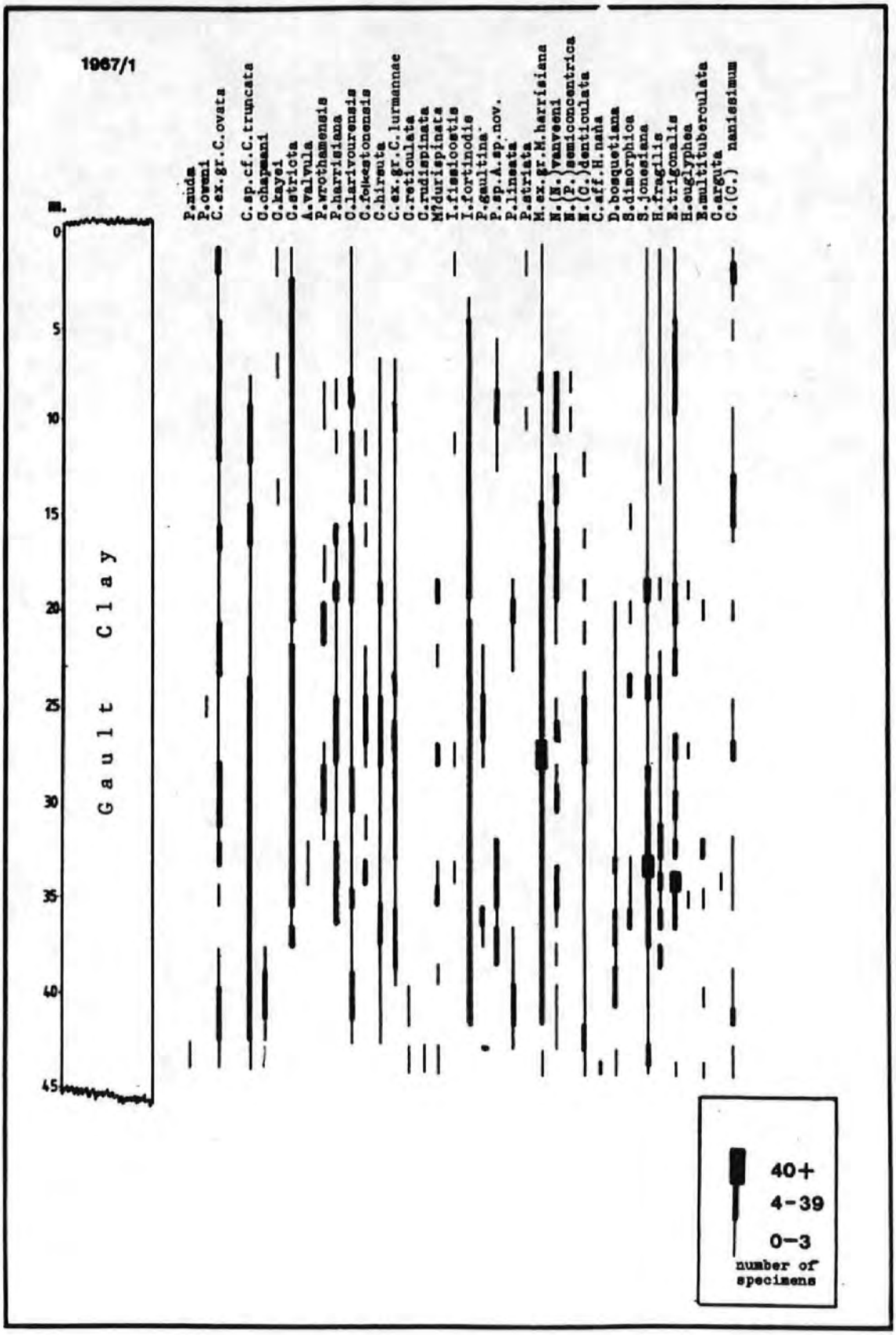


Fig. 8:26 The distribution of Ostracoda (first occurrence) in the M.25 borehole 1967/1.

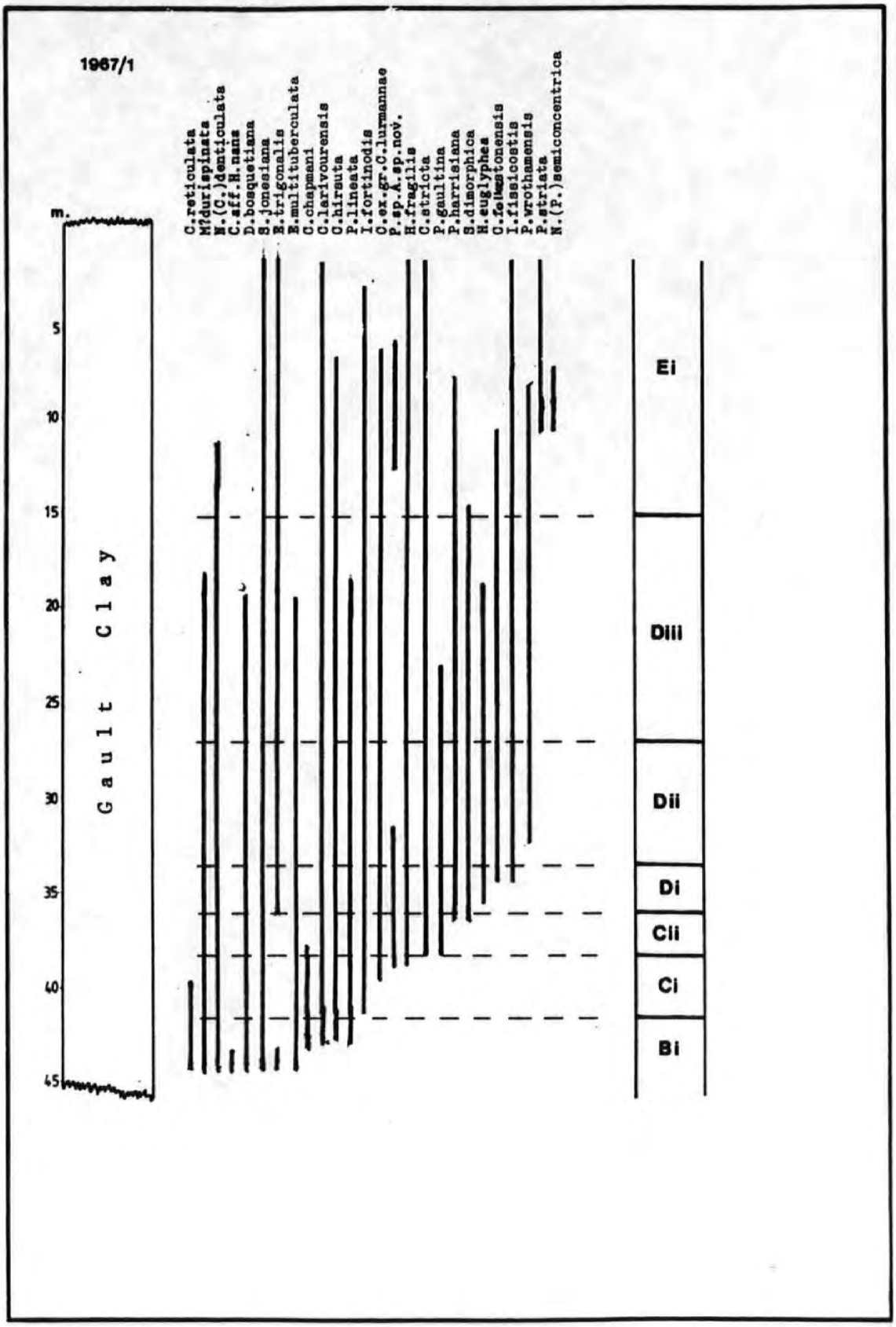
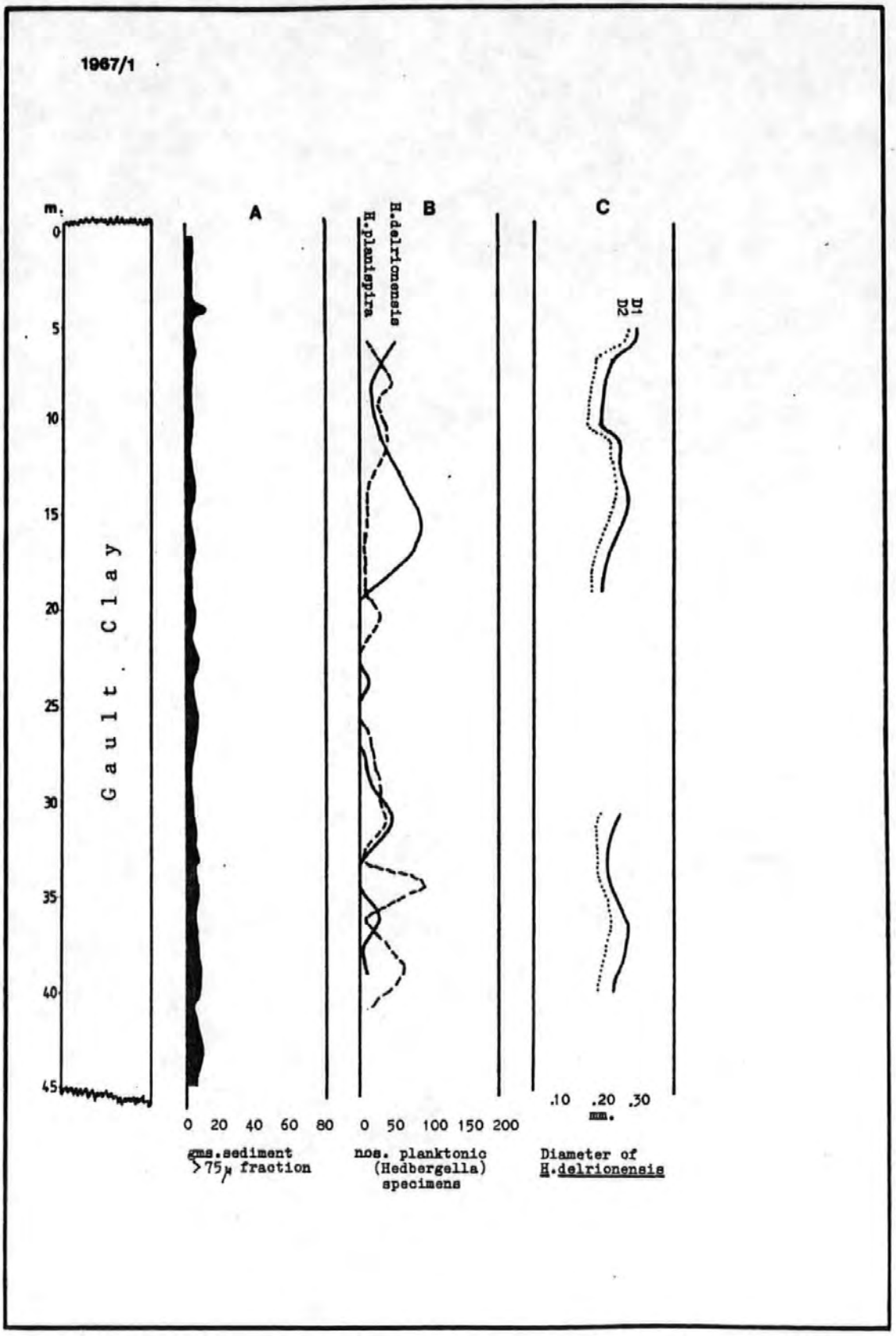


Fig. 8:27 Foraminiferal analysis of the M.25 borehole 1967/1.



These three Subzones total 33m in thickness. Subzone Eii may be present in the top 5m of this section but the data is inconclusive.

BOREHOLE 113/2

Planktonic Foraminifera (figs. 8:28, 8:29, 8:32)

H.delrionensis and H.planispira both range throughout this section. F.washitensis was only recorded at 35'6" depth.

Benthonic Foraminifera (figs. 8:28, 8:29)

E.spinulifera was recorded from the base of this section to 94' depth while H.chapmani and H.carpenteri were recorded from the base of this section to 105' depth. Epistomina sp.A. sp.nov. was recorded between 66' and 16' depth and T.chapmani was found from 94' depth to the top of the section. A.macfadyeni was recorded in the basal part of this section up to 102' depth while A.chapmani occurred from 98' depth to the top of the section. C.pinnaeformis was recorded between 104' and 18' and G.baltica was recorded from 35' depth upwards to the top of this section. Both Q.antiqua and S.papyracea were recorded from 65' depth upwards.

Ostracoda (figs. 8:30, 8:31)

C.chapmani was only recorded between 112' and 106' depth while C.stricta was first recorded at 100' depth and ranged to the top of the section. C.hirsuta, C.ex.gr.C.lurmannae, and C.larivourensis were all recorded throughout this section whilst M?durispinata was recorded between 112' and 42' depth and I.fortinodis from 112' to 22' depth. C. folkestonensis was recorded between 60' and 24' while C.thoerenensis was found in the topmost sample. Both P.lineata and N.(C.)denticulata were recorded from the base up to 28' depth while N.(P.)semiconcentrica was only recorded in the topmost sample. C.aff.H.nana was only

Fig. 8:28 The distribution of foraminifera (abundance/taxonomic order) in the M.25 borehole 113/2.

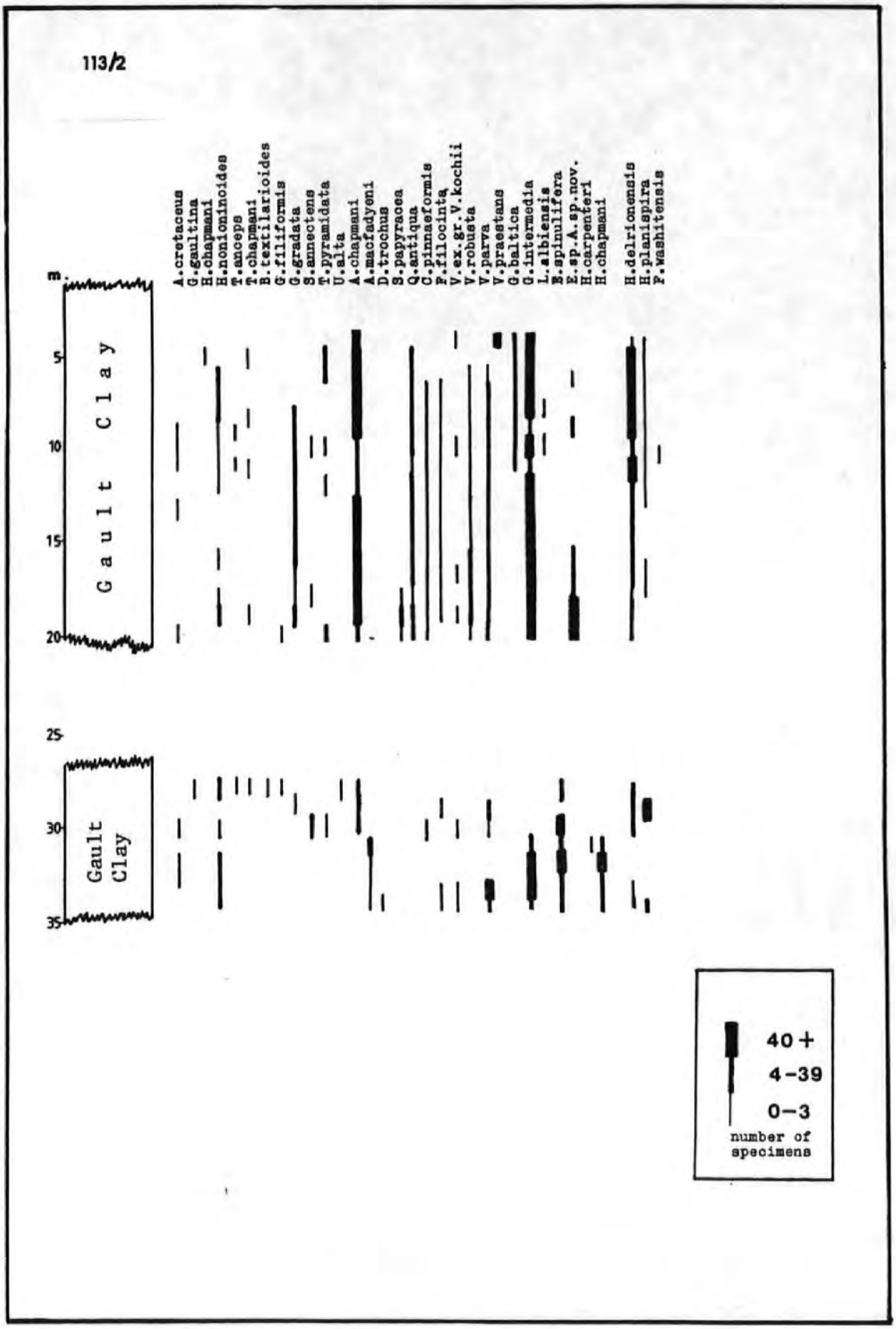


Fig. 8:29 The distribution of foraminifera (first occurrence) in the M.25 borehole 113/2.

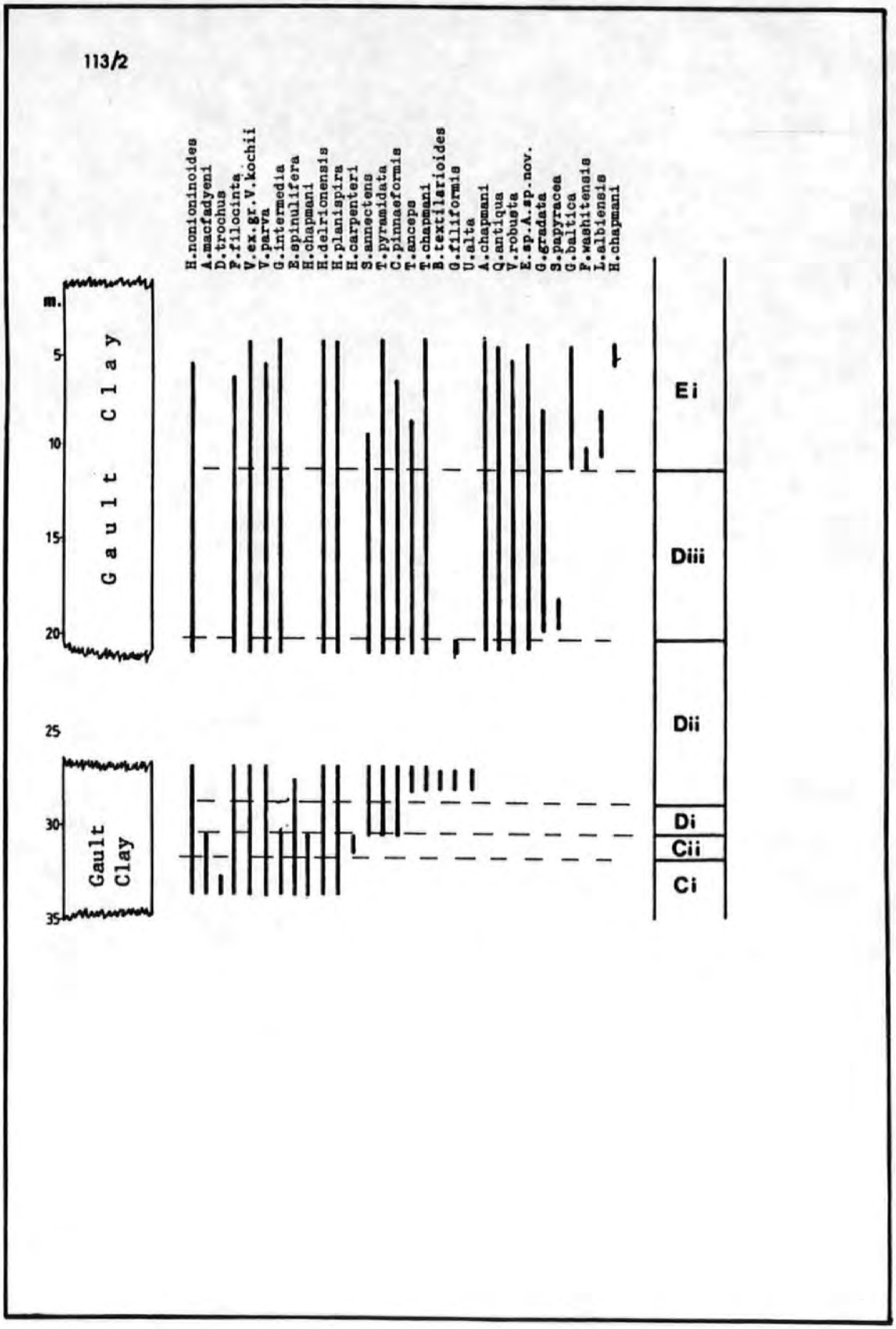


Fig. 8:30 The distribution of Ostracoda (abundance/taxonomic order) in the M.25 borehole 113/2.

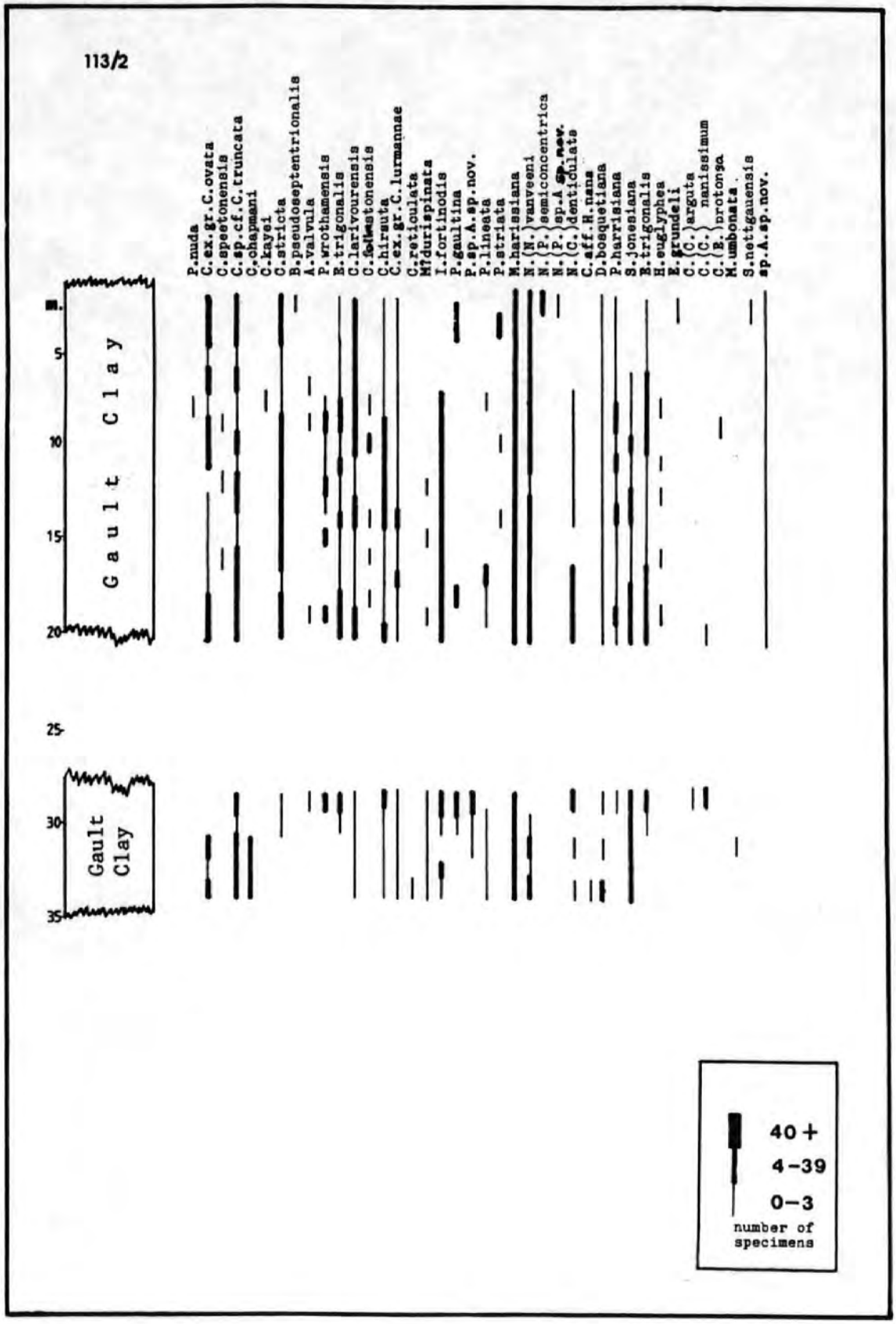


Fig. 8:31 The distribution of Ostracoda (first occurrence) in the M.25 borehole 113/2.

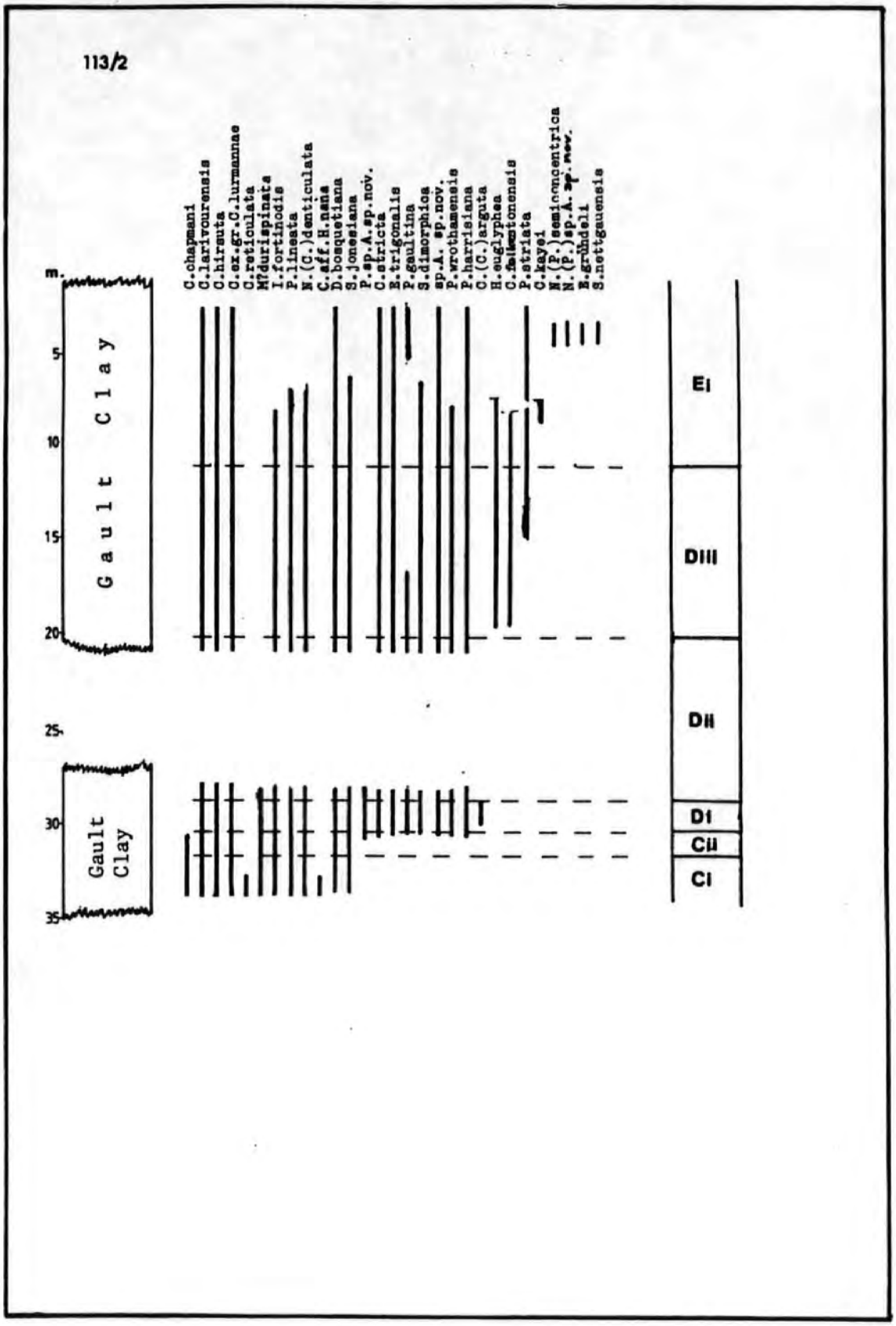
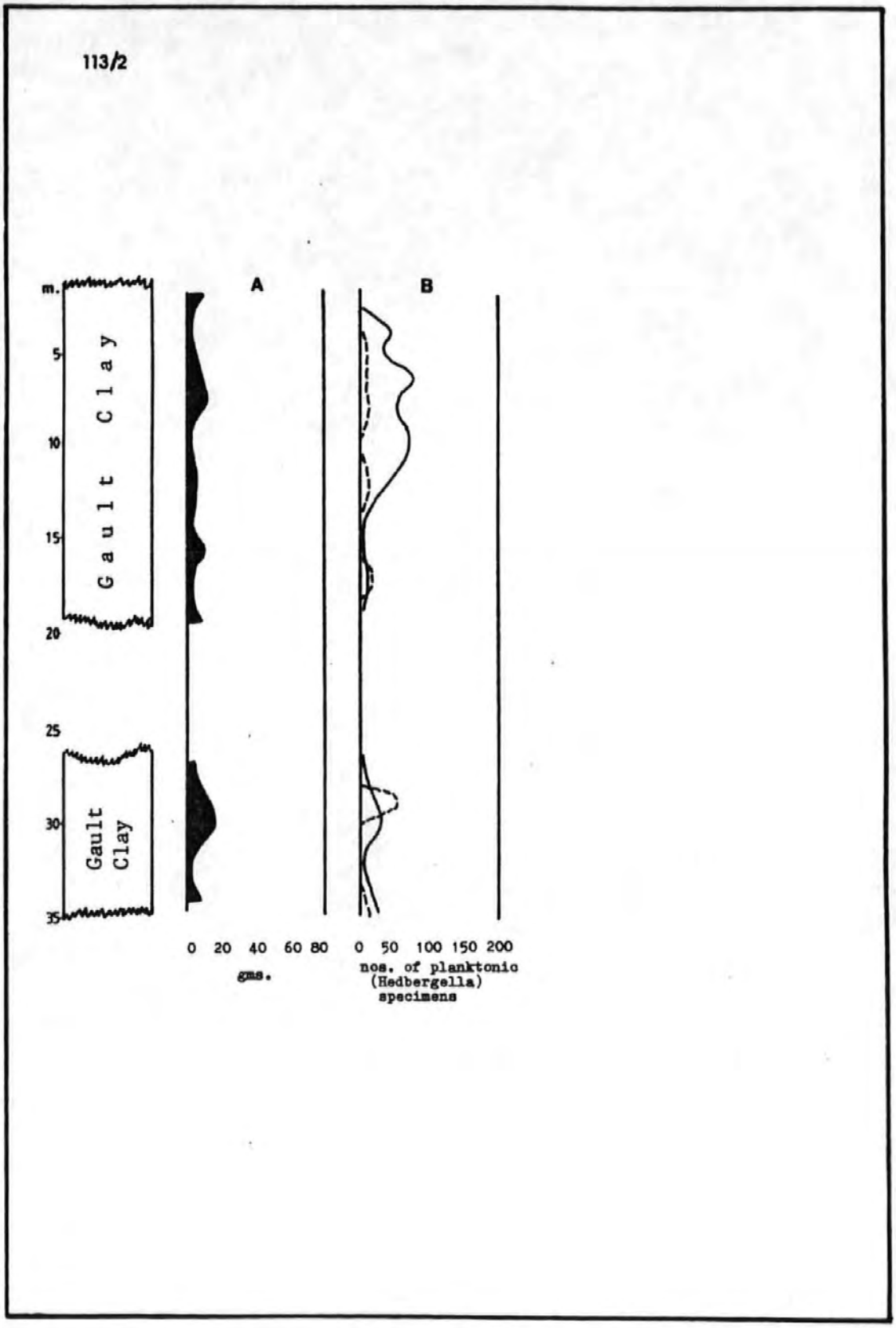


Fig. 8:32 Foraminiferal analysis of the M.25 borehole 113/2.



recorded rarely at 112' depth. E.trigonalis was found from 100' depth to the top of the section and sp.A was recorded from 60' to the top of the section. B.pseudoseptentrionalis, C.gründeli and S.nettgauensis were only recorded in the topmost sample.

Conclusions

Biohorizon 3 was recorded 3m from the base of this section indicating the presence of Subzone Ci. The base of Subzone Di is indicated by the first appearance of C.stricta, E.trigonalis and A.chapmani while the base of Subzone Dii is marked by the first appearance of C.folkestonensis and C.pinnaeformis.

Most of this section is composed of the Upper Albian Subzones Dii to Ei which are 25m thick. Unfortunately a sampling gap is present within Subzone Dii. However, the top of this Subzone is clearly defined at 20m depth by the presence of Biohorizon 5 and the first appearance of miliolids in abundance. Biohorizon 6 was recorded at 10m depth indicating the base of Subzone Eii. At this horizon the clay appears to have been extensively weathered and, therefore, no firm conclusions have been drawn.

BOREHOLE 16/3

Planktonic Foraminifera (figs. 8:33, 8:34, 8:37)

H.delrionensis was recorded throughout this section while H.planispira was recorded between 90' and 32' depth. G.harrisi was found from 49' depth to the top of the section and H.moremani was recorded from 62' depth to the top of this section.

Benthonic Foraminifera (figs. 8:33, 8:34)

A.chapmani ranges through most of this section. Transitional forms to A.advena were recorded between 20' and 11' depth while specimens of A.advena were recorded from 18' depth to the top of this

Fig. 8:33 The distribution of foraminifera (abundance/taxonomic order) in the M.25 borehole 16/3.

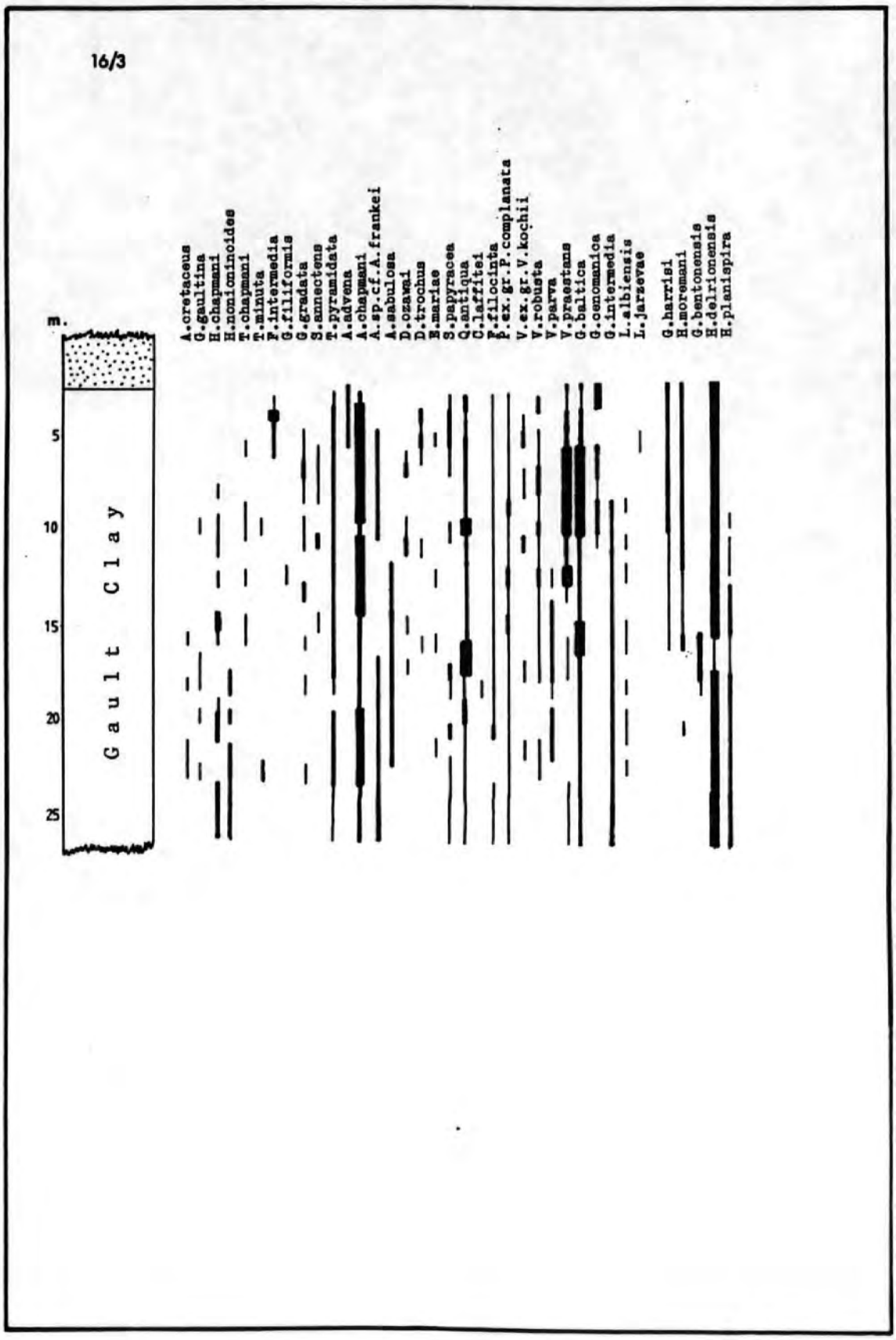
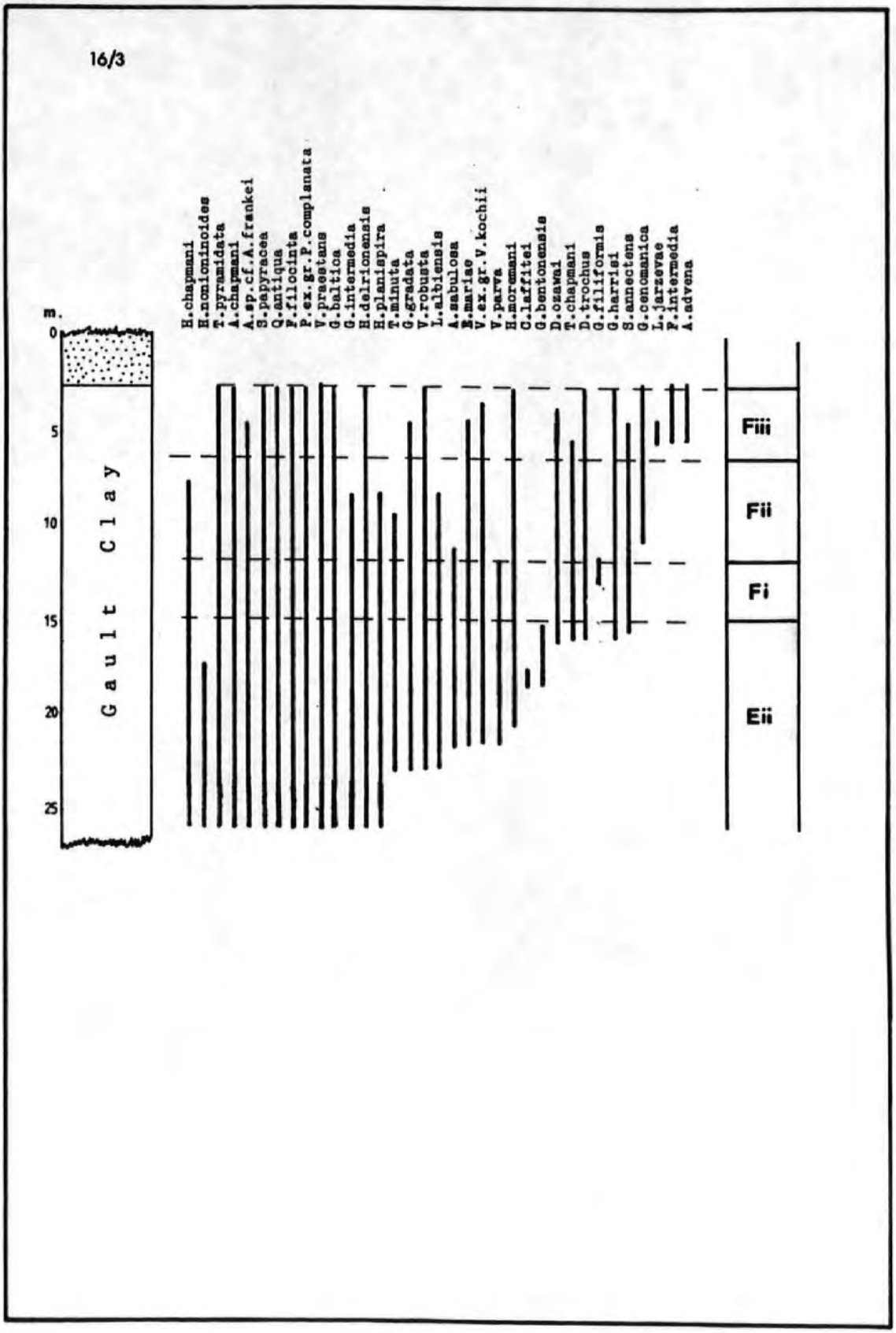


Fig. 8:34 The distribution of foraminifera (first occurrence) in the M.25 borehole 16/3.



section. Forms transitional to A. sp.cf. A.frankei were recorded between 90' and 48' depth while typical specimens of A.sp.cf.A.frankei were found between 36' and 18' depth. A.sabulosa was recorded between 75' and 18' depth and transitional forms to F.intermedia between 49' and 20'. Typical specimens of F.intermedia were only recorded between 18' and 11' depth.

G.baltica was recorded throughout this section , G.cenomanica was found between 35' and 11' depth and while L.albiensis was recorded throughout this section L.jarzevae was only recorded at 17' depth. Both Q.antiqua and S.papyracea were recorded throughout this section and D.ozawai was found from 57' depth to the top of the section.

Ostracoda (figs. 8:35, 8:36)

C.hirsuta, C.ex.gr.C.lurmannae, C.thoerenensis, and N.(P.)semiconcentrica were all recorded throughout this section. I.fortinodis and I.fissicostis were both last recorded at 25' depth while M? durispinata was last recorded at 16' depth. C.milbournei and E. trigonalis were last found at 16'. C.kayei was found between 90' and 11' depth while N.(P.)steghausi was found between 43' and 32' depth. P. chapmani was only recorded between 46' and 18' depth and M.lapparenti was only found between 48' and 42' depth.

P.chathamensis, C.h.hindei, P.sandersi, L?icknieldensis and H.euglyphea were all first recorded at 45' depth. All these species range through into the Cenomanian.

Conclusions

Biohorizon 7 was recorded 14.5m below the base of the 'Glauconitic Marl' while Biohorizon 8 was recorded 12m below the 'Glauconitic Marl'. These horizons indicate the base of Subzones Fi and Fii respectively. The top 3.5m. of the Gault Clay at this locality contains a fauna characteristic of Subzone Fiii, below this

Fig. 8:35 The distribution of Ostracoda (abundance/taxonomic order) in the M.25 borehole 16/3.

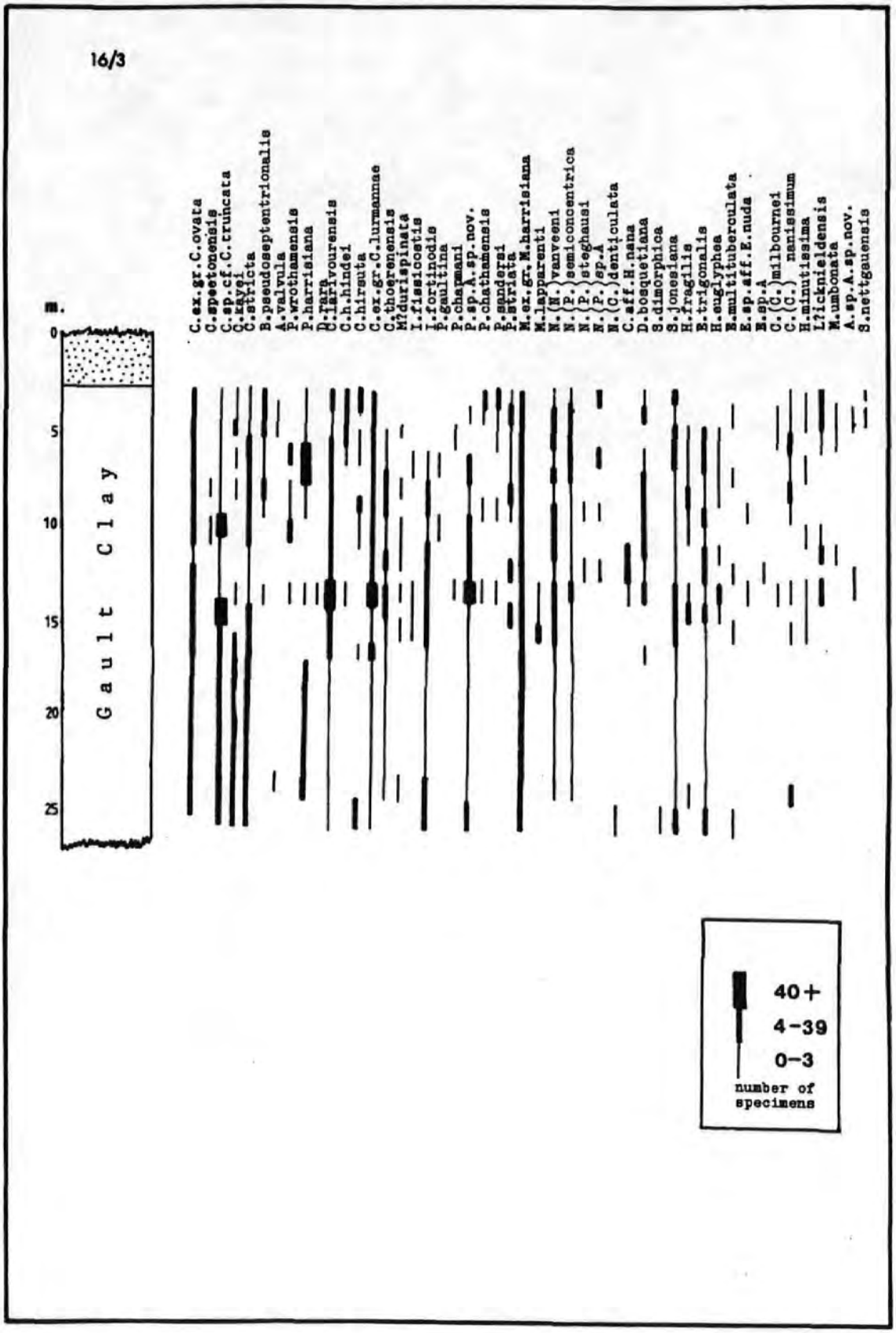


Fig. 8:36 The distribution of Ostracoda (first occurrence) in the M.25 borehole 16/3.

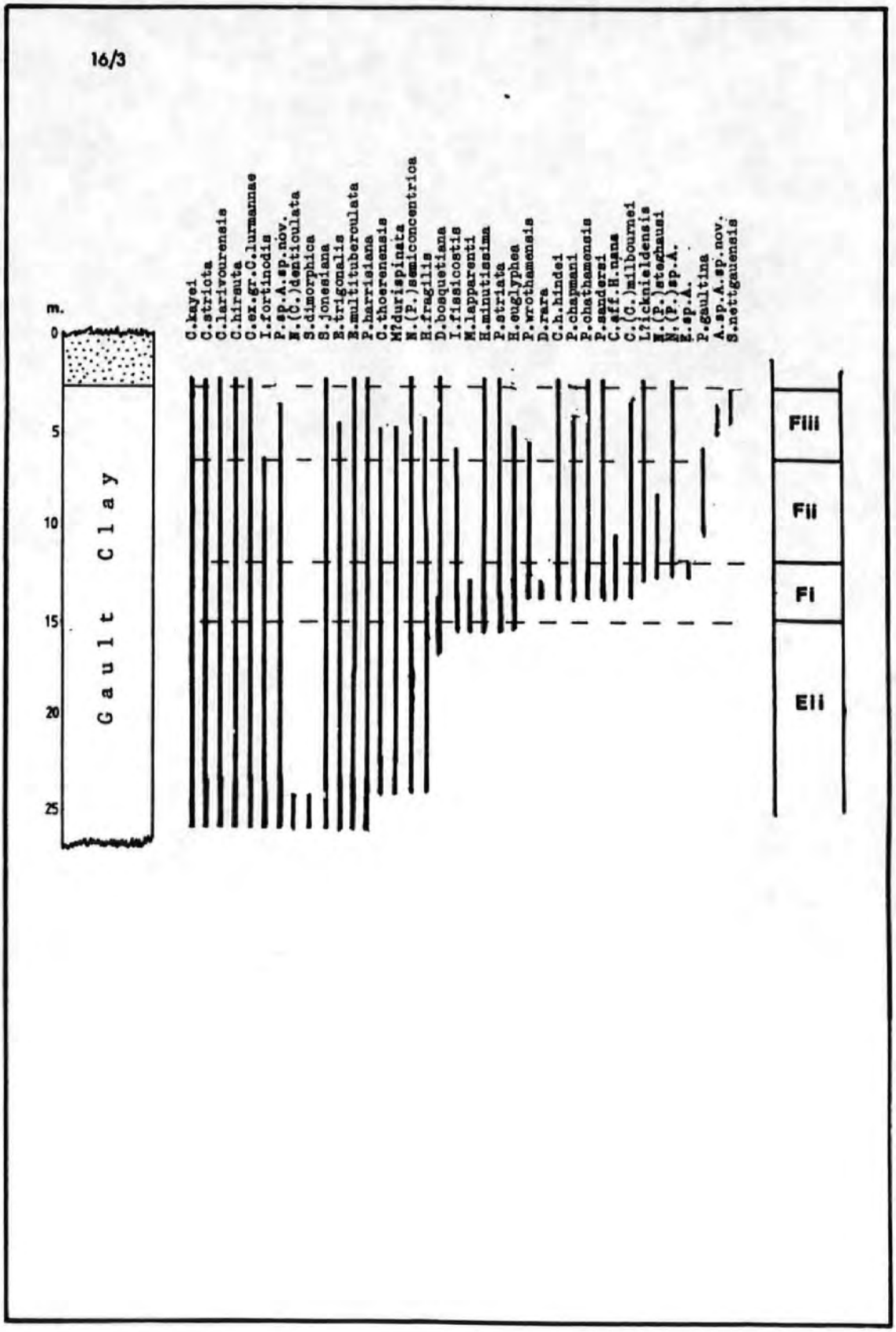
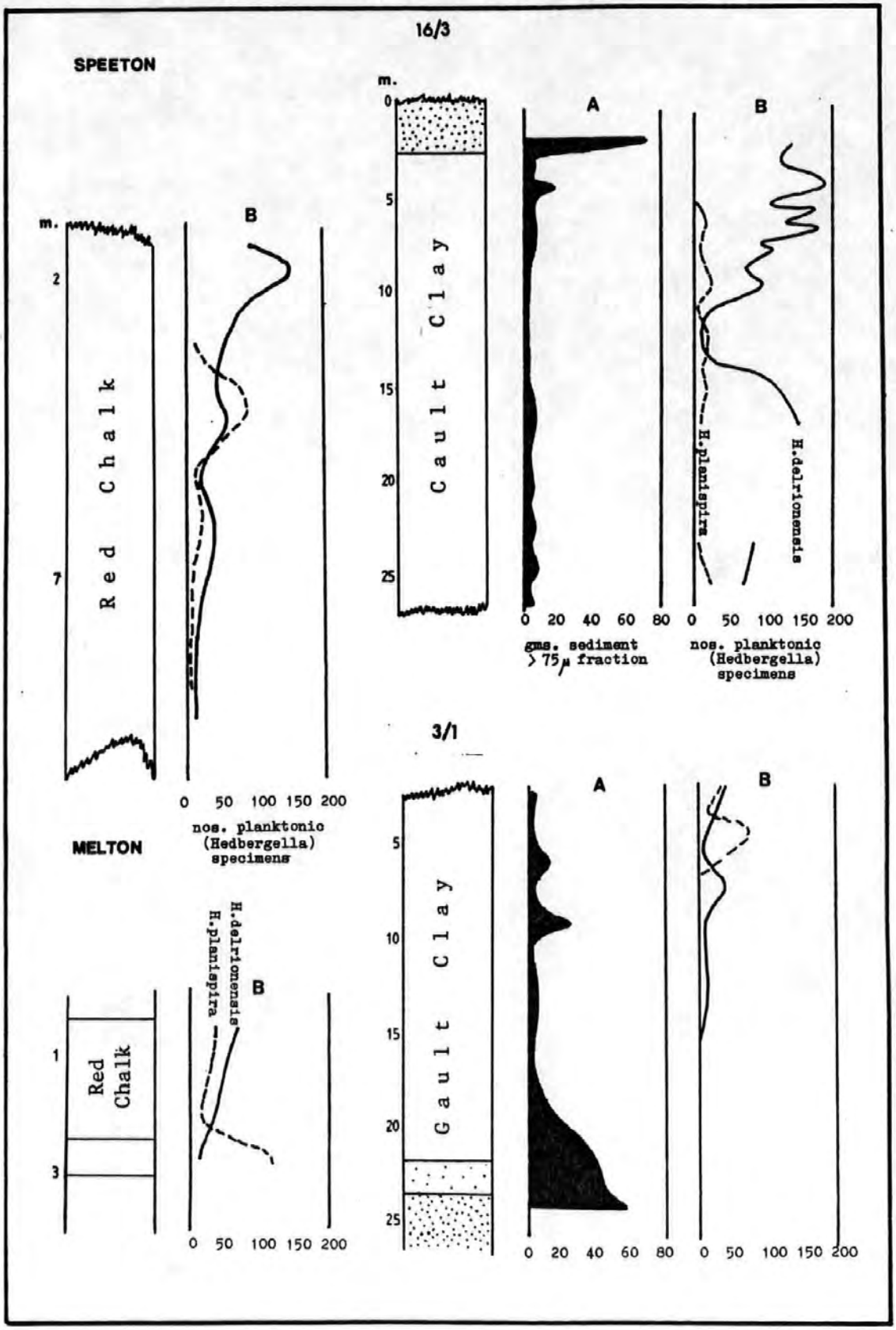


Fig. 8:37 Foraminiferal analysis of four sections



Subzone 9m of Subzone Fii is present.

The basal sample of this section contained specimens of N.(C.) denticulata which are probably indicative of the top of Subzone Ei.

WISSANT

Planktonic Foraminifera (figs. 8:18, 8:38, 8:39)

H.delrionensis and H.planispira were recorded from all but the basal sample collected from this section. F.washitensis was found in two samples, W7 and W17, while G.harrisi was found in the samples above W10.

Benthonic Foraminifera (figs. 8:38, 8:39)

Both E.spinulifera and H.chapmani were recorded up to the level of sample W7 while E.cretosa was only recorded from W4. A.macfadyeni was found up to the level of W5 and A.chapmani was recorded between samples W7 and W12. G.intermedia was recorded throughout this section, G.baltica from W6 upwards and L.jarzevae only from W7. C.pinnaeformis was found to range from W6 to W13 while both Q.antiqua and S.papyracea were recorded from sample no. W11 and above. S.asperula was only recorded from W11 and W17.

Ostracoda (figs. 8:40, 8:41)

C.hirsuta, C.ex.gr.C.lurmannae and C.larivourensis were all recorded from W4 to the top of the section while M?durispinata was recorded ranging from W4 to W14. C.chapmani was recorded from W4 and then again in W10 and W12, C.stricta was also first recorded from W4 as were I.fortinodis and I.fissicostis. N.(C.)denticulata was recorded from W4 to W14 while N.(P.)semiconcentrica was found in samples W9 and W13. E.trigonalis and P.gaultina were recorded from W5 to the top of the section. C.folkestonensis was recorded from W17 to W13 while M. lapparenti was found in samples W.16 and W10. P.striata was recorded

Fig. 8:38 The distribution of foraminifera (abundance/taxonomic order) in the Wissant section.

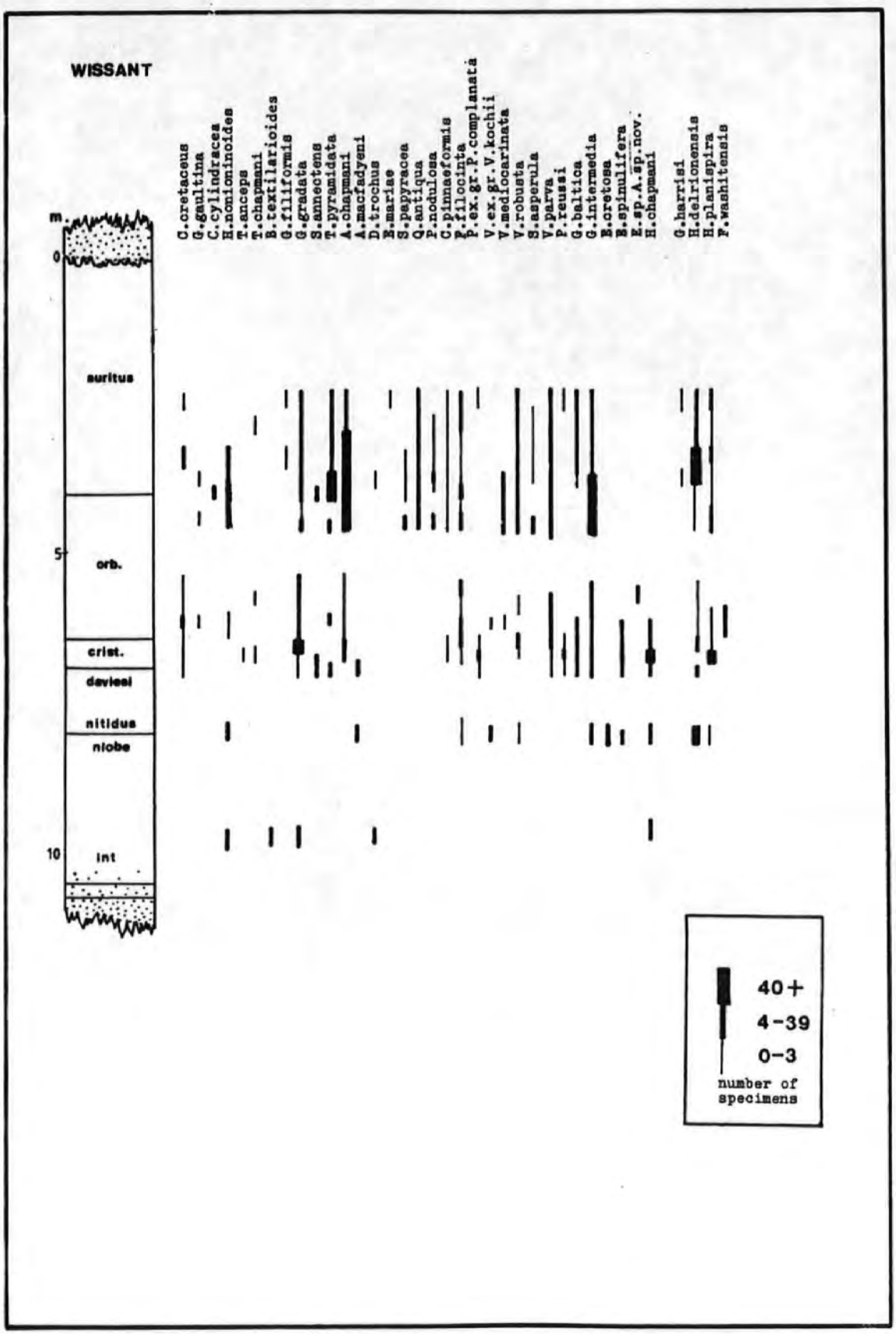


Fig. 8:39 The distribution of foraminifera (first occurrence) in the Wissant section.

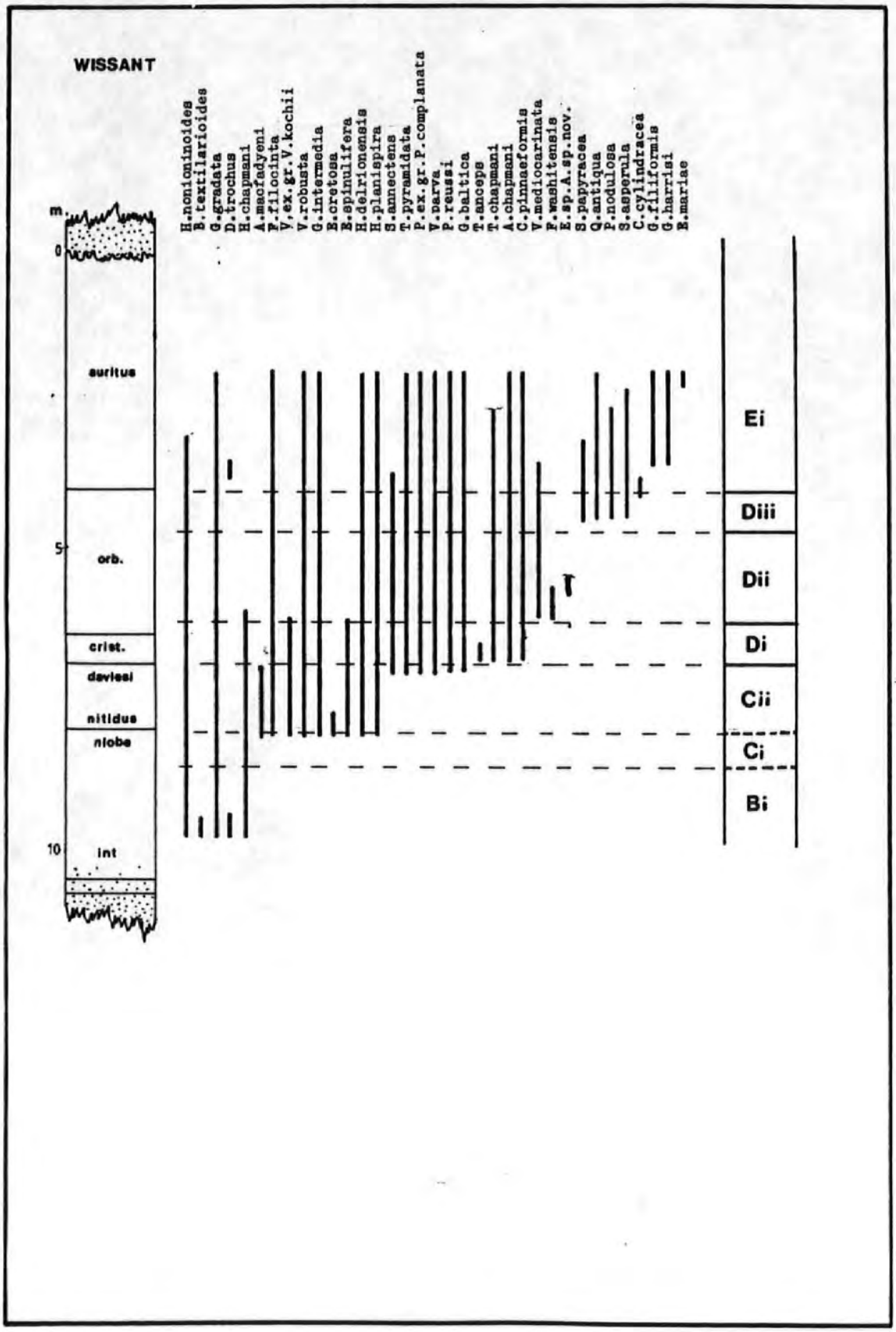


Fig. 8:40 The distribution of Ostracoda (abundance/taxonomic order) in the Wissant section.

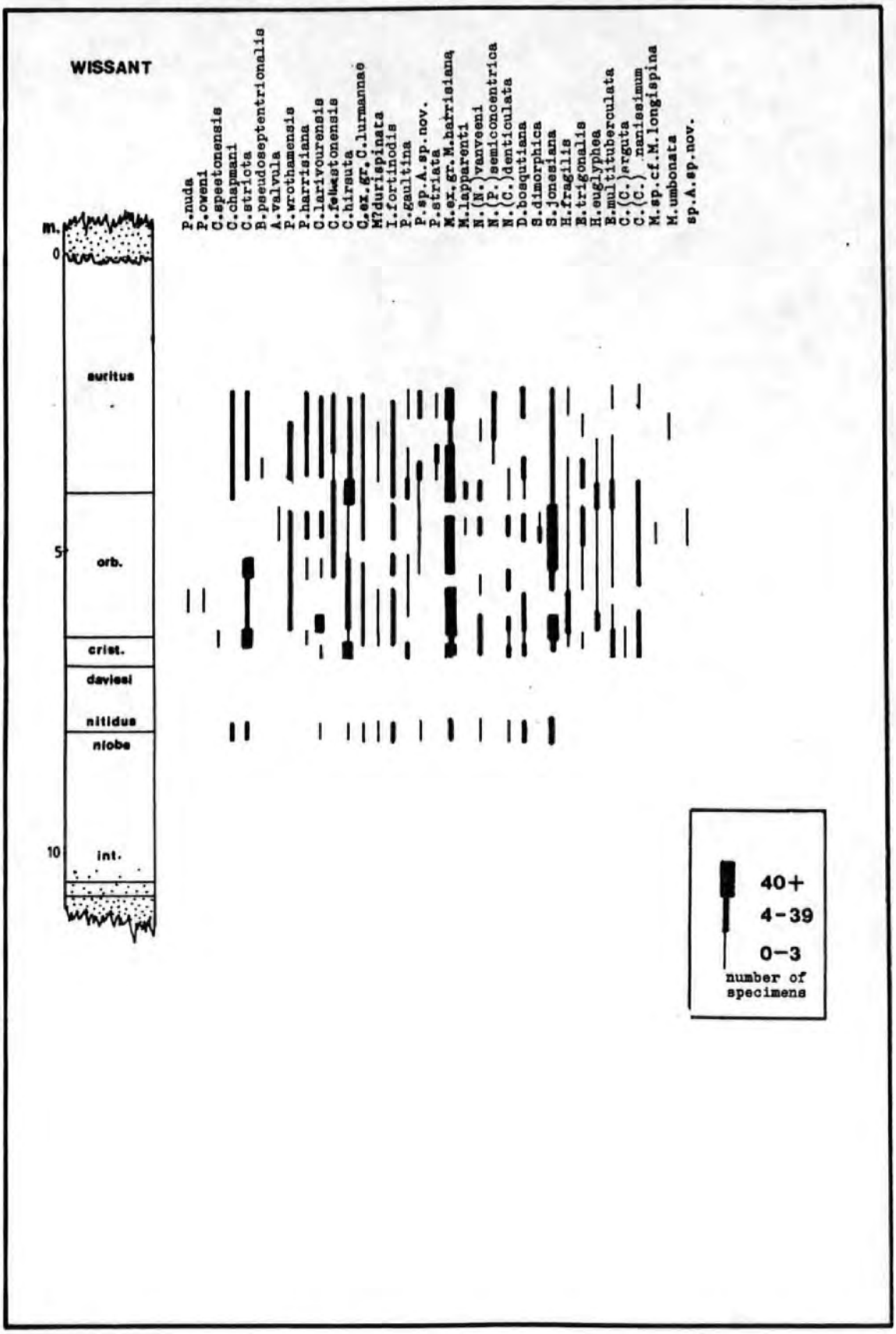
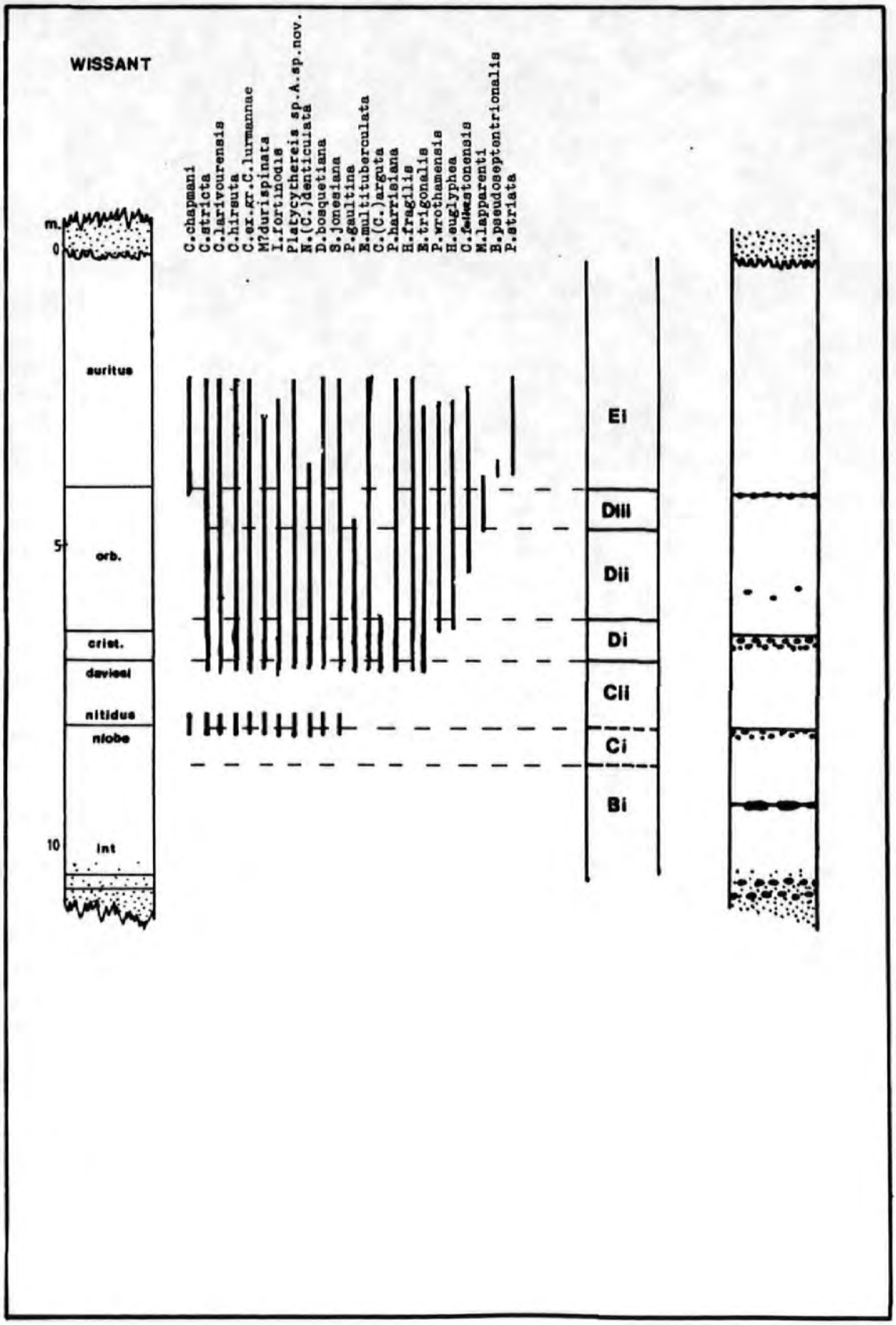


Fig. 8:41 The distribution of Ostracoda (first occurrence) in the Wissant section.



from W10 to the top of the section and B.pseudoseptentrionalis was found in W8.

Conclusions

This section was collected mainly for comparative material and, therefore, insufficient samples were collected from this locality to enable precise subdivision of this section. However, sample W3 indicates the presence of Subzone Bi at the base of this section and W4 indicates that Subzone Ci is present. Above this nodule bed Subzone Di is clearly defined, the base of which is below the D.cristatum nodule bed. The first appearance, in abundance, of Q.antiqua and S.papyracea below the H.varicosum nodule bed indicates that this Subzone is not confined to the nodule bed. Above the nodule bed the planktonic element of the fauna indicates that this bed is stratigraphically younger than Biohorizon 6 while the presence of C. pinnaeformis and C.folkestonensis indicates Subzone Ei. Biohorizon 6 must occur within the H.varicosum nodule bed.

CAUVILLE

Planktonic Foraminifera

No planktonic foraminifera were recorded from this section.

Benthonic Foraminifera (figs. 8:42, 8:43)

U.alta was found in samples C11 and C8 while A.chapmani was recorded from samples C10 to C5. The last sample contained specimens transitional to A.advena. A.macfadyeni was recorded from samples C12 and C9, many of these specimens were transitional to A.chapmani. Early forms of G.cenomanica were recorded from sample C5 while G. baltica and L.jarzevae were recorded from C6.

Specimens of H.chapmani and H.carpenteri were recorded from

Fig. 8:42 The distribution of foraminifera (abundance/taxonomic order) in the Cauville section.

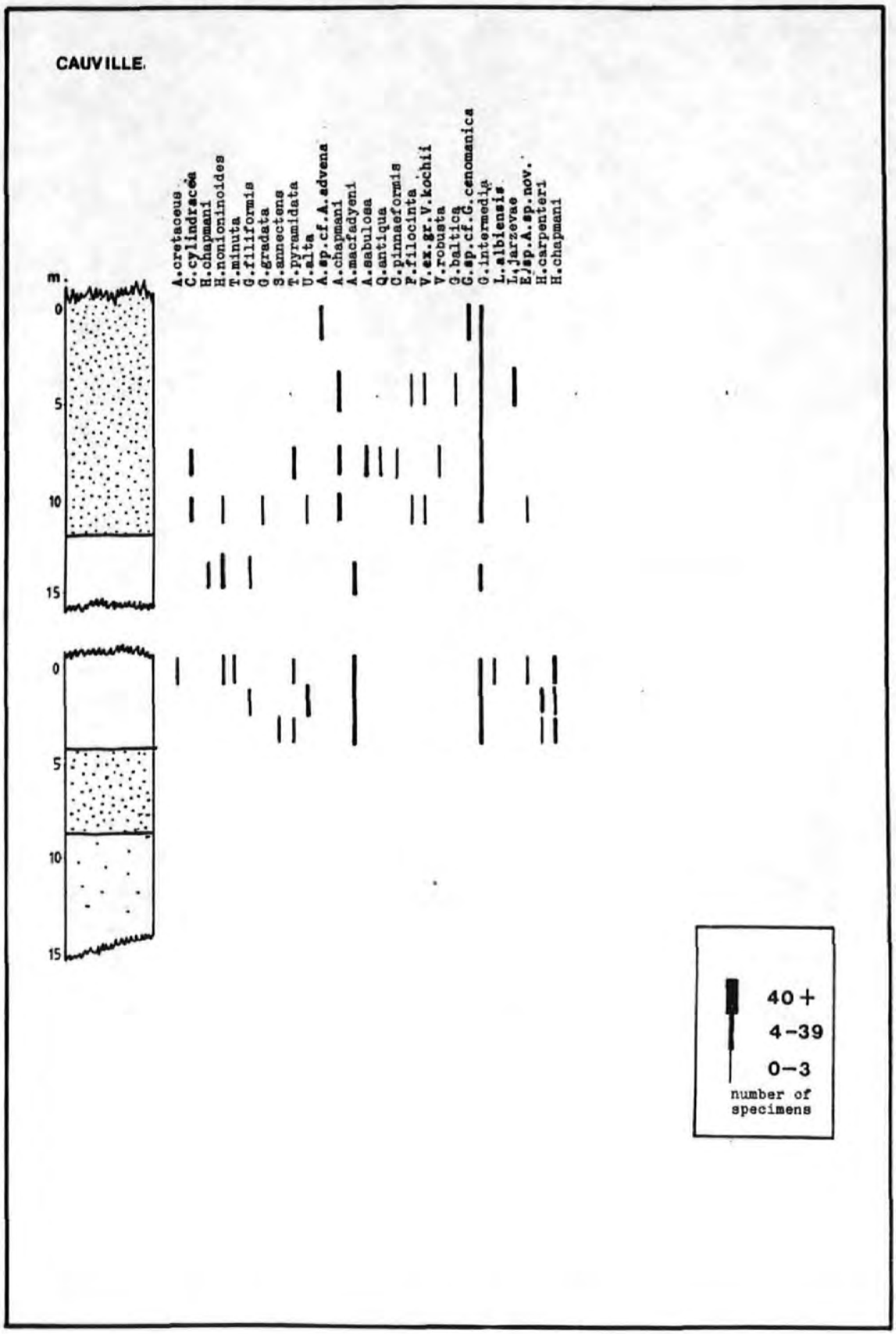
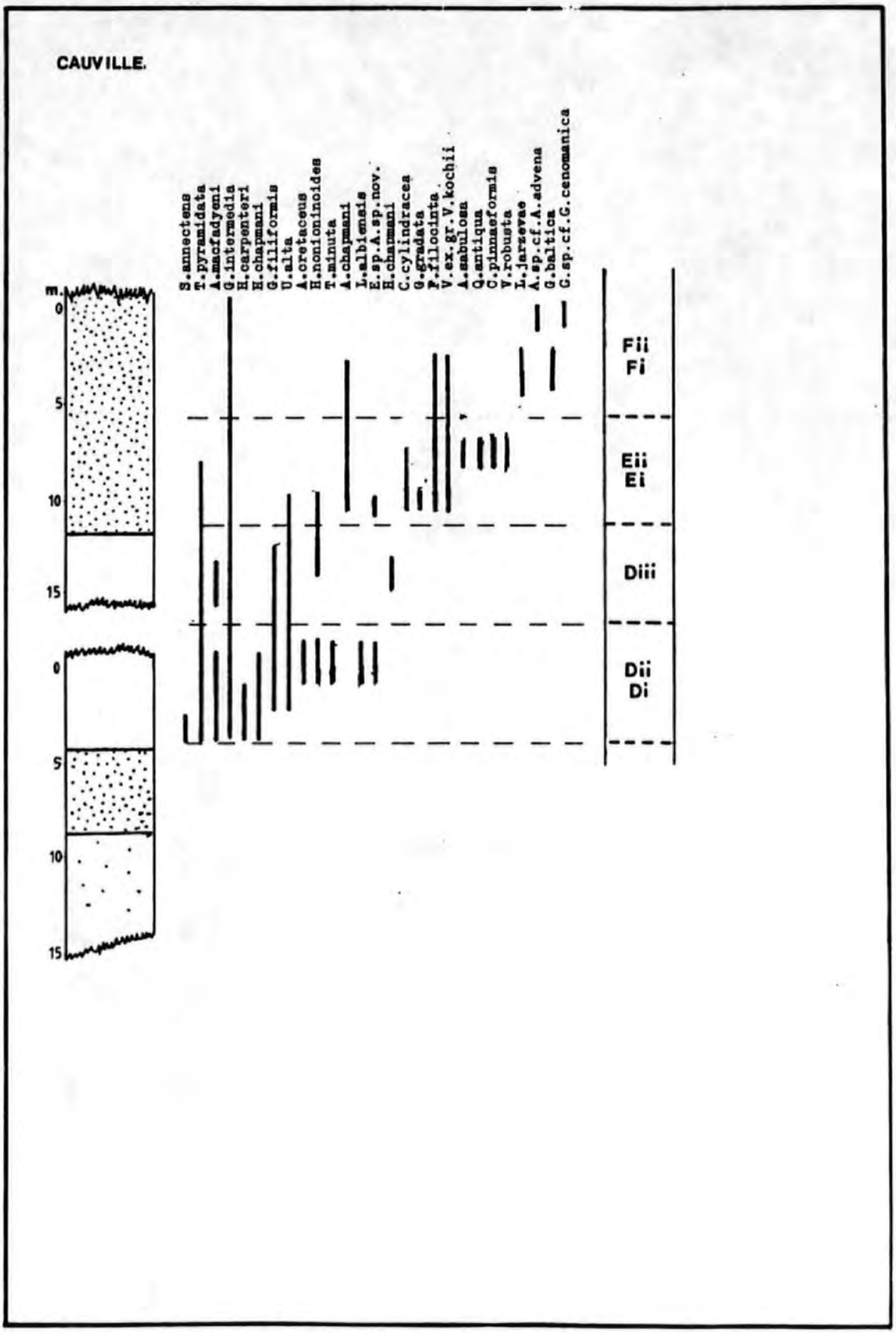


Fig. 8:43 The distribution of foraminifera (first occurrence) in the Cauville section.



samples C10 and C12 while specimens resembling Epistomina sp.A. sp. nov. were recorded from C10 and C8. Both C.pinnaeformis and Q.antiqua were recorded from C7.

Ostracoda (figs. 8:44, 8:45)

M.ex.gr.M.harissiana was recorded throughout this section while C.hirsuta and I.fortinodis were recorded from C7 and C8. Specimens of C.larivourensis were recorded from samples C12, C8 and C5. Specimens from C12 were referred to C.sp.aff.C.cornueli. M?durispinata was recorded from C8 while C.stricta was found in samples C7 and C8. B.pseudoseptentrionalis, S.nettgauensis, P.siddiqui and C.aff.H.nana were recorded from the topmost four samples.

Conclusions

An insufficient number of samples were collected from this locality to enable precise subdivision. However, the presence of both A.advena and A.sabulosa, along with the occurrence of G.sp.cf.G. cenomanica, L.jarzevae and B.pseudoseptentrionalis in the topmost two samples of this section indicate the presence of Zone F. The occurrence of specimens of C.stricta and C.pinnaeformis in the lower part of the Upper Greensand and the lack of Robertinacea indicate the presence of Zone E. H.chapmani and H.carpenteri were both recorded from the topmost Gault Clay which is of Diii subzonal age. The basal 5m of the Gault Clay belong to Subzones Di and Dii. No microfauna was recorded from the samples collected from the Lower Greensand.

COMPTON BAY (Isle of Wight)

Planktonic Foraminifera

No planktonic foraminifera were recorded from this section.

Fig. 8:44 The distribution of Ostracoda (abundance/taxonomic order) in the Cauville section.

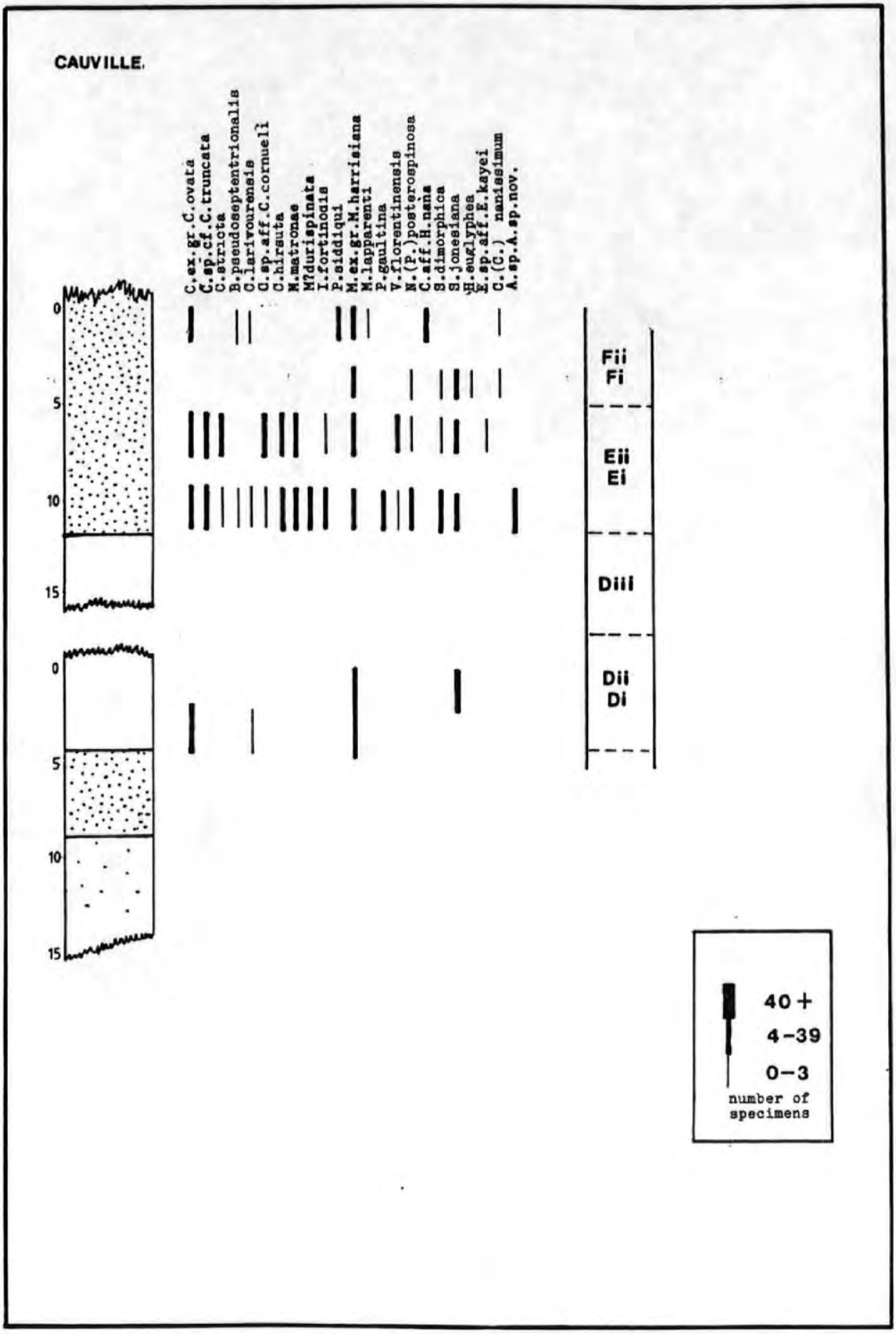
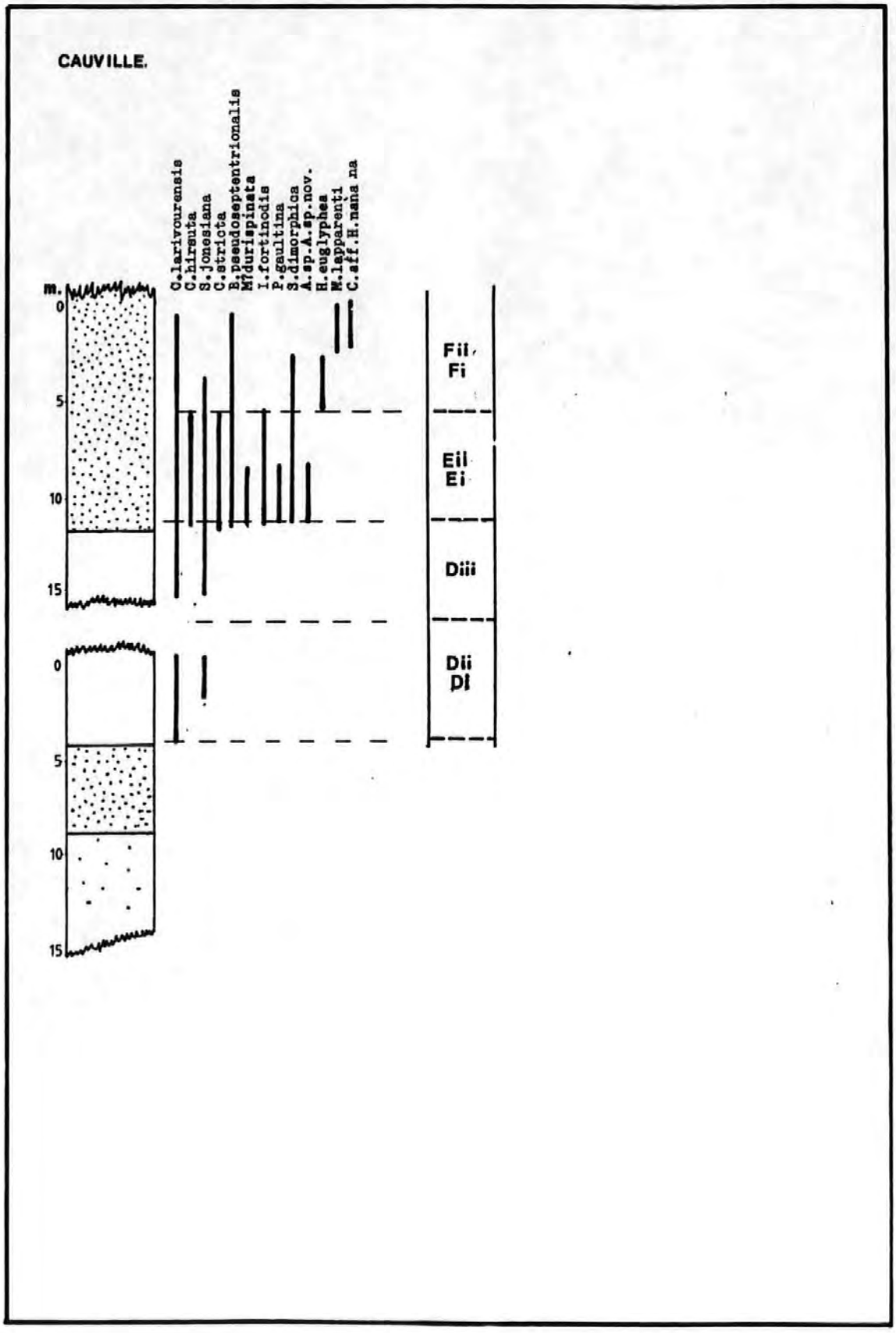


Fig. 8:45 The distribution of Ostracoda (first occurrence) in the Cauville section.



Benthonic Foraminifera (figs. 8:46, 8:47)

Samples 42 and 36 were dominated by several long ranging agglutinated species while U.alta was recorded from samples 40 and 37 and D.gradata from sample 38. The dominance of agglutinated species in the lower most samples of this section may indicate the presence of the lower portion of Subzone Bi or of Subzone Ai. A.chapmani was recorded ranging from sample 18 to sample 11 while A.sp.cf.A.advena was found in samples 1 & 11 and specimens of A.truncata were recorded from samples, 2, 3 & 11.

G.cf.G.cenomanica was recorded from samples 10 and 11 while G.baltica was found in samples 1, 2 and 10 and L.jarzevae was recorded from sample 3. C.pinnaeformis was only found in sample 11 and Q.antiqua was only recorded from sample 16.

Ostracoda

Very few Ostracoda were recorded from this section. They are, therefore, of limited stratigraphic value.

Conclusions

The basal samples of this section were dominated by agglutinated foraminifera which probably indicate the presence of Subzone Bi. The topmost 5m. of the Gault Clay contains specimens of A.chapmani and C.pinnaeformis indicating an Upper Albian age. Q.antiqua was first recorded in the topmost Gault Clay sample and may indicate the base of Subzone Diii. The Passage Beds may be the sedimentary representative of the transitional Subzone Diii. The topmost 10m. of the Upper Greensand includes transitional forms of A.sabulosa, A.advena, and G.cenomanica which along with the presence of L.jarzevae and B.pseudoseptentrionalis indicate the presence of Zone F. The remaining majority of the Upper Greensand, between the top of the

Fig. 8:46 The distribution of foraminifera (abundance/taxonomic order) in the Compton Bay section.

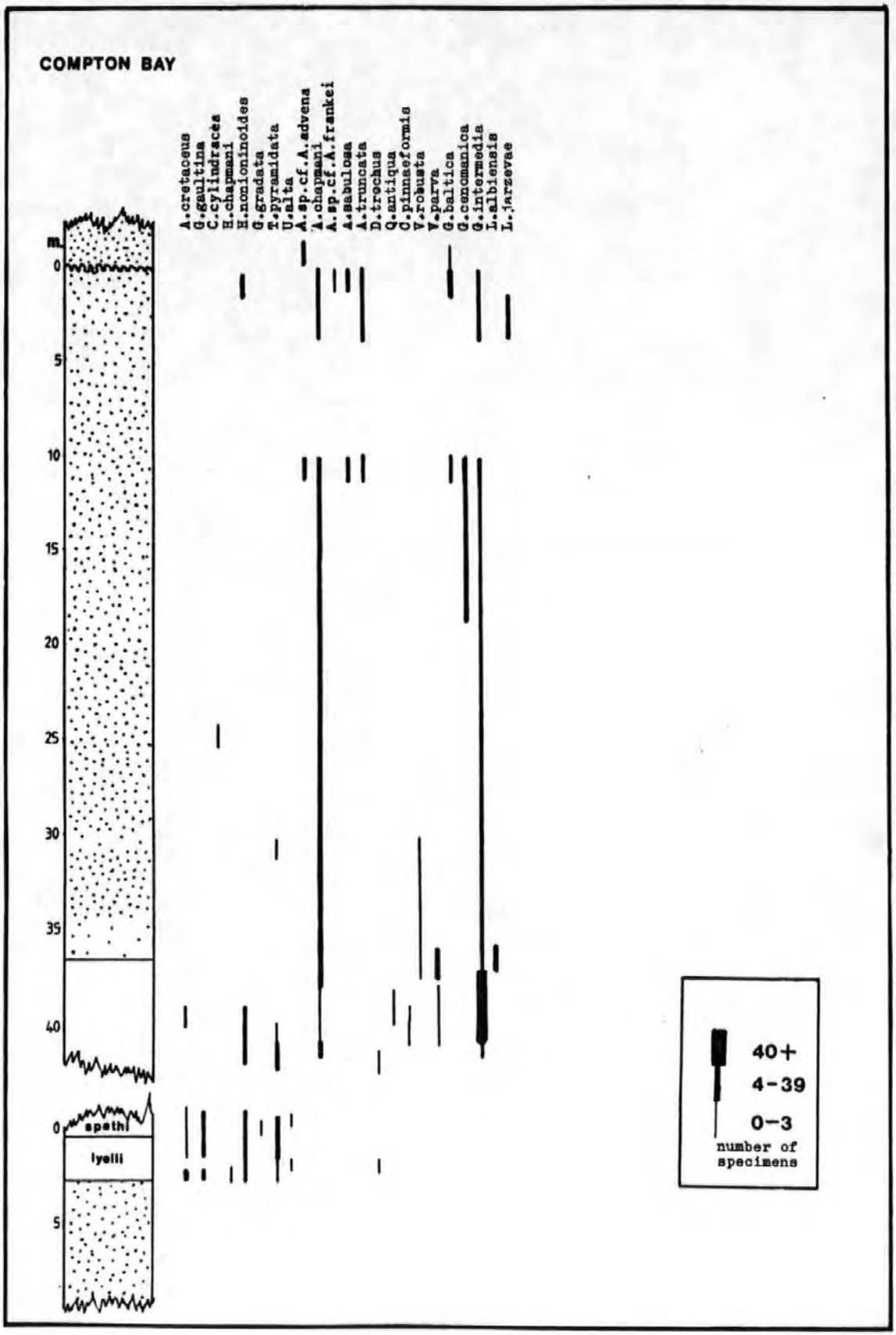
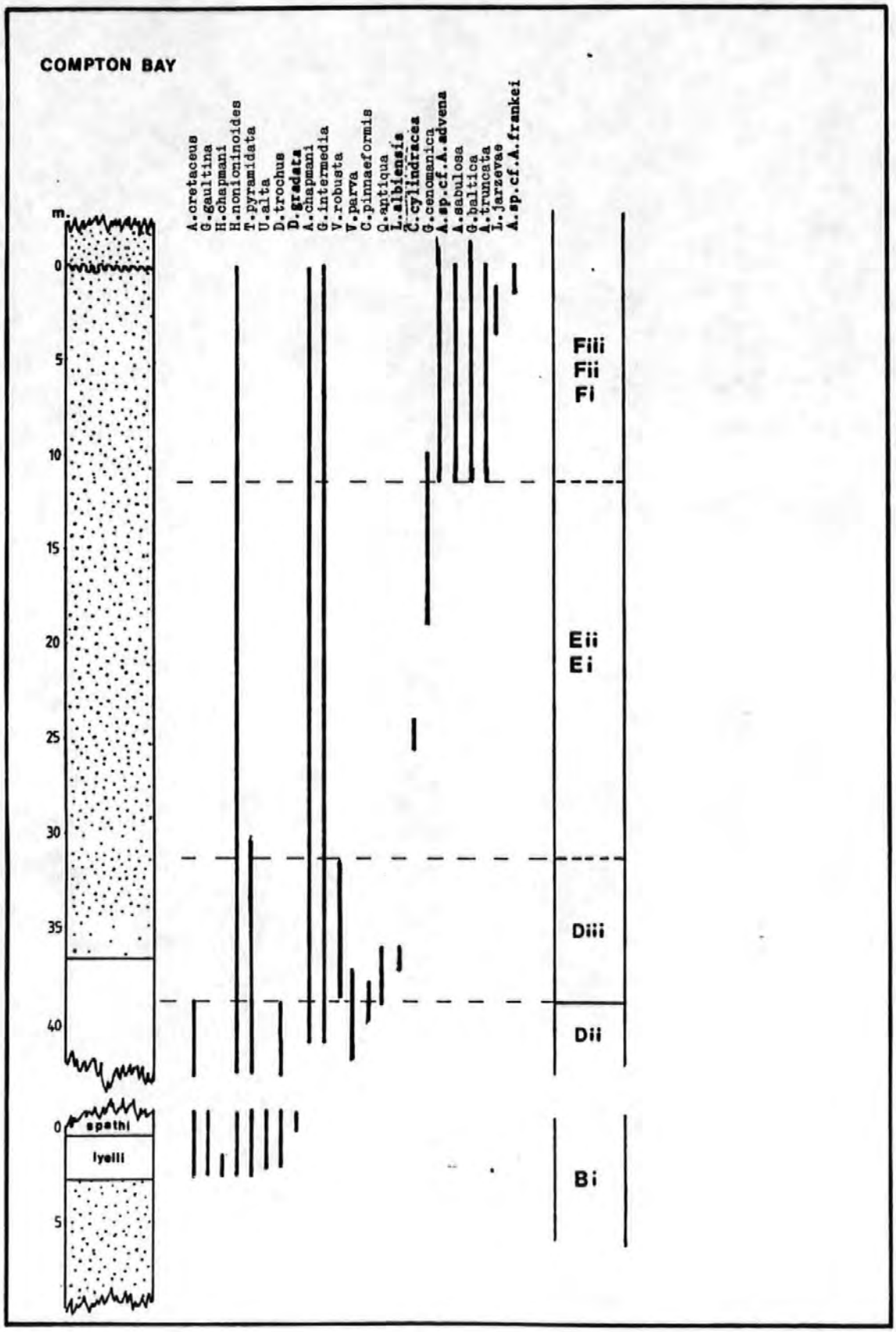


Fig. 8:47 The distribution of foraminifera (first occurrence) in the Compton Bay section.



Passage Beds and the base of Zone F, represents Subzones Ei and Eii.

SEATON BAY

Planktonic Foraminifera

No planktonic foraminifera were recorded from this section.

Benthonic Foraminifera

The populations of benthonic foraminifera in this section can be easily separated into two Superfamily categories: Lituolacea and Nodosariacea. Sample numbers 1 to 4 are dominated by the Lituolacea while samples 5 to 7 were dominated by the Nodosariacea. One specimen of the stratigraphically significant species H.chapmani was recorded from sample no. 1 while a specimen of A.chapmani was recorded from sample no. 7.

Ostracoda

Ostracoda were commonly found in samples 5 to 7. This population is completely different from that recorded in the Gault Clay facies and only Kaye has recorded a similar population from Pinhay, Devon.

Conclusion

At this locality there is a marked change in the microfaunal populations before the lithological change from the Gault Clay to the Foxmould Sands (Upper Greensand). This occurs 3m below the base of the Foxmould Sands and consists of a change from a fauna dominated by Lituolacea to one dominated by Nodosariacea and Ostracoda. This horizon is probably equivalent to Biohorizon 5 and thus Subzones Di and Dii are present in the basal portion of the Gault Clay. Subzone Diii is present in the topmost Gault Clay and lowest Foxmould Sands.

SOUTHERN NORTH SEA BASIN

SPEETON

Planktonic Foraminifera (figs. 8:48, 4:49)

H.delrionensis and H.planispira were both recorded throughout this section while G.bentonensis was recorded from samples Sp.6 and Sp.7.

Benthonic Foraminifera (figs. 8:48, 8:49)

A.chapmani was found to range from sample Sp.10 to Sp.1 while G.baltica was recorded from sample Sp.10 to Sp.6. D.ozawai was recorded in samples Sp.7 and Sp.6 while E.mariae was recorded from samples Sp.6 to Sp.1. Q.antiqua was found from Sp.10 to the top of the section and S.papyracea was found from Sp.4 to the top of the section.

Ostracoda (figs. 8:50, 8:51)

C.gatyensis, C.reticulata, P.laminata, and P.lineata were only recorded from the clay sample, Sp.11. Both C.bonnemai and I.fortinodis range through the Red Chalk at this locality while I.fissicostis was recorded from samples Sp.11 and Sp. 8 M?durispinata was only recorded from Sp.9 while both P.striata and M.muelleri were recorded from sample Sp.9 to the top of this section.

Conclusions

The basal sample (Sp.11) of this section contained several species, which, in the Anglo-Paris Basin, are regarded as characteristic of Subzone Bi. Samples Sp.1 to Sp.9 all contained abundant H.delrionensis indicating the presence of Zones E & F while the occurrence of G.bentonensis in samples Sp.6 and Sp.7 indicates the presence of Subzone Fi. The presence of A.frankei above this Subzone indicates the presence of Subzone Fii.

Fig. 8:48 The distribution of foraminifera (abundance/taxonomic order) in the Speeton and Melton sections.

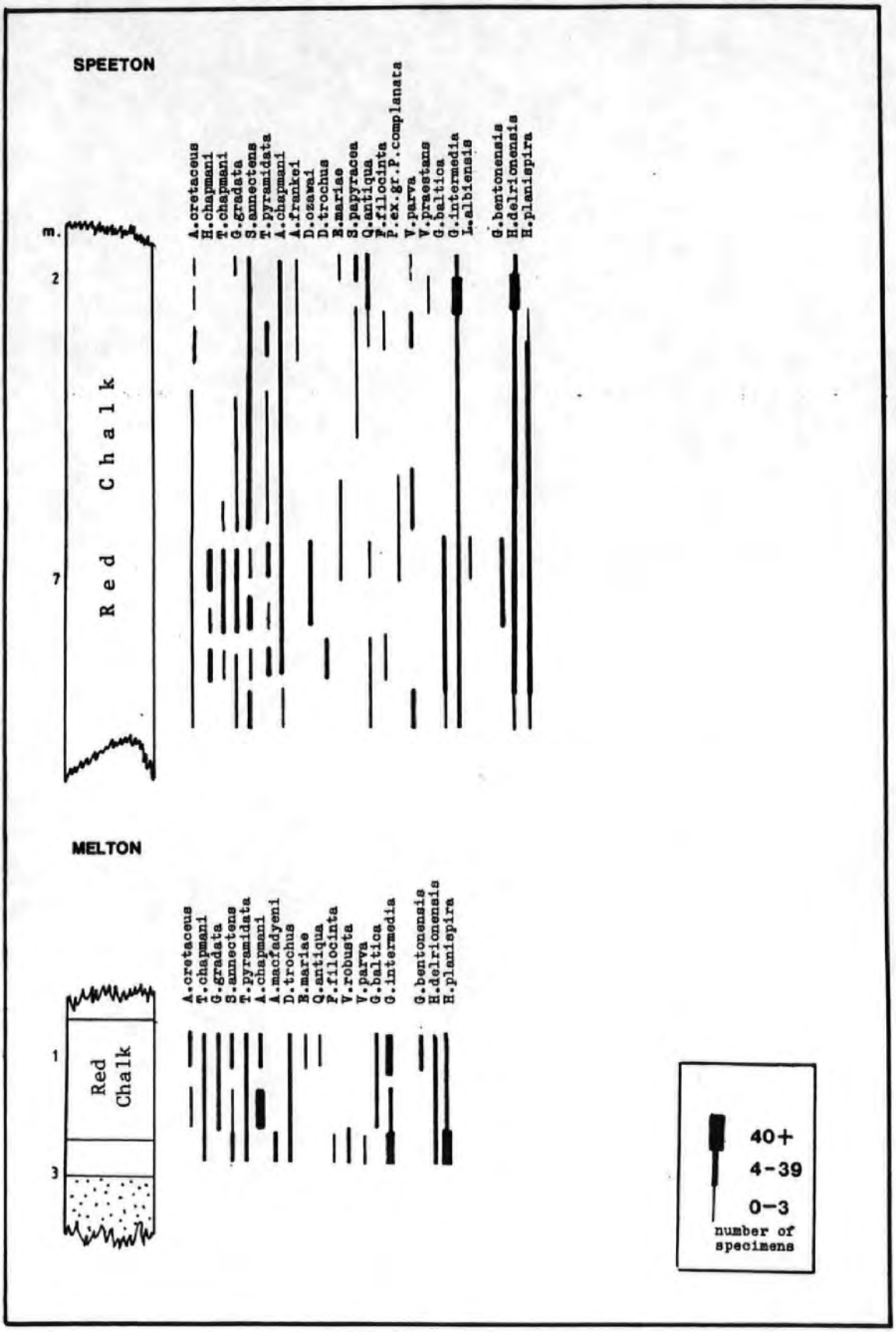


Fig. 8:49 The distribution of foraminifera (first occurrence) in the Speeton and Melton sections.

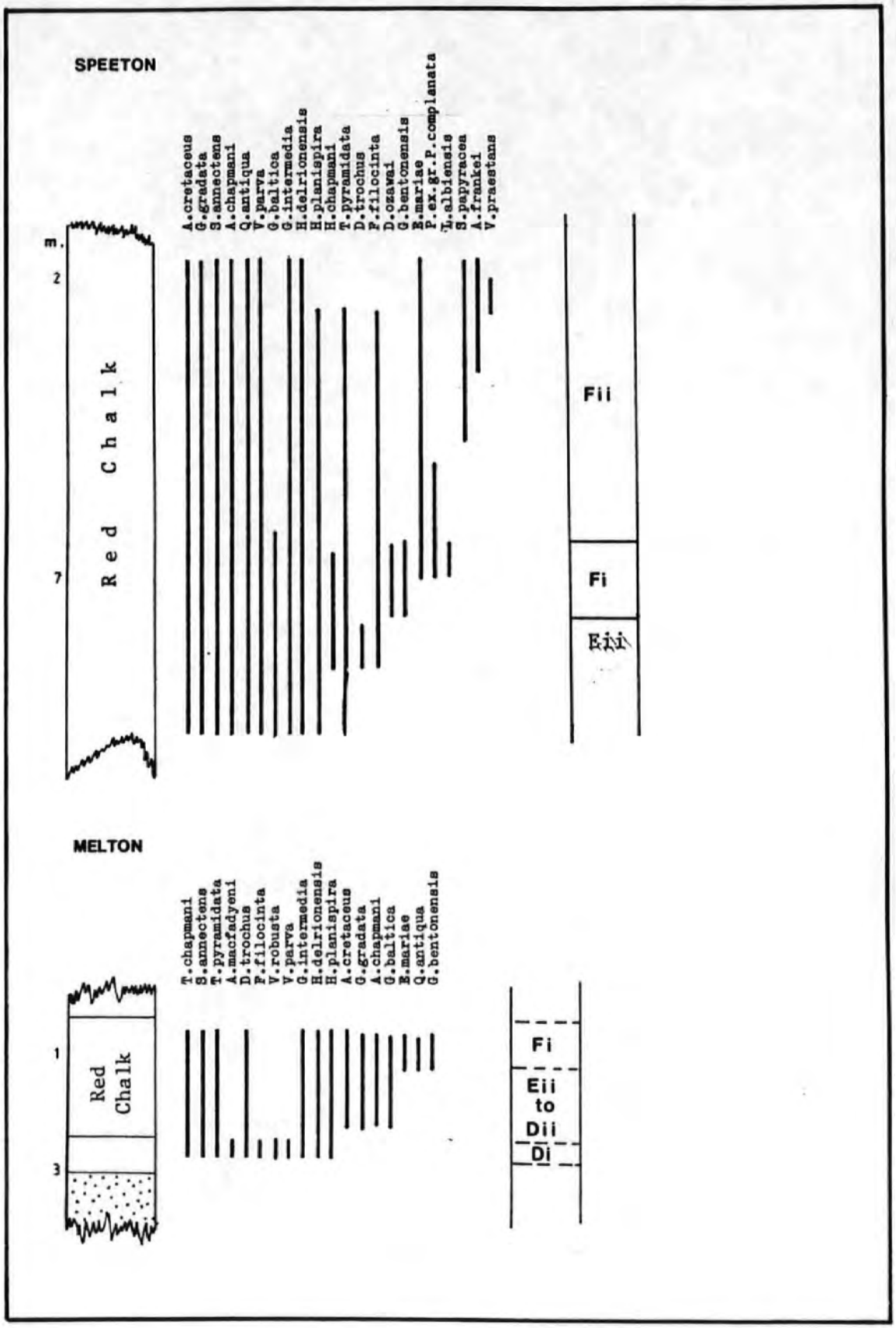


Fig. 8:50 The distribution of Ostracoda (abundance/taxonomic order) in the Speeton and Melton sections.

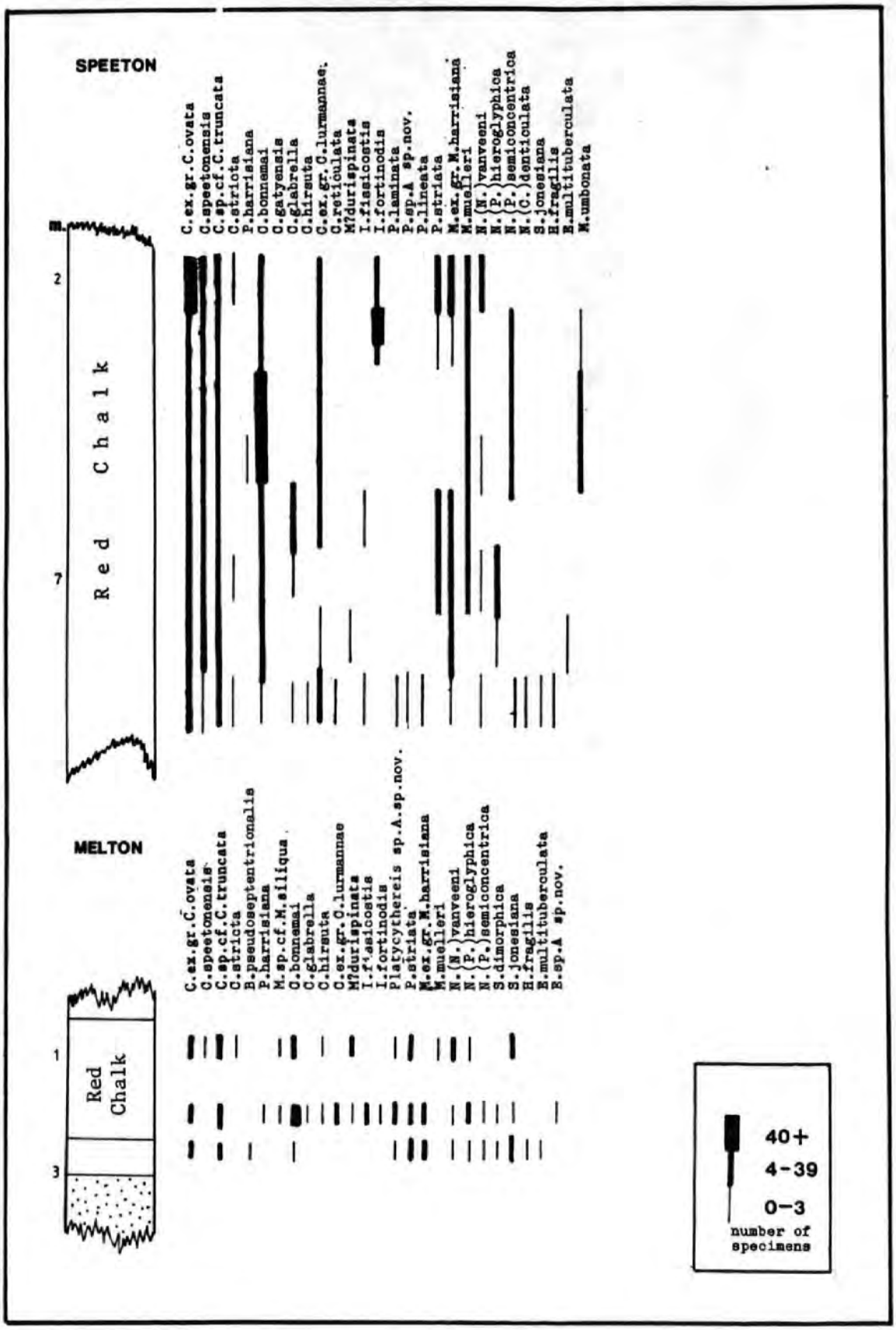
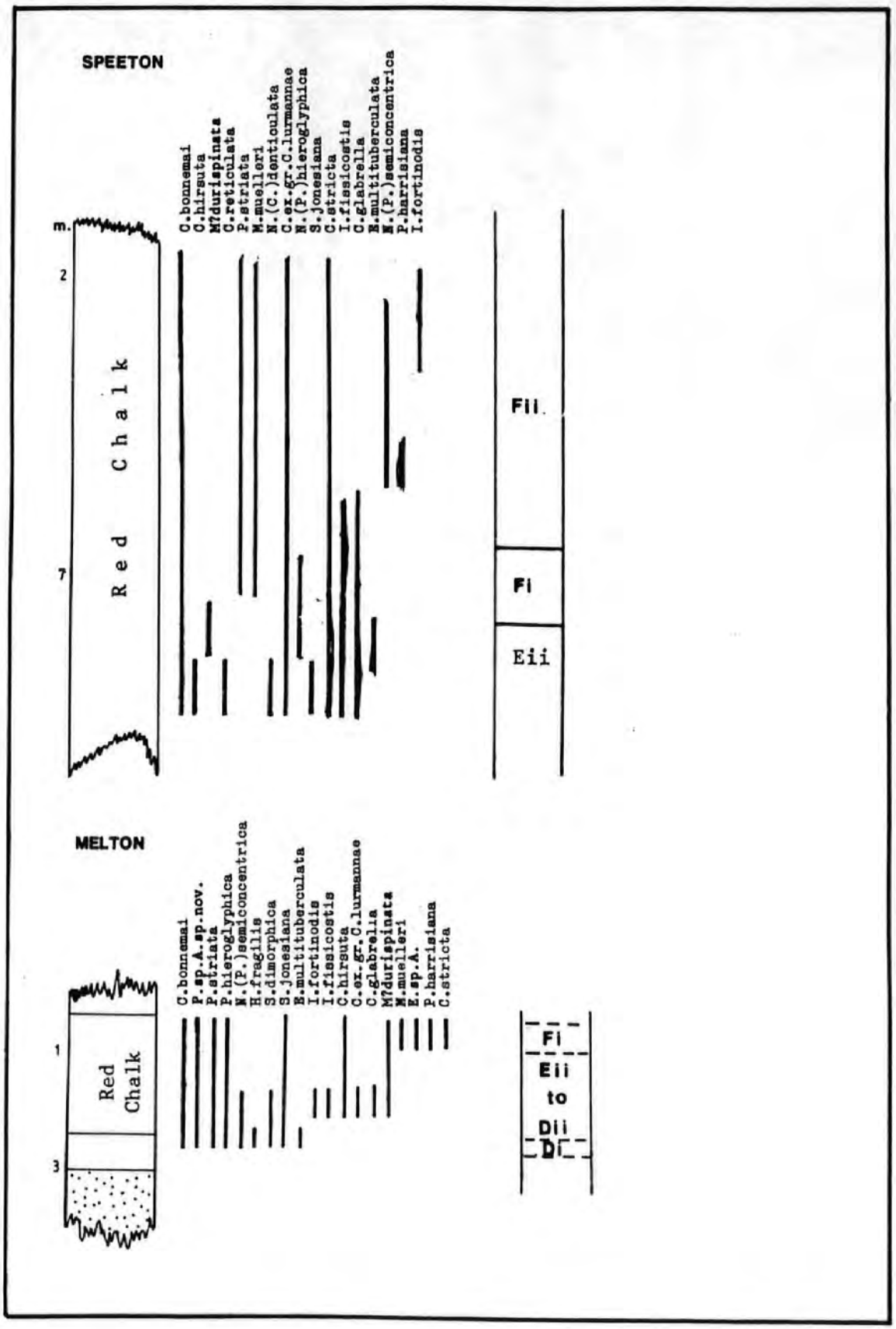


Fig. 8:51 The distribution of Ostracoda (first occurrence) in the Speeton and Melton sections.



MELTON

Planktonic Foraminifera (figs. 8:48, 8:49)

H.delrionensis and H.planispira were recorded throughout this section. G.bentonensis was recorded from sample M.1.

Benthonic Foraminifera (figs. 8:48, 8:49)

A.macfadyeni was recorded from M.3 while A.chapmani was recorded from samples M.2 and M.1. G.baltica was recorded from the topmost two samples while both Q.antiqua and E.mariae were recorded from M.1.

Ostracoda (figs. 8:50, 8:51)

C.stricta was recorded from sample M.1 while I.fortinodis, I.fissicostis, and C.ex.gr.C.lurmannae were recorded from sample no.M.2. C.hirsuta and M?durispinata were recorded from both of these samples while C.bonnemai and Platycythereis sp.A.sp.nov. were both recorded from all three samples.

Conclusions

The presence of A.macfadyeni and abundant H.planispira in the lowermost sample indicates that it is transitional between Subzones Cii and Di. A.chapmani occurs in sample M.2 which is probably of Dii or Diii Subzonal age. The presence of G.bentonensis in sample M.1 indicates the presence of Subzone Fi.

HUNSTANTON

Planktonic Foraminifera (figs. 8:52, 8:53)

Few planktonic foraminifera were recorded from this section.

Benthonic Foraminifera (figs. 8:52, 8:53)

A.chapmani was recorded from samples H5 to H1. In sample H.1

Fig. 8:52 The distribution of foraminifera (abundance/taxonomic order) in the Hunstanton and offshore borehole 49/24-1 sections.

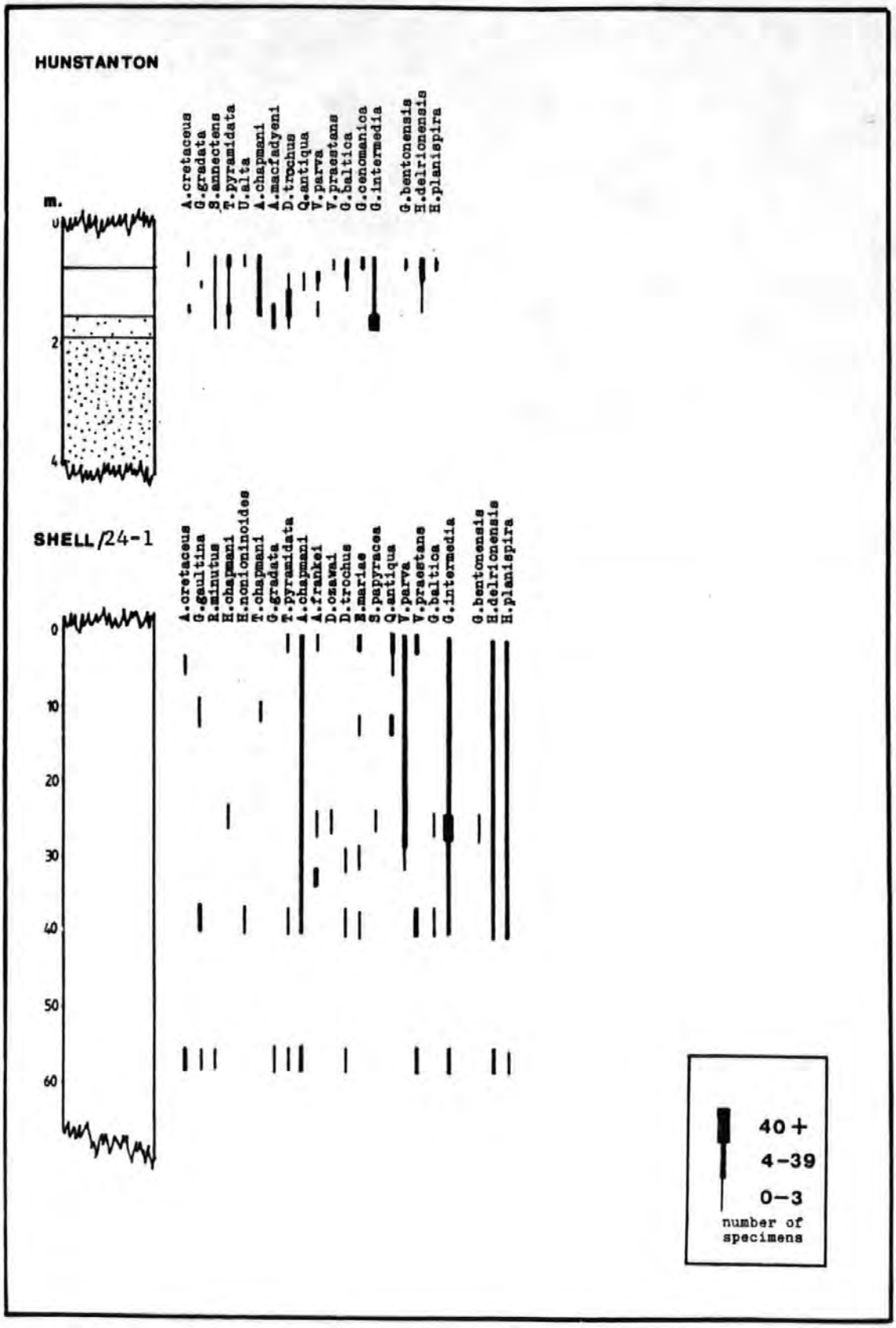
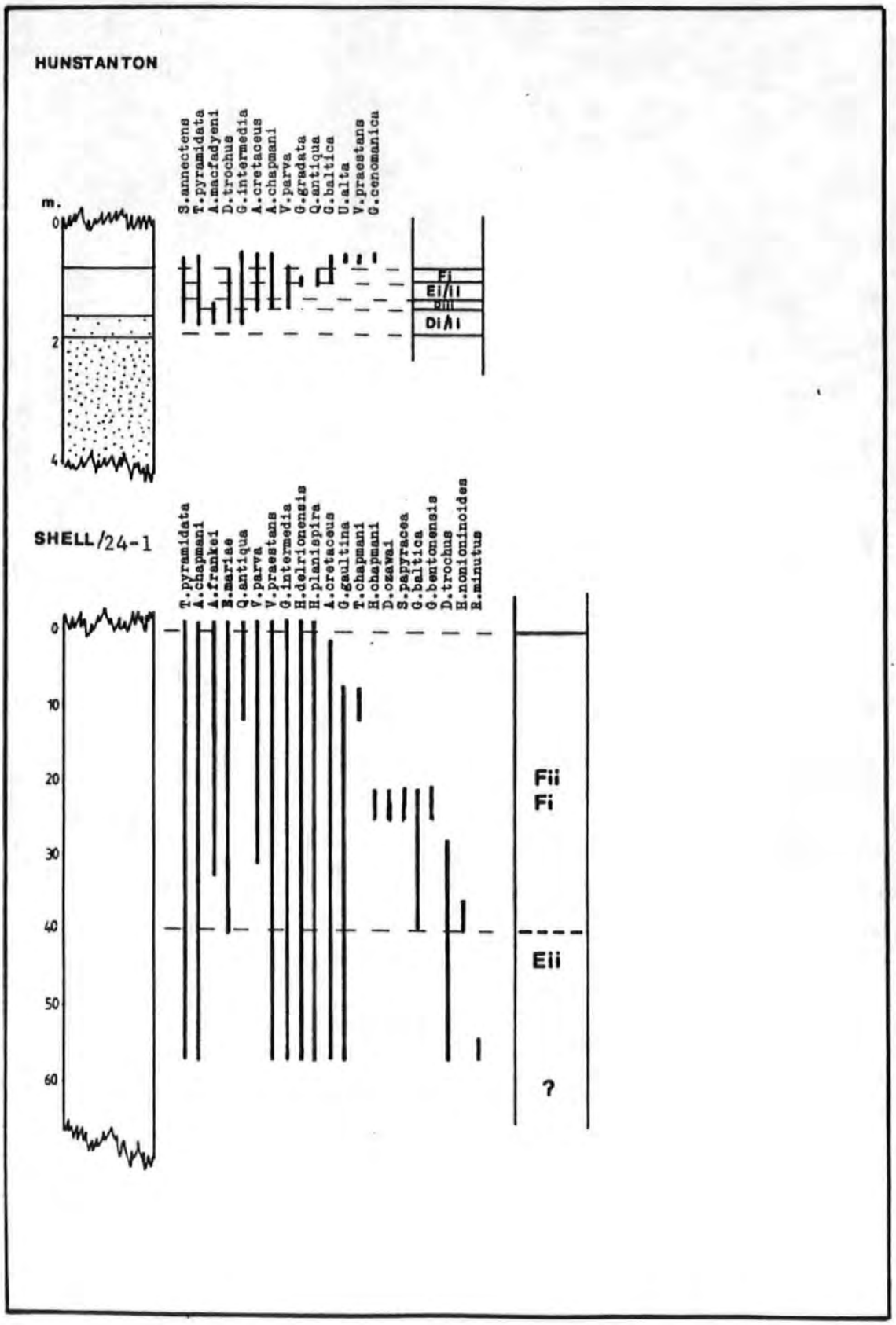


Fig. 8:53 The distribution of foraminifera (first occurrence) in the Hunstanton and offshore borehole 49/24-1 sections.



these specimens were transitional to A.advena. Transitional specimens from A.macfadyeni were recorded from samples H.5 and H.6. G.baltica was only recorded from samples H.3 to H.1 while G.cenomanica was only recorded from H.1. Q.antiqua was recorded from samples H.2 and H.3 while S.papyracea was only recorded from H.2.

Ostracoda (figs. 8:54, 8:55)

C.stricta and C.globosa were both recorded from sample H.6 while C.bonnemai and P.striata were both recorded throughout the section. B.pseudoseptentrionalis was recorded from samples H.4 and H.2.

Conclusions

The presence of C.stricta and of specimens of A.chapmani (transitional from A.macfadyeni) in the basal sample indicate the presence of Subzone Di. The topmost sample of the Red Chalk contained specimens of G.bentonensis which indicate the presence of the Fi Subzone. The presence of specimens of Bairdia in the topmost samples indicates an E or F zonal age. The fragments of Red Chalk which were collected from the basal white chalk are of Fii or Fiii subzonal age.

SHELL/ESSO BOREHOLE 49/19-1

Planktonic Foraminifera (figs. 8:56, 8:57)

H.delrionsis was recorded in abundance from throughout the Red Chalk of this section, H.planispira was only recorded sporadically. G.bentonensis was first recorded in abundance 'downhole' at 3090' depth and was last recorded 'downhole' at 3340'. This species was most abundant between 3100' and 3160' depth.

Fig. 8:54 The distribution of Ostracoda (abundance/taxonomic order) in the Hunstanton and offshore borehole 49/24-1 sections.

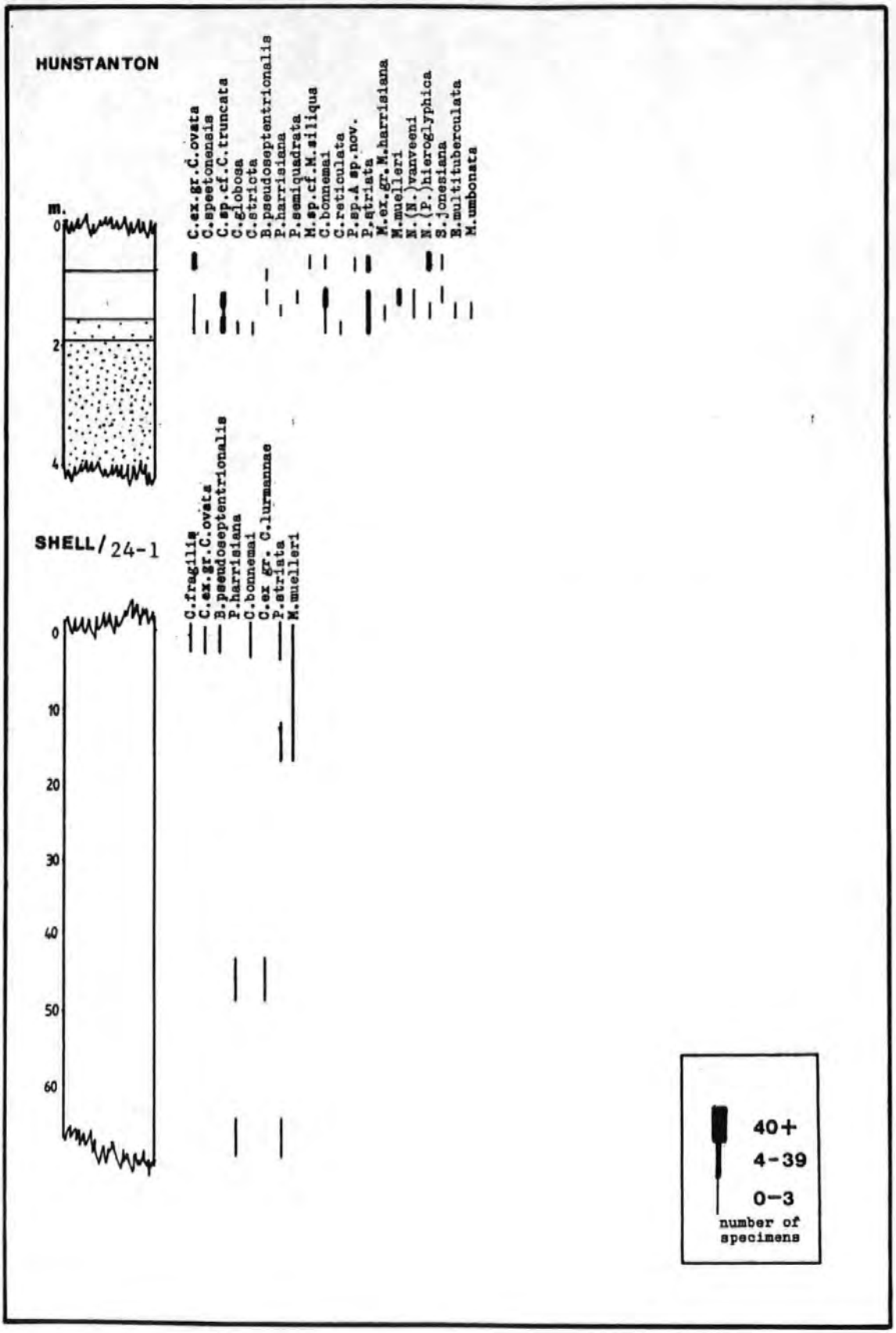


Fig. 8:55 The distribution of Ostracoda (first occurrence) in the Hunstanton and offshore borehole 49/24-1 sections.

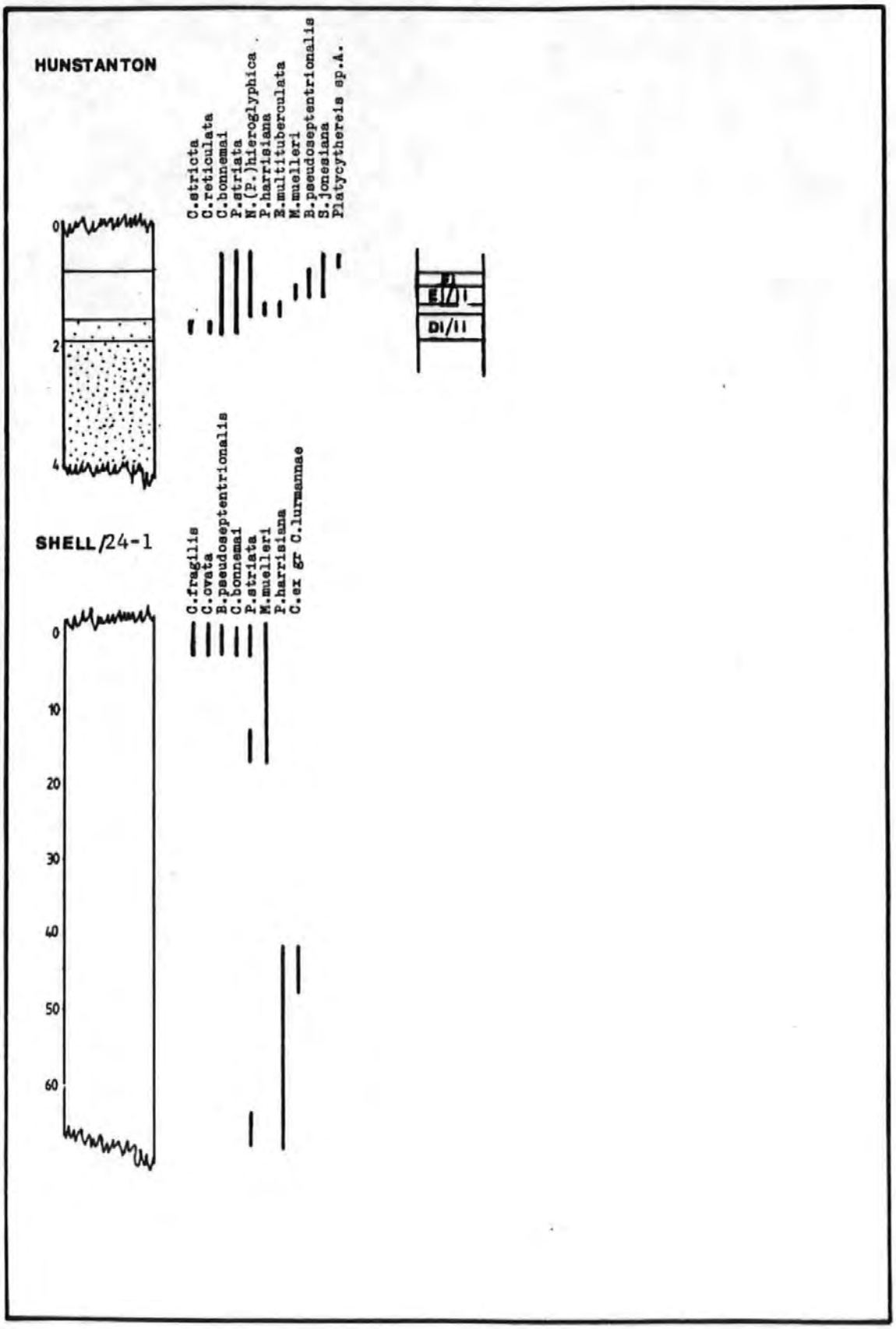


Fig. 8:56 The distribution of foraminifera (abundance/taxonomic order) in the offshore borehole 49/19-1.

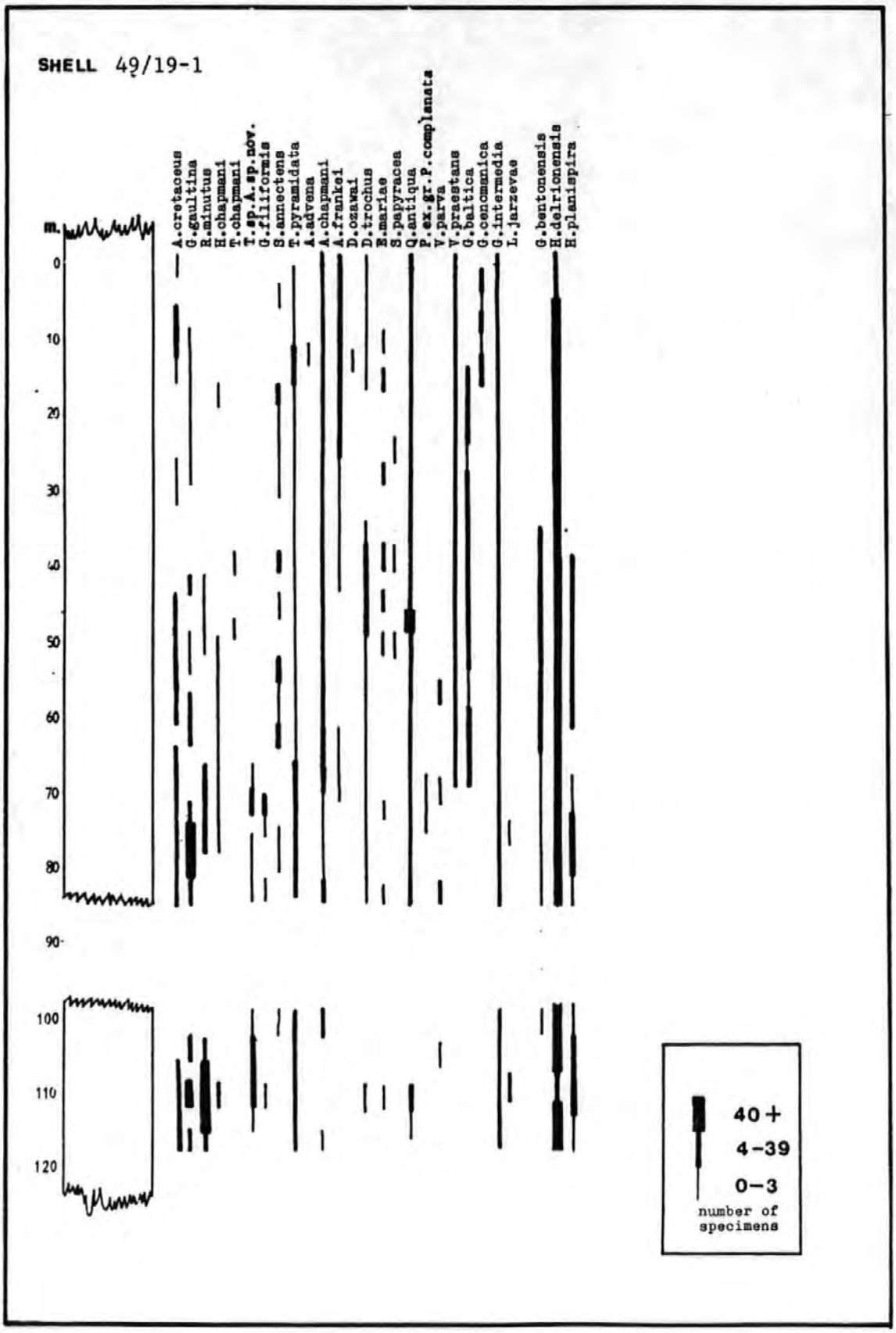
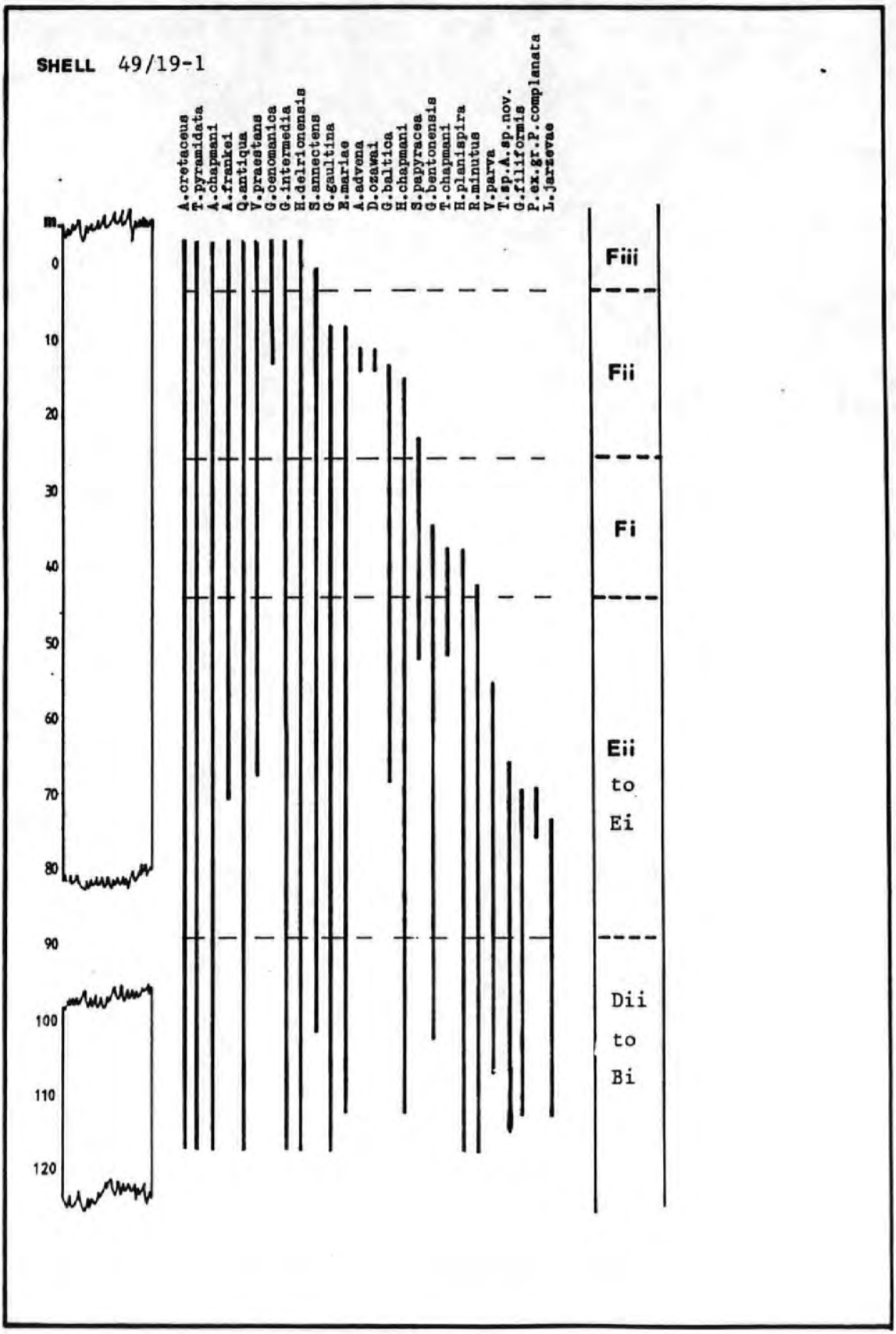


Fig. 8:57 The distribution of foraminifera (first occurrence) in the offshore borehole 49/19-1.



Benthonic Foraminifera (figs. 3:56, 8:57)

Transitional specimens of A.chapmani (to A.advena) first occur 'downhole' at 2970' depth, these forms were last recorded at 3000' depth. Several specimens of A.advena were recorded from 3010' depth and A.frankei was recorded commonly from 2960' depth to 3100' depth and then sporadically to 3200' depth. G. baltica was recorded from 3030' and 3200' depth while G.cenomanica was found between 2980' and 3020' depth. V.praestans was recorded from 2970' to 3210' depth. E.mariae was recorded downhole from 3000' depth while Q.antiqua and S.papyracea first occur downhole in the Red Chalk at 3000' and 3040' respectively.

Ostracoda (figs. 8:58, 8:59)

C.reticulata and P.goerlichi were only recorded from the basal clay sample of this section while P.lineata and C.chapmani were only recorded below 3310' depth. Both D.rara and P.derooi were only recorded from 3240' depth. C.bonnemai was recorded throughout this section while I.fortinodis was first recorded 'downhole' at 3160' depth and I.fissicostis was first recorded 'downhole' at 3100' depth. M.muelleri was recorded between 3000' and 3160' depth while P.striata was found between 2990' and 3070' depth. C.sp.aff.c.kayei was found between 3020' and 3070' depth.

Conclusions

The first occurrence 'downhole' of G.bentonensis in abundance at 3090' depth indicates that this horizon is the upper limit of the Fi Subzone (Biohorizon 8). The Red chalk between this horizon and the base of the white Chalk contains specimens of A.frankei and E.mariae together with rare specimens of A.advena indicating the presence of Subzones Fii and Fiii. The basal samples appear to be of Middle Albian age and contain several species which in the Anglo-Paris Basin are considered characteristic of Bi. All the samples examined from

Fig. 8:58 The distribution of Ostracoda (abundance/taxonomic order) in the offshore borehole 49/19-1.

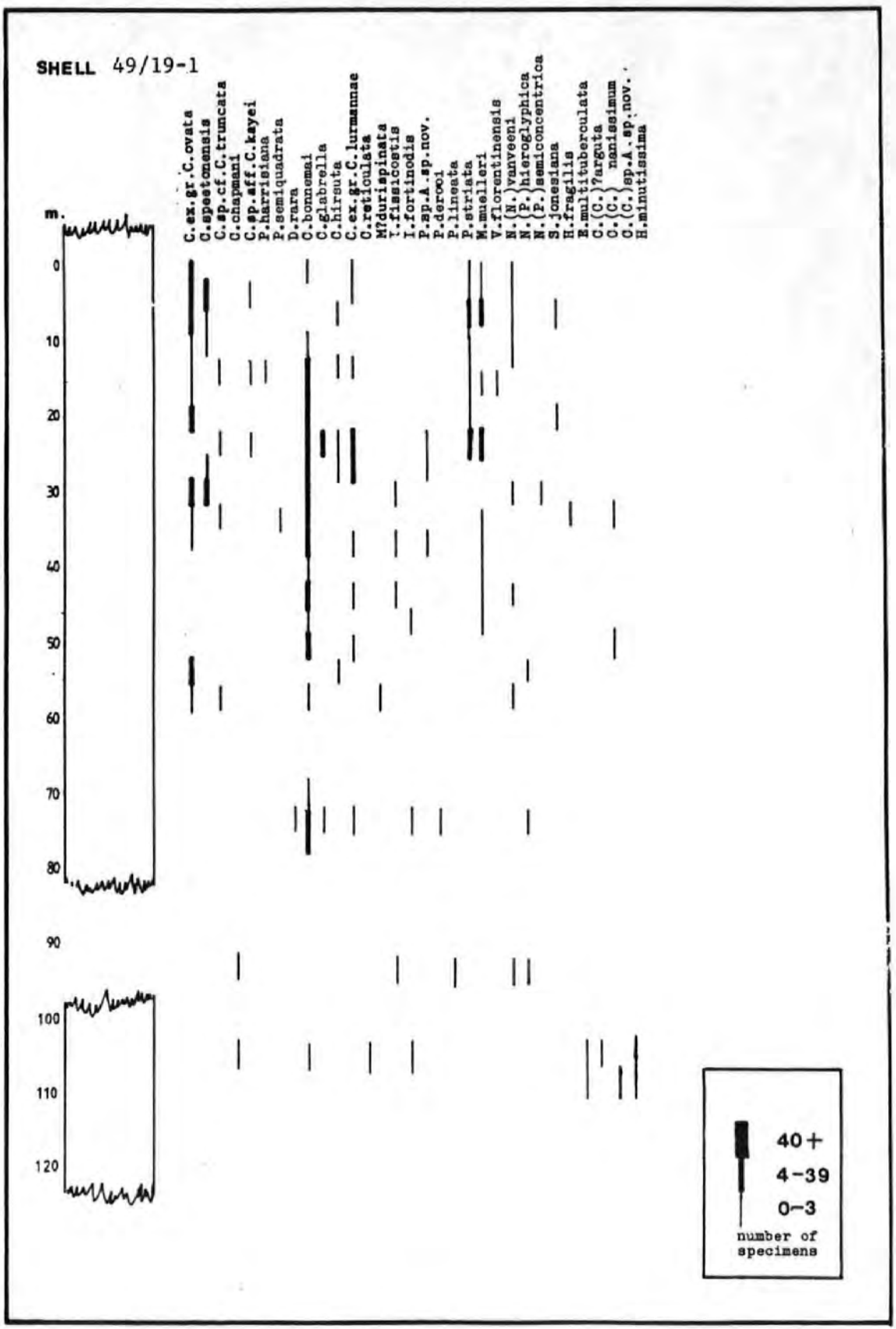
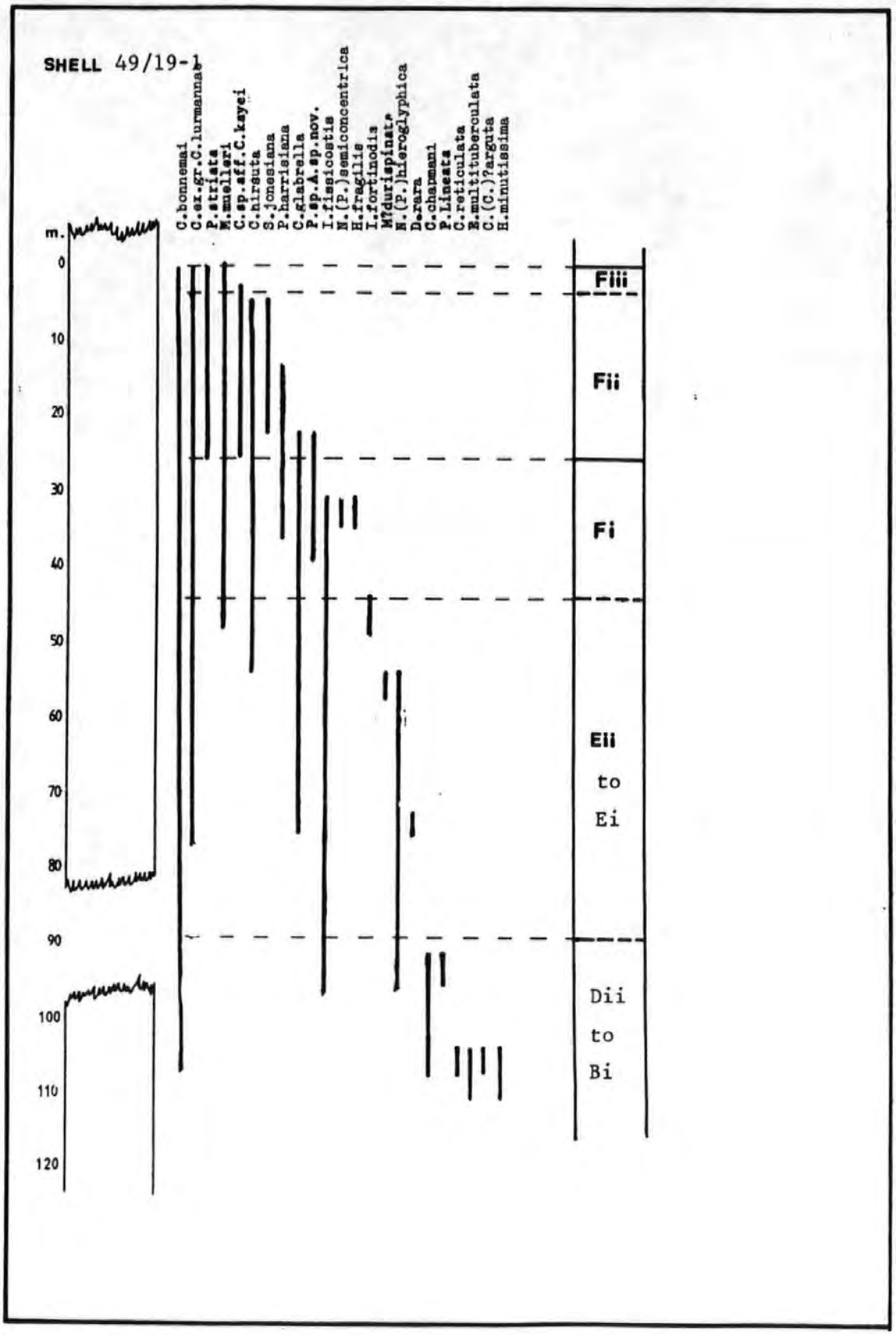


Fig. 8:59 The distribution of Ostracoda (first occurrence) in the offshore borehole 49/19-1.



this section of Red Chalk are of Upper Albian age. Unfortunately, further differentiation was impossible.

SHELL/ESSO BOREHOLE 49/24-1

Planktonic Foraminifera (figs. 8:52, 8:53)

H.delrionensis was recorded throughout this section while H.planispira was only recorded sporadically. G.bentonensis was only recorded from 4370' depth.

Benthonic Foraminifera (figs. 8:52, 8:53)

A.chapmani was recorded throughout this section while A.frankei was only recorded between 4270' and 4350' depth. M.ozawai was only recorded from 4350' depth while E.mariae was recorded between 4270' and 4400' depth. Q.antiqua was recorded between 4270' and 4310' depth.

Ostracoda (figs. 8:54, 8:55)

Ostracoda were not recorded in abundance from this section. C.bonnemai was only recorded from 4270' depth while P.striata was found between 4270' and 4400' depth and M.muelleri between 4270' and 4310' depth.

Conclusions

The presence of A.frankei, E.mariae and G.bentonensis from the topmost 20-40m of the Red Chalk at this locality indicates the presence of Zone F. No zonally diagnostic species were recorded from the basal portion of this section which is probably all of Upper Albian age.

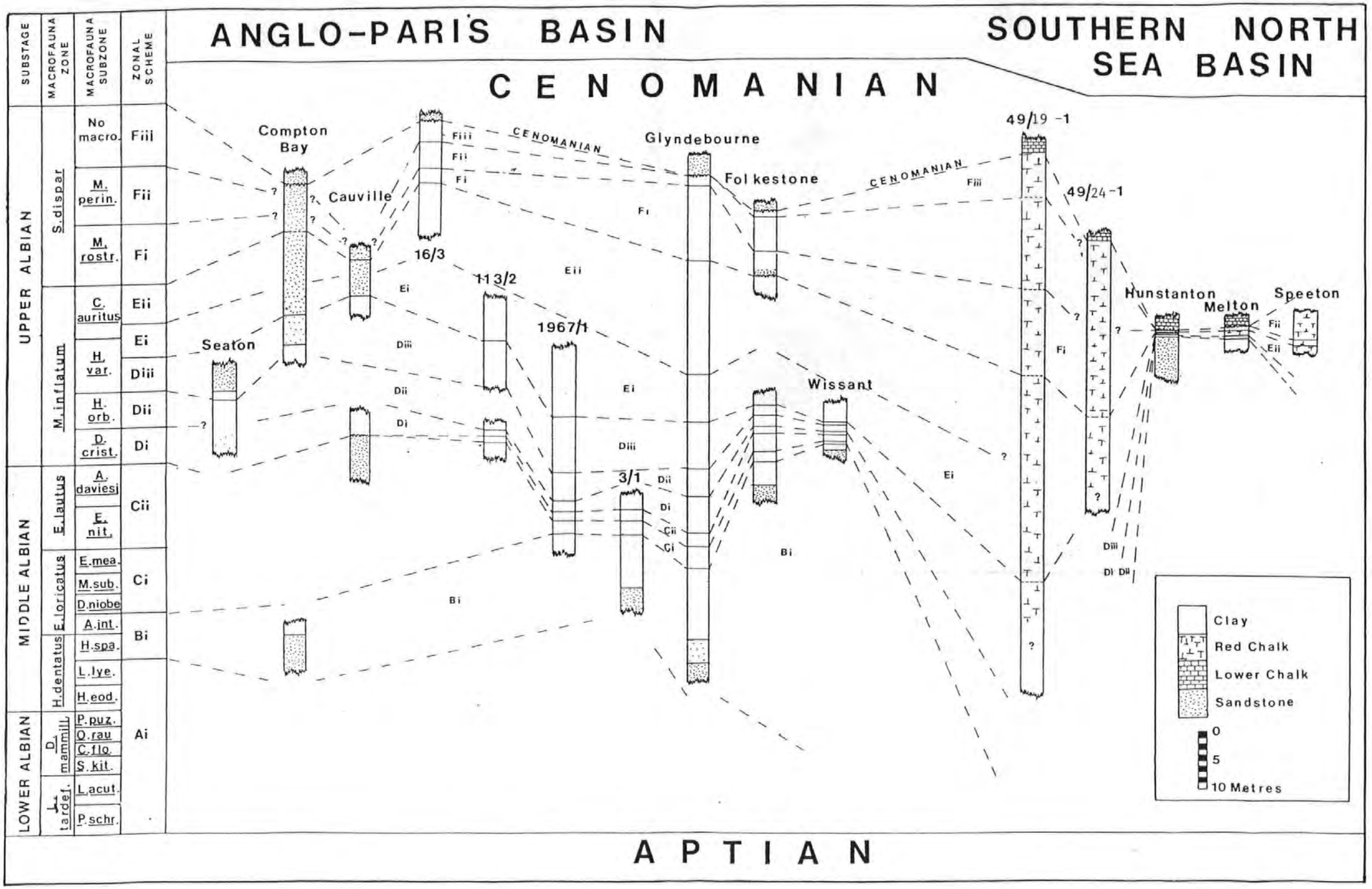
8:6 Stratigraphic Summary (fig.8:60)

The sections discussed in this thesis can be divided into three categories based on their lithology (Chapter 1:3).

The 'marginal' Upper Greensand sections of Seaton Bay, Compton Bay and Cauville have been correlated and the major lithological boundaries in the Upper Albian have been shown to be roughly contemporaneous. The top of the Lower Greensand, below the Gault Clay, was shown to be highly diachronous across northwestern Europe. At Compton Bay the basal Gault Clay and the top of the Lower Greensand are of Bi Subzonal age while at Cauville the Lower Greensand directly below the Gault Clay is of higher Middle Albian age (Price, 1977b). The basal Gault Clay at both Cauville and Seaton Bay are of Di Subzonal age and the topmost Gault Clay at each of these sections is of Diii Subzonal age. The 'passage beds' of Compton Bay span most of the Diii Subzone. At Cauville the lithological change from the Gault Clay to the Upper Greensand occurs at the top of the Diii Subzone while at Seaton Bay this change occurs within the Diii Subzone. At both Compton Bay and Cauville there is evidence for the presence of Zone F at the top of the Upper Greensand. The Upper Greensand at these localities thus appears to span the upper part of the M.inflatum Subzone and most of the S.dispar Zone.

The base of the Gault Clay sections was consistently assigned a Bi subzonal date within southern England. This Subzone is the thickest of the Middle Albian Subzones at Glyndebourne, Copt Point, and the M.25 borehole 3/1. Subzones Ci to Dii are thicker at Glyndebourne and in the M.25 boreholes 3/1, 1967/1, and 113/2 than at Copt Point and Wissant. These Subzones thin from southern England towards Wissant where they are thinnest. Subzone Diii also thins towards Wissant but in the centre of the southern England sedimentary basin it is thicker than the preceding Subzones. Subzone Ei also shows an increase in thickness in comparison to the preceding Subzones, this is most apparent

Fig. 8:60 A comparison of the sample localities based on the proposed zonal scheme.



at Wissant. Subzone Eii is extremely thick (fig.8:60) both at Glyndebourne and in the Sevenoaks area. This Subzone is approximately equivalent to the top half of the C.auritus Subzone. The succeeding Subzone (Fi) is thicker at Glyndebourne than at the other Gault Clay localities. At Folkestone the base of this Subzone is within the diastem at the base of Bed XII. Subzone Fii is thicker at Folkestone and in the Sevenoaks area than at Glyndebourne where it directly underlies the 'Glauconitic Marl'. At Glyndebourne Subzone Fiii, the thinnest of the F Subzones, is absent.

The Upper Albian of the southern North Sea Basin shows marked lateral variation in thickness. The offshore Shell/Esso boreholes are mainly composed of Zones E and F which are extremely thick. At both Melton and Hunstanton the basal bed of the Red Chalk contains faunas of Di/Dii subzonal age. At Speeton Subzones Eii to Fii were recognised. Zone F was recognised in all of the southern North Sea Basin localities and Subzone Fi was recognised at all of the localities.

The major lithological changes of the Albian Stage occur at four major horizons. During the Bi Subzone in the southern England Basin the transition from the Lower Greensand to the Gault Clay occurs. During the Di Subzone the gault facies first occurs at Cauville and the transition from Carstone to the Red Chalk occurs at Melton and Hunstanton. The transition from the Gault Clay to the Upper Greensand occurs during Subzone Diii at Seaton Bay, Compton Bay, and Cauville. The 'Glauconitic Marl' and/or the white chalk overlies the Albian at all the localities (Cenomanian age).

SUMMARY

In the preceding chapters the distribution and palaeoecology of selected species has been discussed and a zonal scheme has been proposed. The stratigraphy of each of the studied sections has been discussed in relation to the zonal scheme and each section has been assigned subzonal ages. Sixty-one species of foraminifera, along with 99 species and 2 subspecies of Ostracoda have been discussed in the taxonomic chapters. The evolution of many of these species has been shown to be directly related to the environmental change, especially changes in the depth of the shallow, epicontinental Albian sea. The depth of the Albian sea was shown to increase (at Glyndebourne) from between 100 and 200 metres for the Middle/Upper Albian boundary to between 200 and 300 metres for the topmost Albian. Marked lateral variations in depth were also illustrated. Although depth appears to have been the major factor controlling the bulk changes in the fossil community during the Albian, changes in surface water temperature and nutrient supply were also major contributing factors. The changes in depth and temperature, as indicated by the planktonic foraminifera, were used to define a number of Biohorizons (on which the zonal scheme is largely based). A number of zones were defined from the benthonic populations. These were compared to the Biohorizons, and to the macrofaunal zonation, and a multi-phyletic zonation was defined. The zonal scheme enabled the correlation of subzones across faunal and sedimentary boundaries. The subzonal boundaries were generally found to coincide with the macrofaunal subzonal boundaries proposed by Casey (1961), and Owen (1971a; 1975).

The Lower Albian seas of northwestern Europe were poorly interconnected and probably semi-enclosed (Saxony Basin, southern England Basin). Much of the Lower Albian of southern England is indicative

of a shallow (0-100 m.), marginal, marine environment. More open marine conditions prevailed during the Middle Albian (especially in the Aube Basin) but southern England still remained partially enclosed with agglutinated species and Robertinacea dominating the microfauna. During the Upper Albian open marine conditions prevailed over much of northwestern Europe. The genera Hedbergella and Arenobulimina dominated the microfauna. The majority of species of foraminifera increase in size during the Albian.

Many species of Ostracoda show distinct environmental control, both in their distribution, and in their morphological change. Species of the genera Cornicythereis, Cythereis, and Isocythereis characteristically decrease in size during the Albian whilst reticulation in the genus Cythereis generally becomes much weaker from the Middle Albian to the topmost Albian. Many species of Ostracoda make their first appearance at, or shortly after, the major Biohorizons.

The application of the zonal scheme has refined Albian stratigraphy and has resolved many of the problems relating to Upper Albian stratigraphy. It has also clarified the stratigraphic position of many of the lithological boundaries.

SUGGESTIONS FOR FUTURE RESEARCH

To gain a more complete understanding of Albian biostratigraphy further, detailed, research is essential. Subjects that require further study include the Albian deposits of the southern and northern North Sea Basins, the Upper Greensand of southwestern England and northwestern France, and the microfauna of the Aptian/Albian boundary (ideally in an open marine clay succession). Many problems relating to the biostratigraphy of the Albian/Cenomanian boundary need to be resolved.

The gradual refinement of Albian stratigraphy is allowing palaeoenvironmental interpretations to be made which are becoming more complex. These, in turn, will allow the resolution of some of the taxonomic problems which will, in future, allow the definition of a more natural taxonomic classification of species, and especially of the foraminifera. Further attempts should be made to incorporate the conclusions of studies of Recent foraminifera and Ostracoda to the Albian especially with regard to the life modes of various species and the ecological relationships between the species. A large amount of work is required on the intraspecific variation of species.

Another major problem that still remains to be resolved is the longevity of many of the species, and whether, especially in the case of many species of agglutinated foraminifera and Nodosariacea, they are long ranging species which have previously been split into a number of morphotypes, because, owing to their limited ecological tolerance, they only occur sporadically in the stratigraphic column. This problem can only be resolved by adhering to the present species concept in palaeontology, however, the emphasis should be changed

from the study of individual specimens to the study of populations and their variation in time and space.

Several other major problems have only been briefly mentioned in this thesis, including the diachronous first appearance of morphospecies and the provincialism of the marine fauna. Both of these topics require a large amount of research.

Owing to the amount of research that has previously been undertaken on the Albian biostratigraphy and the fine resolution of this it might appear that no more research should be undertaken. However, some of the possible future research topics are outlined above and it is precisely because an accurate biostratigraphy is available that further research should be undertaken on the Albian Stage, as it presents an ideal platform for the definition of a very detailed palaeoenvironmental model, in both time and space. This is probably the only Cretaceous Stage in which this would be possible.

REFERENCES

Alexander, C.I. 1929. Ostracoda of the Cretaceous of North Texas. Bull. Univ. Texas Bur. Econ. Geol., 2907: 1-137, pls. 1-10, 2 t-figs.

------- 1933. Shell structure of the Ostracode genus Cytheropteron and fossil species from the Cretaceous of Texas. J. paleont., 7(2): 181-214, 3 pls.

------- 1934. Ostracoda of the genera Monoceratina and Orthonotacythere from the Cretaceous of Texas. Ibid., 8(1); 57-67, 1 pl.

------- 1936. Ostracoda of the genera Eucythere, Cytherura, Eucytherura and Loxoconcha from the Cretaceous of Texas. Ibid., 10(8): 689-694, 1 pl.

Ali, M.T. 1974. Environmental implications of infilling in the Upper Greensand of the Beer District, South Devon. Proc. Geol. Ass., 85(4): 519-531.

------- 1976. The significance of a mid-Cretaceous Cobble conglomerate, Beer District, South Devon. Geol. Mag., 113(2): 151-158.

Allen, P. 1975. Wealden of the Weald: a new model. Proc. Geol. Ass., 86(4): 389-437.

------- 1969. Lower Cretaceous sourcelands and the North Atlantic. Nature, 222: 647-648.

Amedro, F., Damotte, R., Manivit, H., Robaszynski, Gornay, J., 1978 Echelles biostratigraphiques dans le Cénomanien du Boulonnais. Géologie Méditerraneenne, 5.(1): 5-18.

Ascoli, P. 1976. Foraminiferal and Ostracod biostratigraphy of the Mesozoic - Cenozoic, Scotian Shelf, Atlantic Canada. 1st International Symposium on Benthonic Foraminifera of Continental

margins. Part B. Paleoecology and Biostratigraphy. Maritime Sediments, Spec. Publ. 1: 653-771, 15 pls., 31 t-figs, 5 tables.

Atkinson, K. 1971. The relationship of Recent foraminifera to sedimentary facies in the turbulent zones, Cardigan Bay. J. Nat. Hist., 5: 385-439.

Baccaert, J. 1973. Contribution à l'étude stratigraphique des foraminiferes planctoniques de l'Albien supérieur de Wissant (Pas de Calais). Annales de la Société Géologique de Belgique, 96(3): 533-564, pls. 1-5.

Bailey, H.W. A foraminiferal biostratigraphy of the Lower Senonian of southern England. Unpublished Ph. D. Thesis, Plymouth Polytechnic, 1978.

Bandy, O.L. 1967. Cretaceous planktonic foraminiferal zonation. Micropaleontology, 13(1): 1-31, 13 t-figs., 1 table.

------- 1960. Concepts of foraminiferal paleoecology. Bull. Am. Ass. Petrol. Geol., 44(12): 1921-1932.

Banner, F.T. and Blow, W.H. 1959. The classification and stratigraphical distribution of the Globigerinacea. Part 1. Palaeontology, 2(1): 1-27, pls. 1-3, t-figs. 1-5.

Barnard, T. 1958. Some Mesozoic adherent foraminifera. Ibid., 1(2): 116-124, pls. 22-25.

------- 1963. The morphology and development of species of Marssonella and Pseudotextulariella from the Chalk of England. Ibid., 6(1): 41-54, pl. 7, t-fig. 9.

------- & Banner, F.T. 1953. Arenaceous foraminifera from the Upper Cretaceous of England. Q. Jl geol. Soc., 109(2): 173-216, pls. 7-9, 8 t-figs.

Bartenstein, H. 1954. Revision von Berthelins Mémoire 1880 über

die Alb-Foraminiferen von Montcley. Senckenberg. leth., 35(1/2): 37-50, pl. 1.

Bartenstein, H. 1976. Benthonic index foraminifera in the Lower Cretaceous of the northern hemisphere between East Canada and North West Germany. Erdol Kohle Erdgas Petrochem., 29(6): 254-256, 2 t-figs.

------- & Brand, E. 1949. New genera of Foraminifera from the Lower Cretaceous of Germany and England. J. paleont., 23(6): 669-672, 10 t-figs.

------- & Oertli, H.J. 1975. Index Ostracodes in the Lower Cretaceous of Heligoland. Bull. Centre Rech. Pau - SNPA 5(suppl):5-25, 3 pls., 3 t-figs.

Bassiouni, M. el A.A. 1974. Paranotacythere n.g. (Ostracoda) aus dem Zeitraum Oberjura bis Unterkreide (Kimmeridgium bis Albium) von Westeuropa. Geol. Jb., 17: 3-111, 13 pls., 5 t-figs., 1 table.

Baynova, E.K. 1965. Ostracodes d'Albien de la partie d'Ouest et Centrale de Bulgarie du Nord. Rev. Bulgarian Geol. Soc., 26(3): 287-315, pls. 1-5.

Bé, A.W.H. 1977. An Ecological, Zoogeographic and Taxonomical Review of Recent Planktonic Foraminifera. In: Oceanic Micropalaeontology, Vol. 1., Ramsay, A.T.S. (Ed.), Academic Press: 1-100.

Bennison, G.M. & Wright, A.E. 1969. The Geological History of the British Isles., Edward Arnold (Publishers) Ltd., London, 406pp., ISBN 0 7131 2206 4.

Berthelin, G. 1880. Mémoires sur les Foraminiferes de l'Étage Albian de Montcley (Doubs.). Mém. Soc. géol. Fr., 3e

Sér., 1(5): 1-84, pls. 24-27(1-4).

Bertram, H. & Kemper, D. 1971. Das Alb von Hannover. Beih. Ber. Naturh. Ges., 7: 27-48, 3 pls.

Bignot, G. 1961. Première idée de la microfaune Albienne des environs due Havre. Bull. Soc. geol. Normandie, 51: 13-16, 1 pl.

Black, M. 1971. Coccoliths of the Speeton Clay and Sutterby Marl. Proc. Yorks. Geol. Soc., 38: 381-424.

------- 1972. British Lower Cretaceous Coccoliths, 1, Gault Clay. Palaeontographical Soc., Publ. no. 534 (126)1: 1-48.

Boltovskoy, E. 1972. Patchiness in the distribution of planktonic foraminifera. Inter. Conf. Plank. Microfossils 2d, Rome Proc., 1: 107-115.

------- & Wright, R. 1976. Recent Foraminifera, 575pp., Dr. W. Junk b.v. (publishers), The Hague, ISBN 90 6193 030 8.

Bonnema, J.H. 1940-1941. Ostracoden aus der kriede des Untergrundes der Nordostlichen Niederlands. Natuur. Maandbl., 29(9-21): 91-95, 104-108, 115-118, 129-132, pls. 1-4; 30: 8-10, 21-24, 26-29, 40-43, 56-60, 70-72, pls. 5-7.

Bosquet, 1847. Description des Entomostacés fossiles de la craie de Maestrict. Mémoires Société Royaume Scientifique Liege, 4: 353-378, pls. 1-4.

------- 1852. Description des Entomostracés fossiles des terrains tertiares de la France et la Belgique. Mémoires Academie Royaume Scientifique Belgique, 24: 1-142, pls. 1-6.

------- 1854. Monographie des crustacés fossiles du terraine crétacé du duché de limborg. Verhand. geol. beschr. Kaar. Nederland, 2: 1-139, 10 pls.

Bowen, R. 1961. Oxygen isotope palaeotemperature measurement on Cretaceous Belemnoidea from Europe, India and Japan.

J. paleont., 35(5): 1077-1084.

Bowen, R.N.C. 1955. Observations on the foraminiferal genus Gaudryina d'Orbigny, 1839. Micropaleontology, 1(4):359-364.

Breistroffer, M. 1947. Sur les zones d'Ammonites dans l'Albien de France et d'Angleterre. Travaux du laboratoire de Géologic de la Faculté des Sciences de l'Université de Grenoble, 26:17-104.

Brotzen, F. 1942. Die Foraminiferengatung Gavelinella nov. gen. und die Systematik der Rotaliformes. Sveriges geol. Undersokrung, Afh., Ser., C, 451(36)8: 1-60, 1 pl., t-figs. 1-18.

Burnaby, T. 1961. The paleoecology of the Chalk Marl. Palaeontology, 4(4): 599-608, 1 t-fig., 2 tables.

Burrows, H.W., Sherborn, C.D. & Bailey, G. 1890. The foraminifera of the Red Chalk of Yorkshire, Norfolk and Lincolnshire. J. Roy. Micro. Soc., 8: 549-566, pls. 8-11.

Carsey, D.O. 1926. Foraminifera of the Cretaceous of Central Texas. Univ. Texas Bull., 2612: 3-56, pls. 1-8.

Carter, D.J. & Hart, M.B. 1977 Aspects of mid-Cretaceous stratigraphical micropalaeontology. Bull. Brit. Mus. (Nat. Hist.) Geol., 29(1): 1-135, 4 pls., 53 t-figs.

Casey, R. 1939. The Upper part of the Lower Greensand around Folkestone. Proc. Geol. Ass., 50(3-4): 362-378.

------- 1961. The stratigraphical palaeontology of the Lower Greensand. Palaeontology, 3: 487-621.

------- 1964. Glauconitic dates from the Upper Jurassic and Lower Cretaceous. In: Dodson, M.H., Rex, D.C., Casey, R. & Allen, P. The Phanerozoic Time-Scale., Q. Jl geol. Soc., 120S: 145-158.

Chamney, T.P. 1973. Micropalaeontological correlation of the boreal Lower Cretaceous. In: The Boreal Lower

Cretaceous. Casey, R. & Rawson, P.F. (Eds.), Geol. Jl Sp. Iss. No. 5 : 19-40.

Chamney, T.P 1978. Albian foraminifera of the Yukon territory. Geol. Surv. Can. Bull., 203: 1-62, 11 pls.

Chapman, F. 1891-1898. The Foraminifera of the Gault at Folkestone. Jl. Roy. Micro. Soc., (Part 1) 1891: 565-575, pl.9; (Part 2) 1892a: 319-330, pls. 5,6; (Part 3) 1892b: 749-758, pls. 11, 12; (Part 4) 1893a: 579-595, pls. 8,9; (Part 5) 1893b: 153-163, pls. 3,4; (Part 6) 1894a: 421-427, pl. 8; (Part 7) 1894b: 645-654, pls. 9,10; (Part 8) 1895: 1-14, pls. 1,2; (Part 9) 1896: 581-591, pls. 12,13; (Part 10) 1898: 1-49, pls. 1,2.

------- 1898. On Ostracoda from the Cambridge Greensand. Ann. Mag. nat. Hist., 7(2): 331-346, 1 pl.

------- 1899. Foraminifera from the Cambridge Greensand. Ibid., 7(3): 303-317, 1 pl.

------- & Sherborn, C.D. 1893 On the Ostracoda of the gault at Folkestone. Geol. Mag., 10: 345-349, pl. 14.

Charollais, J., Moullade, M., Oertli, H.J. & Rapin, F. 1977 Découverte de microfaunes de l'Albien moyen et Supérieur dans la Vallée de joux (Jura, Vaudois, Suisse). Géobios., 10(5): 683-695, 2 pls, 2 t-figs.

Cooper, M.R. 1977. Eustacy during the Cretaceous: its implications and importance. Palaeogeogr. Palaeoclimat. Palaeoecol., 22: 1-60.

Cornuel, J. 1849. Description des nouveaux fossiles microscopiques du terrain Crétacé inferieur du Département de la Haute-Marne. Mém. Soc. géol. Fr., 3: 241-246, pl. 1.

Cushman J.A. 1927. An outline of a re-classification of the Foraminifera. Contr. Cushman lab. foram. Res., 3(1): 1-105, pls. 1-2.

Cushman, J.A. 1932. The relationships of Textulariella and description of a new species. Ibid., 8(4): 97, 98.

------- 1933. Some new foraminifera genera. Ibid., 9(2): 32-38, pls. 3,4.

------- 1934. The generic position of Cornuspira cretacea, Reuss. Ibid., 10(2): 44-47.

------- 1936. New genera and species of the Families Verneuilinidae and Valvulinidae and the Subfamily Virgulininae. Cushman lab. foram. Res. Sp. Publ., 6: 1-62, pls. 1-8.

------- 1937a. A monograph of the foraminiferal Family Verneuilinidae Ibid., 7: 1-157, pls. 1-20.

------- 1937b. Ibid. A monograph of the foraminiferal Family Valvulinidae. Ibid., 8: 1-210, pls. 1-24.

------- 1937c. A monograph of the foraminiferal Family Virgulinidae. Ibid., 9: 1-228, pls. 1-24.

------- 1938. Cretaceous species of Guembelina and related genera. Contr. Cusham lab. foram. Res., 14(1): 2-28, pls. 1-4.

------- 1940. Midway Foraminifera from Alabama. Ibid., 16(3): 51-73, pls. 9-12.

------- 1946. Upper Cretaceous foraminifera of the Gulf Coastal region of the United States and adjacent areas. Prof. Pap. U.S. geol. Surv., 206: 1-241, pls. 1-66.

Damotte, R. 1961. Un nouveau sous-genre d'Ostracode de l'Albien Moyen de l'Yonne: Veenia (Protoveenia) florentinensis n. subgen., n.sp., Rev. Micropaléont., 4(2): 99-104, pls. 1,2.

------- 1968. Protocythere Triebel 1938, Mandocythere Grŭndel 1964 et Costacythere Grŭndel 1966 (Ostracodes) dans le Crétacé du bassin de Paris. Bull. Soc. géol. Fr., 10(7): 384-392, 1 pl., t-figs. 1-3, 2 tables.

------- 1971a. Quelques Ostracodes du Cénomanien de Dordogne et de Touraine. Revue micropaléont., 14(1): 3-20, pls. 1-3.

Damotte, R. 1971b. Contribution à l'étude des Ostracodes marins dans le Crétacé du Bassin de Paris. Soc. Géol. France n. série t.l. mém. No. 113: 1-152, 8 pls.

------- 1974. Un nouveau genre d'Ostracode de l'Albien du Bassin de Paris; Matronella n.g. Palaeontographica, A, 146: 181-189.

------- 1975. Ostracodes Cénomaniens du Bassin de Paris; Quelques resultats d'ordre paleoécologique et paleogéographique. Bull. Am. Paleont. 65(282): 263-269.

------- 1976. Sur le problème de l'évolution dans empreintes musculaires chez les Trachyleberidinae albiennes et Cénomaniennes du Bassin de Paris. Abh. Verh. naturw. Ver. Hamburg, (NF), 18/19 (suppl.): 295-303.

------- 1977. Sur les genres crétacés: Rehacythereis, Veeniacythereis, Cornicythereis, Parvacythereis, et Chapmanicythereis (Trachyleberididae, Ostracoda) crées par J.Grundel en 1973. Rev. Micropaléont., 19(4): 200-210, 2 pls.

------- & Grosdidier, E. 1963. Quelques Ostracodes du Crétacé de la Champagne Humide, 1 Albian-Cénomanien. Ibid. 6(1): 51-66, pls. 1-3, 1 t-fig.

------- & Magniez-Jannin, F. 1973. Ostracodes et foraminifères de l'Aptien inferieur de sondage du Bois du Perchois (Aube). Bull. d'Inform. des géol. du Bassin de Paris, 36: 3-47.

------- ------- 1973. An investigation of Microplankton assemblages from the latest Albian (Vraconian) sediments. Revista Espanola de micropal., 5(2): 173-212, 5 pls.

Deroo, G. 1956. Études Critiques au sujet des ostracodes marins du Crétacé Inférieur et Moyen de la Champagne Humide et du Bas Boulonnais. Révue Inst. fr. Petrole, 11(12): 1499-1535, pls. 1-5.

Destombes, P. 1958. Révision de l'Albien de la région du Havre déductions paléogéographiques sur le N.W. du Bassin Parisien au Crétacé moyen. Bull. Soc. géol. Fr., 4: 305-313.

------- & Destombes, J.P. 1965. Distribution zonale des Ammonites dans l'Albien du Bassin de Paris. Mém. B.R.G.M. 34: 255-270, 4 tables.

------- Gamble, H.J., Juignet, P. & Owen, H.G., 1977. Cretaceous and Lower Tertiary of Seine-Maritime, France: a guide to key localities. Proc. Geol. Ass., 88(1); 15-38, 9 t-figs.

------- & Shephard-Thorn, E. 1972. Resultats Géologiques des Recherches pour l'implantation d'un tunnel sous la Manche 1964-1965. In: Colloque sur la géologie de la Manche. Mém. B.R.G.M., 79: 101-121.

Dilley, F.C. 1969. The Foraminiferal fauna of the Melton Carstone. Proc. Yorks. geol. Soc., 37:321-322.

Douglas, R.G. & Savin, S.M. 1978. Oxygen isotopic evidence for the depth stratification of Tertiary and Cretaceous planktic foraminifera. Marine Micropaleontology, 3: 175-196.

Drummond, P.V.O. 1970. The mid Dorset swell: Evidence of Albian-Cenomanian movements in Wessex. Proc. Geol. Ass., 81: 679-714, t-figs. 1-10.

Eichenberg, W. 1933. Die Foraminiferen des Unterkreide. 1 Folge: Foraminiferen aus dem Albien von Wenden am Mittelland Kanal. Jb. neidersächs. geol. Ver., 25: 1-32, pls. 1-8.

Eicher, D.L. 1965. Foraminifera and biostratigraphy of the Graneros Shale. J. paleont., 39(5): 875-909, pls. 103-106, t-figs. 1-6, 1 table.

Ellermann, C. 1962. Neue Alb-Vorkommen in der Münsterschen Kreidebuchtundike Microfauna. Jahrbuch Geologie Paläontologie, 8: 385-408, 2 pls.

France, D.S. 1975. The Geology of the Indefatigable Gas-Field.

In Woodland, A.W.(Ed.) Petroleum and continental Shelf of North West Europe, Vol. 1, Geology : 233-239, 5 t-figs (Applied Science Publishers, London).

Franke, A. 1928. Die Foraminiferen der Oberen Kreide Nord-und Mitteldeutschlands. Abhand. Press. Geolog. Landesanstalt, nouvelle série, 111: 1-208, pls. 1-18., 2 t-figs.

Frerichs, W.F. 1971. Evolution of planktonic foraminifera and palaeotemperatures. J. paleont., 45: 963-968.

Fuchs, W. 1967. Die foraminiferen fauna eines Kernes des höheren Mittel-Alb der Teifbohrung Delft 2-Niederlande. Jb. geol. Bundesanst., 110(2): 255-341, pls. 1-18, 2 tables.

Funnel, B.M. 1967. Foraminifera and Radiolaria as depth indicators in the marine environment. Marine geol., 5(5/6): 333-347.

Gawor-Biedowa, E. 1969. The genus Arenobulimina Cushman from the Upper Albian and Cenomanian of the Polish lowlands. Roczn. pol. Tow. geol. 39: 73-104, pls. 5-8, t-figs. 1-13.

------- 1972. The Albian, Cenomanian and Turonian Foraminifers of Poland and their Stratigraphic Importance. Acta palaeont. pol., 17: 3-151, pls. 1-20, t-figs. 1-14, tables 1-4.

Glaessner, M.F. 1937. Plankton foraminiferen aus der Kreide und dem Eozän und ihre stratigraphische Bedeutung. Etyudy Mikropaleont., 1: 27-52, pls. 1,2, t-figs. 1-6.

------- 1966. Notes on foraminifera of the genus Hedbergella. Eclog. Geol. Helv., 59(1): 179-184, pl.1.

Grosdidier, E. 1962. Quelques Ostracodes Nouveaux du Crétacé Inférieur de Champagne Humide III Barrémien - Hauterivian. Rev. Micropaléont., 6(4): 223-236, pls. 1-7.

Gründel, J. 1964a. Neue ostracoden aus der deutschen unterkreide 1. Mber. det. Akad. Wiss. Berl., 6: 743-749, pl. 1.

Gründel, J. 1964b. Neue ostracoden aus der deutshen Unterkreide 2. Ibid., 6: 849-858, pls. 1,2.

------- 1966. Taxionomische, biostratigraphische und variationstatische Untersuchungen an den Ostracoden der Untekreide in Deutschland. Freib. Forsch., C200 Palaontologie: 1-105, pls. 1-10, 29 t-figs.

------- 1967. Neue Ostracoden aus dem Hauterive und Alb. Deutschlands. Jb Geol., 1: 629-650, 2 pls., 2 tables.

------- 1973. Zur Entwicklung der Trachyleberididae (Ostracoda) in der Unterkreide und in der teiferen Oberkreide. 1: Taxonomie. z. Geol. Wiss., 1(11): 1463-1474.

------- 1974. Zue Entwicklung der Trachyleberididae (Ostracoda) in der Unterkreide und in der teiferen Oberkreide. 2: Phylogenie. Ibid., 2(1): 61-71.

------- & Kozur, H. 1971. Zur taxionomie der Bythocytheridae und Tricorninidae (Podocopida, Ostracoda). Montasber. Deutsch. Akad. Wiss. : 907-937.

------- 1973. Zur phylogenie der Tricorninidae und Bythocytheridae (Podocopida, Ostracoda). Freib. Forsch. C. 282: 99-111, 1 t-fig.

Hamblin, R.J.O. & Wood, C. 1976. The Cretaceous (Alb-Cenomanian) stratigraphy of the Haldon Hills, S. Devon, England. Newsl. stratigr., 4(3): 135-149, 2 t-figs., 1 table.

Hancock. J.M. 1969. The transgression of the Cretaceous sea in the south-west of England. Proc. Ussher Soc., 2: 61-83.

------- 1975. The petrology of the Chalk. Proc. Geol. Ass., 86(4): 499-535, pls. 1-4, 2 t-figs., 4 tables.

------- & Kauffman, E.G. 1979. The great transgression of the late Cretaceous, Jl geol. Soc., 136: 175-186.

------- Milbourne R.A. & Owen, H.G. 1965. The gault of the Weald. Proc. Geol. Ass., 76: 243-260.

Harper, C.W. 1975. Origin of species in geologic time: alternatives. Science, 190: 47-48.

Hart, M.B. 1973a. A correlation of the macrofaunal and microfaunal zonations of the Gault Clay in S.E. England. In: The Boreal Lower Cretaceous. Casey, R. & Rawson, P.F. (Eds.), Geol. Jl. Sp. Iss. No. 5: 267-288, t-figs. 1-6.

------- 1973b. Foraminiferal evidence for the age of the Cambridge Greensand. Proc. Geol. Ass., 84: 65-82, t-figs. 1-5.

------- 1973c. Some observations on the Chert Beds (Upper Greensand) of South-West England. Proc. Ussher Soc., 2(6): 599-607, t-figs. 1-4.

------- 1980. A water depth model for the evolution of the planktonic Foraminiferida. Nature, 286 (577); 252-254, 2 t-figs.

------- & Bailey H.W. 1979. The distribution of planktonic Foraminiferida in the mid-Cretaceous of N.W. Europe. Aspekte der Kreida Europas, IUGS Series A, 6: 527-542, t-figs. 1-8.

------- & Carter, D. 1975. Some observations on Cretaceous Foraminifera of S.E. England. J. foramin. Res., 5: 114-126, t-figs. 1-10.

------- & Tarling, D.H. 1974. Cenomanian palaeogeography. Palaeogeogr. Palaeoclimat. Palaeoecol., 15: 95-106, t-figs. 1-5.

------- Weaver, P.P.E. & Harris, C.S. 1979. Microfaunal investigation of Shapwick Grange Quarry, East Devon. Proc. Ussher Soc., 4(3): 312-316, 1 t-fig.

Hay, W. 1977. Cretaceous Nannofossils. In: Oceanic Micropalaeontology, Vol.1., Ramsay, A.T.S. (Ed.), Academic Press: 1055-1201.

Hays, J.D. & Pitman, W.C.III 1973. Lithospheric plate motions, sea level changes and climatic and ecological consequences. Nature, 246: 18-22, 4 t-figs.

Hartmann, G. & Puri, H.S. 1974. Summary of neontological and palaeontological classification of Ostracoda. Hamburgischen

Zoological Museum und Institut, 70: 7-73

Hecht, F.E. 1938. Standard-Gliederung der Nordwest - deutschen Unterkreide nach Foraminiferen. Abh. senckenb. naturforsch. Ges., 443: 1-34, table 2.

Hermes, J.J. 1979. Late Albian Foraminifera from the Subbetic of Southern Spain. Geologie en Mijnbouw 48(1): 35-66, pls. 1-5.

Hinte, J.E. van 1976. A Cretaceous time scale. Bull. Am. Ass. Petrol. Geol., 60, 498-516, 9 t-figs.

Hofker, J. 1949. On Hagenowella and a new species. J.paleont., 23(4): 431-435, 4 t-figs.

------- 1954. Uber die Familie Epistomariidae (Foram.). Palaeontographica, A, 105: 166-206, t-figs. 1-56.

------- 1960. The taxonomic status of Praeglobotruncana, Planomalina, Globigerinella and Biglobigerinella. Micropaleontology, 6(3): 315-322, 2 pls., 1 t-fig.

------- 1961. The gens Globigerina cretacea in northwestern Europe. Ibid., 7(1): 95-100, 1.pl., 2 figs.

Hollis, E. & Neaverson, E. 1921. Gault foraminifera from Ford, Bucks. The Naturalist : 235-240.

Howe, V.H. & Laurencich, L. 1958. Introduction to the study of Cretaceous Ostracoda. Louisiana State Univ. Press, Baton Rouge, 536pp., 1667 t-figs.

Hughes-Clarke. 1957. Ostracoda from the Gault of Southern England Unpublished Ph. D. thesis, University College London.

Jannin, F. 1965. Contribution a l'étude du stratotype de l'Albien: variations des microfaunes. Rév. Micropaléont., 8(2): 106-117.

------ 1967. Les "Valvulineria" de l'Albien de l'Aube. Rév. Micropaléont., Paris, 10(3):153-178, pls. 1-4, figs. 1-7.

------- 1968. Sur la disposition et la taille des pores chez quelques Nodosariidae de l'Albien de l'Aube. C.R. Acad. Sc. Paris, Sér. D., 266: 321-324, 2 pls.

Jannin-Magniez, F. 1975. Les foraminifères de l'Albien de l'Aube.

Paléontologie, Stratigraphie, Écologie. Cah. Paléont., Paris 360 pp., 21 pls, 141 t-figs., Éditions du centre national de la recherche scientifique, Paris. ISBN 2 222 01713 0.

Jenkyns, H.C. 1980. Cretaceous anoxic events: from continents to oceans. Jl geol. Soc., 137: 171-188, 6 t-figs.

Jones, T.R. 1849. The Entomostraca of the Cretaceous Formation. Palaeontographical Soc., 3(1): 1-40, pls. 1-7

------- 1870. Notes on the Cretaceous Entomostraca. Geol. Mag., 7: 74-77.

------- & Hinde, G.J. 1890. A supplementary monograph of the Cretaceous Entomostraca of England and Ireland. Palaeontographical Soc., 43: 1-70, pls. 1-4.

Juignet, P. 1970. Précisions stratigraphiques et sédimentologiques sur le Cénomanien du Pays de Caux entre St-Jouin-Bruneval et le cap d'Antifer (Seine-Maritime). Bull. B.R.G.M., Sér. 2, 1: 11-15, 2 t-figs.

------- 1971. Modalités du contrôle de la sédimentation sur la marge armoricaine du Bassin de Paris à l'Aptien-Albien-Cénomanien. Ibid., Sér. 2, 1(3): 113-126, 4 t-figs. 1 table.

------- , Rioult. M. & Destombes, P. 1973. Boreal influence in the Upper Aptian- Lower Albian beds of Normandy, northwest France. In: The Boreal Lower Cretaceous. Casey, R. & Rawson, P.F. (Eds.), Geol. Jl, Sp. Iss., No. 5: 303-326.

Jukes-Brown, A.J. & Hill, W. 1900. The Cretaceous Rocks of Britain 1. Gault and Upper Greensand. Mem. geol. Surv. U.K., 499 pp., 5 pls., 85 t-figs.

Kauffman, E.G. 1969. Cretaceous marine cycles of the Western Interior. Mt. Geol., 6: 227-245.

Kaye, P. 1963a. The Ostracod genus Neocythere in the Speeton Clay. Palaeontology, 6(2): 274-281, pl. 41.

Kaye, P. 1963b. Species of the Ostracod Family Cytherellidae from the British Lower Cretaceous. Senckenbergiana, 44: 109-125, pls. 18-20.

------- 1963c. The interpretation of the mesozoic Ostracod genera of the family Cytherideidae Sars, 1925. Rév. micropaléont., 6(1): 23-40, 3 pls.

------- 1963d. Ostracoda of the subfamilies Protocytherinae and Trachyleberidinae from the British Lower Cretaceous. Paläont. Z., 37(3/4): 225-238, pls. 18,19.

------- 1963e. The Ostracod species Orthonotacythere inversa (Cornuel) and its allies in the Speeton Clay of Yorkshire. Palaeontology, 6(3): 430-439, pl. 61.

------- 1964a. Species of the Eucytherura and Cytheropteron from the Speeton Clay. Geol. Mag., 101(2): 97-101, pls. 4,5.

------- 1964b. Revision of the Ostracoda from the Bargate Beds in Surrey. Palaeontology, 7(2): 317-330, pls. 54,55.

------- 1964c. Revision of British marine Cretaceous Ostracoda with notes on additional forms. Bull. Br. Mus. (nat. Hist.) Geol., 10(2): 37-79, pls. 1-9.

------- 1965a. Further Ostracoda from the British Lower Cretaceous. Senckenberg. leth., 46(1): 73-81, pl. 5, t-figs. 1,2.

------- 1965b. Ostracoda from the Aptian of the Isle of Wight. Paläont. Z., 39(1/2): 33-50, 2 pls.

------- 1965c. Some new British Albian Ostracoda. Bull. Brit. Mus. (nat. Hist.) Geol., 11: 217-253, 11 pls., 5 t-figs.

------- 1966. Lower Cretaceous palaeogeography of N.W. Europe. Geol. Mag., 103(3): 257-262.

------- & Barker, D. 1965. Ostracoda from the Sutterby marl (Upper Aptian) of S. Lincs. Palaeontology, 8(3): 375-390, pls. 48-50, 1 t-fig.

Keen, M.C. & Siddiqui, Q.A. 1971. Cenomanian Ostracoda from the Carrs' Glen Shell bed of Belfast, Northern Ireland. Rév. Micropaléont., 14(1): 62-68, 2 pls.

Keller, B.M. 1935. Die mikrofauna der oberkreide im Dnjepr-Donez-Bechen und einigen angrenzenden Gebieten. Bull. Soc. Natural, Moscow, Sect. Geol., B: 522-558, 3 pls., 3 tables.

Kemper, E. 1971. Batavocythere und Saxocythere, zwie neue Protocytherinae - Gattung (Ostracoda) der Unterkreide. Senckenberg. leth., 52(5/6): 385-431, 8 pls.

------- 1973. The Aptian and Albian stages in N.W. Germany. In: The Boreal Lower Cretaceous. Casey, R. & Rawson, P.F. (Eds.), Geol. Jl,Sp. Iss., No. 5: 345-360.

Kemper, E., Bertram, H. & Deiters, H. 1975. Zur Biostratigraphie und Palakologie der Schictenfolge Ober-Apt/Unter-Alb im Beckenzentrum nordlich und ostlich von Hannover. Beih. Ber. Naturh. Ges., 119: 49-85.

Kennedy, W.J. 1967. Burrows and surface traces from the Lower Chalk of southern England. Bull. Br. Mus., (nat. Hist.) Geol., 15(3): 125-167, 9 pls.

------- 1970. The correlation of the uppermost Albian and Cenomanian of S.W. England. Proc. Geol. Ass., 81: 613-678, 16 t-figs.

------- & Cobban, W.A. 1976. Aspects of ammonite biology, biogeography and biostratigraphy. Spec. Pap. Palaeontology, 17: 1-94, 11 pls.

------- & Garrison, R.E. 1975. Morphology and genesis of nodular Chalks and hardgrounds in the Upper Cretaceous of southern England. Sedimentology, 22: 311-386.

Kent, P.E. 1967. Outline Geology of the Southern North Sea Basin. Proc. Yorks. geol. Soc., 36: 1-22.

Khan, M.H. 1950a. On some new foraminifera from the Lower Gault of

southern England. J. Roy. Micro. Soc., 70: 268-279, 2 pls.

Khan, M.H. 1950b. Note on the depth and temperature of the Gault Sea as indicated by foraminifera. Geol. Mag., 87: 175-180.

------- 1952. Zonal analysis of the Lower Gault of Kent based on Foraminifera. Contr. Cushman Lab. foram. Res., 3: 71-80.

------- 1962. Lower Cretaceous index foraminifera from northwestern Germany and England. Micropaleontology, 8(3): 385-390.

Kileyni T.I. 1970. Some basic questions in the palaeoecology of Ostracods. Bull. Centre Rech. Pau., SNPA-5 (supp.) : 31 (Pau Symposium Volume).

------- & Allen, N.W. 1968. Marine brackish bands and their microfauna from the lower part of the Weald Clay of Surrey and Sussex. Palaeontology, 11:141-162, pls. 29,30.

King, C.B. 1968. Ostracoda from the Upper Chalk of the British Isles. Unpublished Ph. D. thesis, University College London.

Kirkaldy J.F. 1939. The history of the Lower Cretaceous period in England. Proc. Geol. Ass., 50(3/4): 379-417.

------- 1963. The Wealden and Marine Lower Cretaceous Beds of England. Ibid., 74: 127-146.

Kornicker, L.S. 1961. Ecology and distribution of Recent Bairdiinae (Ostracoda). Micropaleontology, 7: 55-70, 1 pl., 10 t-figs., 3 tables.

Lalicker, C.G. 1935. New Cretaceous Textulariidae. Contr. Cushman lab. foram. Res., 2(1): 1-13, pls. 1,2.

Lambert, G. & Scheibnerova, V. 1974. Albian foraminifera of Zululand (South Africa) and Great Artesian Basin (Australia). Micropaleontology, 20(1): 76-96, pls. 1-3.

Lamplugh, G.W. 1896. On the Speeton Series in Yorkshire and Lincolnshire. Q. Jl geol. Soc., 52: 179-220.

Larwood, G.P. 1961. The Lower Cretaceous deposits in Norfolk. In: Larwood, G.P. & Funnel, B.M. (eds.), The Geology of Norfolk. Trans. Norfolk Norwich Nat. Soc., 19(6): 280-292.

Lasker, H. 1976. Effects of differential preservation on the measurement of taxonomic diversity. Paleobiology, 2: 84-93.

Liebau, A. 1969. Comment on suprageneric taxa of the Trachyleberididae s.n. (Ostracoda, Cytheracea). N. Jb geol. Paläont., 148: 353-379.

Loeblich, J.R. & Tappan, H. 1953. Studies of Arctic foraminifera. Smith. Misc. Coll., 121(7): 1-150, pls. 1-24.

------- ------- 1961. Cretaceous planktonic foraminifera. Part 1 - Cenomanian. Palaeontology 7(3): 257-304, pls., 1-8.

------- ------- 1964. Foraminifera, facts, fallacies and frontiers. Bull. geol. Soc. Am., 75: 367-392.

Longoria, J.F. 1977. El limite cretacico inferior-cretacia superior en Mexico Basada en los Foraminiferes Planctonicos. Univ. Nal. Autón. México Inst. Geologia Revista, 1(1): 5-9.

------- & Gamper, M.A. 1977. Albian planktonic Foraminifera from the Sabinas Basin of N. Mexico. J. foramin. Res., 7(3): 196-215, pls. 1-6.

Lowenstam, H.A. & Epstein, S. 1954. Palaeotemperature of the Post-Aptian Cretaceous as determined by the Oxygen Isotopte method. J. geol., 62(3): 207-248, t-figs. 1-22.

Malapris, M. 1965. Les Gavelinellidae et Formes Affines du gisement Albien de Courcelles (Aube). Rév. Micropaléont., 8(3): 131-150, 5 pls., 6 t-figs.

Malapris-Bizouard, M. 1967. Les lingulogavelinelles de l'Albien Inférieur et Moyen de l'Aube. Ibid., 10(2): 128-150, pls. 1-2, t-figs. 1-6, tables 1-3.

------- & Rat, P. 1961. Données sur les Rosalines du Cénomanien et du Turonien de Côte-d'or. Ibid., 4(2): 85-98.

Marcinowski, R. 1974. The transgressive Cretaceous deposits of the Polish Jura Chain (U. Alb. through Turonian). Acta geologica polonica, 24(1): 117-217.

Marie, P. 1938. Sur quelques foraminifères nouveaux ou peu connus du Crétacé du Bassin de Paris. Bull. Soc. géol. Fr., 5(8): 91-104, pls. 7-8.

------- 1939. Zones a foraminifères du Crétacé moyen de Saint-Florentin (Yonne). C.R. som. Soc. géol. Fr., 11: 173-175.

------- 1941a. Zones à foraminifères du Gault dans le département de l'Aube. Ibid., 8: 38-40.

------- 1941b. Zones à foraminifères du Gault atteintes par forage dans la région parisienne. Ibid., 15: 45-61.

------- 1941c. Sur la microfaune des argilles albiennes du Pays de Bray. Ibid., 12: 82-84.

------- 1941d. Zones à foraminifères des marnes du Gault de Wissant (Pas de Calais). Ibid., 10: 53-55.

------- 1965. Sur une échelle stratigraphique de l'Albien du bassin Parisien basée sur les foraminifères. Mém. B.R.G.M. 34: 271-288.

Maslakova, N.I. 1963. (Contribution to systematics of genus Hedbergella). Paleont. Zh., 4: 112-116, t-figs. 1,2. (In Russian; English summary, 1965) Int. Geol. Rev. 7(6): 1071.

Masters, B.A. 1977. Mesozoic planktonic foraminifera. In: Oceanic Micropaleontology, Vol. 1, Ramsay, A.T.S. (Ed.), Academic Press: 301-732, pls. 1-58, t-figs. 1-148.

Mertens, E. 1956. Zur Grenzziebung Alb/Cenoman in Nordwestdeutschland mit Hilfe von Ostracoden. Geol. Jb., 72: 173-230, pls. 8-14, 1 table.

Michael, E. 1966. Die Evolution der Gavelinelliden (Foram.) in

der N.W. deutschen Unterkreide. Senckenberg. leth., 47(516): 411-459, pl. 5, t-figs. 1-16.

Michael, F.Y. 1972. Planktonic Foraminifera from the Comanchean series (Cretaceous) of Texas. J. foramin. Res., 2(4): 200-220, 7 pls., 7 t-figs.

Middlemiss, F.A. 1975. Studies in the sedimentation of the Lower Greensand of the Weald, 1875-1975: a review and commentary. Proc. Geol. Ass., 86(4): 457-471.

Milbourne R.A. 1963. The gault at Ford Place, Wrotham, Kent. Ibid., 74(1): 55-79.

Moreman, W.L. 1927. Fossil zones of the Eagle Ford of north Texas. J. paleont., 1(1): 89-101, pls. 13-16.

Morkhoven, F.P.C.M. van 1962. Post-Palaeozoic Ostracoda. Their Morphology, Taxonomy and Economic Use. 1 general: 204 pp., Elsevier (Publ.), Amsterdam.

------- 1963. Post-Palaeozoic Ostracoda. Their Morphology, Taxonomy and Economic Use. 2 generic Descriptions: 478pp., Elsevier (Publ.), Amsterdam.

Morozova, V.G. 1948. Foraminifères du Crétacé inferieur dans la région de Sotchi (Caucase Sud-Ouest). Bjull. moskovsk. Obshchest. Ispytatel. Prirochy, Otdel. geol., 23(1): 24-43, 2 pls.

Morrow, A.L. 1934. Foraminifera and Ostracoda from the Upper Cretaceous of Kansas. J. paleont., 8(2): 186-205, pls. 29-31.

Moullade, M. 1960. Sur quelques Foraminifères du Crétacé inférieur des Baronnies (Drôme). Rév. Micropléont., 3(2): 131-142, 2 pls., 2 t-figs.

------- 1961. Quelques foraminifères et Ostracodes nouveaux du Crétacé inférieur vocontien. Ibid., 3(4): 213-216, 1 pl.

------- 1966. Etudes stratigraphique et micropaléontologique

du Crétacé inférieur de la "Fosse vocontienne". These Doct. État. Doc. Lab. géol. Fac. Sci., Lyon, 15: 369pp., 17 pls., 27 t-figs.

Moullade, M. 1967. Sur l'importance des phénomenès de convergence morphologique chez les foraminifères planktoniques du Crétacé inférieur. Proc. 1st Int. Conf. on planktonic microfossils. Vol. 2: 460-467.

Mountjoy, E.W. & Chamney, T.P. 1969. Lower Cretaceous (Albian) of the Yukon: Stratigraphy and foraminiferal divisions, Snake & Peel rivers. Geol. Surv. Canada Dpt. Energy, Mines & Resources, paper 68-26: 1-71.

Murray, J.W. 1970. Foraminifera of the Western Approaches to the English Channel. Micropaleontology, 16(4): 471-485, pls. 1,2.

Naylor, P. & Mounteney, S. 1975. Geology of the North West European Continental Shelf. Vol. 1. West British Shelf. 162 pp., Graham Trotman Dudley Ltd. (Publ.), London.

Neagu, T. 1965. Albian foraminifera of the Rumanian Plain. Micropaleontology, 11(1): 1-38, pls. 1-10.

Neale, J.W. 1960. Marine Lower Cretaceous Ostracoda from Yorkshire England. Ibid., 6(2): 203-224, pls. 1-4, t-figs. 1-4, table 1.

------- 1961. The Senonian (Upper Cretaceous) ostracod Paracypris siliqua Jones & Hinde, 1890. Ann. Mag. Nat. Hist., 13(4): 193-197, pl. 7.

------- 1962. Ostracoda from the type Speeton Clay (Lower Cretaceous) of Yorkshire. Micropaleontology, 8(4): 425-484, pls. 1-13.

------- 1964. Some factors influencing distribution of Recent British ostracoda. Pubbl. staz. zool. Napoli, 33 suppl.: 247-307.

------- 1970. Microfaunas and some aspects of the Speeton Clay environment. Bull. Centre Rech. Pau - SNPA 5 (suppl.):

633-681, 4 t-figs., 4 tables (Pau Symposium volume).

Neale, J.W. 1973. Ostracoda as means of correlation in the Boreal Lower Cretaceous, with special reference to the British marine Ostracoda. In: The Boreal Lower Cretaceous. Casey, R. & Rawson, P.F. (Eds.) Geol. Jl, Sp. Iss. No. 5:169-184.

------- 1974. Cretaceous: 225-243, In: The Geology and Mineral resources of Yorkshire. Rayner, D.H. & Hemingway, J.E. (Eds.), Yorks. geol. Soc., Leeds.

------- 1978. In: A stratigraphical index of British Ostracoda, The Cretaceous, Bate, R. & Robinson, E. (Eds.) Geol. Jl, Sp. Iss. No. 8: 325-384, 17 pls., 5 tables.

Oertli, H.J. 1958. Les ostracodes de l'Aptien-Albien D'Apt. Revue. Inst. fr. Pétrole, 13: 1499-1537, pls. 1-9.

Omhert, W. 1970. Ecology of some Trachyleberididae (Ostracoda) from the Bavarian Upper Cretaceous. In: Paleoecologie Ostracodes. Bull. Centre Rech. Pau. - SNPA, 5 (suppl.): 601-614.

d'Orbigny A.D. 1840. Mémoires sur les Foraminifères de la craie blanche du bassin de Paris. Mém. Soc. géol. Fr., 4(1): 1-51, pls. 1-4.

------- 1842. Pteropoda, Gastapoda. Paléontologie français, Terrains crétacés. 2: 456 pp., Atlas 236.

------- 1852. In: Cours Élémentaire de Paléontologie et de Géologie stratigraphiques. Masson, Paris.

Owen, E.F., Rawson, P.F. & Whitham, F. 1968. The Carstone (Lower Cretaceous) of Melton, E. Yorks., and its Brachiopod fauna. Proc. Yorks. geol. Soc., 36: 513-524, pls. 22,23.

Owen, H.G. 1963. Some sections in the Lower Gault of the Weald. Proc. Geol. Ass., 74(1): 35-53.

------- 1971a. Middle Albian Stratigraphy in the Anglo-Paris

Basin. Bull. Brit. Mus. (nat. Hist) Geol. Suppl. 8: 1-164, pls. 1-3.

Owen, H.G. 1971b. The stratigraphy of the Gault in the Thames Estuary. Proc. Geol. Ass., 82: 187-207.

------- 1973. Ammonite faunal provinces in the Middle and Upper Albian and their palaeogeographical significance. In: The Boreal Lower Cretaceous. Casey, R. & Rawson, P.F. (Eds.), Geol. Jl, Sp. Iss. No. 5: 145-154.

------- 1975. The Stratigraphy of the Gault and Upper Greensand of the Weald. Proc. Geol. Ass., 86(4): 475-498, 10 t-figs., 1 table.

Parker, W.K. & Jones, T.R. 1863. On the nomenclature of Foraminifera Part 8 Textularia. Ann. Mag. nat. Hist., ser. 3, 11:91-98.

Pegrum R.M., Rees, G. & Naylor, D. 1975. Geology of the North-West European Continental Shelf. Vol. 2, The North Sea: 225 pp. Graham Trotman Dudley Ltd., London.

Perner J. 1892. Foraminifery České ho Cenomaru: Česká Akademic Cisáre Františka Josefa pro Vědy, Stovesposta Uměni v. Praze. Paleontographica Bohemiae, 1: 1-65.

Plummer, H.J. 1931. Some Cretaceous foraminifera in Texas. Univ. Texas Bull., 3101: 109-234, pls. 8-15.

Pokorny, V. 1968. The diversity of fossil ostracode communities as an indicator of palaeogeographic conditions. In. Bull. Centre Rech. Pau-SNPA, 5 (Suppl.): 46-61.

Porrenga, D.H. 1967. Glauconite and Chamosite as depth indicators in the Marine Environment. Marine geol., 5: 495-501.

Price, F.G.H. 1874. On the Gault of Folkestone. Q. Jl, geol. Soc., 30: 342-366.

Price, R.J. 1975. Palaeoenvironmental interpretations in the

Albian of West and South Europe, as shown by the distribution of selected Foraminifera. Marine Sediments, Spec. Pub. 1: 625-648, 14 t-figs.

Price, R.J. 1977a. The evolutionary interpretation of the Foraminiferida Arenobulumina, Gavelinella, and Hedbergella in the Albian of N.W. Europe. Palaeontology, 20: 503-527, pls. 59-61.

------- 1977b. The Stratigraphical zonation of the Albian sediments of northwest Europe, as based on foraminifera. Proc. Geol. Ass., 88(2): 65-91, 6 t-figs.

------- 1977c. A Fortran IV Program for Foraminiferid stratigraphic correlation and palaeoenvironmental interpretation. Computers & Geosciences, 3: 601-615, 6 t-figs.

Rawson, P.F., Curry, D., Dilley, F.C., Hancock, J.M., Kennedy, W.J., Neale, J.W., Wood, C.J. & Worssam, B.C. 1978 A correlation of Cretaceous rocks in the British Isles. Geol. Soc., Sp. Rep., London, No. 9: 70 pp, 6 t-figs.

Reuss, A.E. 1844. Geognostiche Shizzen aus Bohem. 2:304 pp., 3 pls.

------- 1845/6. Die Versteinerungen der Bohmischen Kreideformation. Schweizerbart, E., Stuttgart, 1: 1-58, pls. 1-14; 2: 59-148, pls. 14-51.

------- 1860. Die Foraminiferen westphalischen Kreideformation. Sitz. Akad. Wiss., 15(8): 147-238, 13 pls.

------- 1862. Entwurf einer systematischen Zusammenstellung der Foraminiferen. Sber. Akad. Wiss., 1(44): 355-396. (1861).

------- 1863. Die Foraminiferen des norddeutschen Hils und Gault. Sitz. Akad. Wiss. 46: 5-100, 13 pls. (1862).

Reyment, R.A. 1978. Quantative biostratigraphical analysis exemplified by Morroccan Cretaceous Ostracoda. Micropaleontology,

24: 24-43.

Reyment, R.A. 1979. Signification paléobiogeographique de la repartition de Oertliella tarfayaensis au Maroc. Rév. Micropaléont., 22(3): 186-190.

Rhys, G.H. 1974. A proposed standard lithostratigraphic nomenclature for the southern north sea and an outline structural nomenclature for the whole of the (UK) North Sea. Rep. Inst. Geol. Sci., 74/8: 14 pp.

Robaszynski, F. & Caron, M. 1979. Atlas of Mid Cretaceous planktonic foraminifera (Boreal sea and Tethys). Cah. Micropaléont., Paris,Part 1 : 1-185, 39 pls.

------- Amerdro, F., Foucher, J.C., Gaspard, D., Magniez-Jannin, F., Manivit, H., Gornay, J. 1980. Synthese Biostratigraphique de l'Aptien au Santonian du Boulonnais a partier de sept groupes paléontologiques: Foraminifères, Nannoplancton, Dinoflagelles et Macrofaunes. Rév. Micropaléont, 22(4): 195-321, pls. 1-20, t-figs. 1-28.

Roemer, F.A. 1840. Die Versteinerungen des Norddeutschen Kreidegebirges, Hannover: 145 pp., 16 pls.

Rosen, B. 1977. The depth distribution of recent hermatypic corals and its palaentological significance. Mem. Bur. Rech. géol. minier. 89: 507-517.

Sanders, H.L. 1969. Benthic marine diversity. Brook-haven Symposia in Biology, USA, 22: 71-81.

Scheibnerová, V. 1973. A comparison of the austral and boreal Lower Cretaceous foraminiferal and ostracodal assemblages. In: The Boreal Lower Cretaceous. Casey, R. & Rawson, P.F. (Eds.). Geol. Jl, Sp. Iss. No. 5: 407-414.

Schlanger, S.O. & Jenkyns, H.C. 1976. Cretaceous anoxic events: causes and consequences. Geol. Mijnbouw., 55: 179-184.

Schmid, F. 1971. Mesfaunen aus dem Alb von Hannover. Beih. Ber. Naturh. Ges., 7: 69.

Sexton, J.V. 1951. The Ostracoda Cytherelloidea in North America J. paleont., 25: 808-816.

Sherlock, R.L. 1914. The foraminifera of the Speeton Clay of Yorkshire. Geol. Mag., n.s., dec. 6,1: 216-222, 255-265, 289-296, pls. 18,19.

Sigal, J. 1965a. Présence d'un Foraminifère Pèlagique Hedbergella washitensis du domaine Méditerranées dans l'Albien du Bassin de Paris. Mém. B.R.G.M., 34: 289-292.

------- 1965b. Bibliographie sur les Foraminifères du Crétacé Inférieur. Ibid., 34: 503-512.

------- 1966. Contribution à une monographie des Rosalines. 1. Le Genre Ticinella Reichel, souche des Rotalipores. Eclog. Geol. Helv., 59(1): 185-218, pls. 1-6.

Sliter, W.V. 1972. Cretaceous foraminiferids. Depth, Habitats and their origins. Nature, 239: 514-515.

Spaeth, C. 1973. Neohibolites ernsti and its occurrence in the Upper Albian of northwest Germany and England. In: The Boreal Lower Cretaceous. Casey, R. & Rawson, P.F. (Eds.). Geol. Jl, Sp. Iss. No. 5: 361-368.

Spath, L.F. 1923. On the ammonite horizons of the Gault and contiguous deposits. Geol. Surv. G.B. & Mus. Practical Geol. Somm. Prog. 1922: 139-149.

Stchépinsky, A. 1954. Études des Ostracodes du Crétacé Inférieur de la Haute-Marne. Bull. Soc. géol. Fr., 6: 485-608, pl. 22.

Stover, L.E. 1966. Cretaceous coccoliths. Micropaleontology, 12(2): 133-167.

Swiecicki, A. A foraminiferal biostratigraphy of the Campanian and Maastrictian chalks of the United Kingdom. Unpublished Ph.D. Thesis, Plymouth Polytechnic, 1980.

Ten Dam, A. 1947. On foraminifera of the Netherlands, No. 9. Sur quelques especes nouvelles ou peu connues dans le Crétacé Inferieur (Albien) des Pays-Bas. Geologie Mijnb., n.s.8: 25-29.

------- 1948. Les éspeces du genre Epistomina Terquem 1883. Revue Inst. fr. Pétrole, 3(6): 161-170, pls. 1,2.

------- 1950. Les Foraminifères de l'Albien des Pays-Bas. Mém. Soc. géol. Fr., n.s., 63-65: 1-66, pls. 1-4.

Teste, G. 1974. Les foraminifères de l'Albien de Bully-Saint-Martin. C.R. Acad. Sci., sér. D., : 278, 3183-3186.

Toogood, J.F. 1973. Albian foraminifera from the Canvey Island borehole. Unpublished M.Sc. thesis. University College of Wales, Aberystwyth.

Tresise, G.R. 1960. Aspects of the lithology of the Wessex Upper Greensand. Proc. Geol. Ass., 71: 316-339, figs. 1-8.

Triebel, E. 1938a. Ostracodes-Untersuchungen; 1. Protocythere und Exophthalmocythere, zwei neue Ostracoden-Gattung aus der deutschen Kreide. Senckenbergiana, 20: 178-200, pls. 1-3.

------- 1938b. Die Ostracoden der deutschen Kreide. 2. Die Cytheridea - Arten der unteren Kreide. Ibid., 20: 471-501, pls. 1-6.

------- 1957. New Cretaceous index foraminifera from north Alaska. Bull. U.S. nat. Mus., 215:201-222, pls. 65-71.

Taylor, R.C. 1823. Geological section of Hunstanton Cliff, Norfolk. Phil. Mag., 61:81-83.

Sylvester-Bradley, P.C. 1948. The ostracod genus Cythereis. J. palaeont., 22(6): 792-797, pl. 122.

------- 1971. Terminology for surface features in ornate ostracodes. Lethaia, 4(3): 249-256, 48 t-figs.

Tappan, H. 1940. Foraminifera from the Grayson formation of N. Texas. J. paleont., 14(2): 73-126, pls. 14-19.

------- 1943. Foraminifera from the Duck Creek Formation of Oklahoma and Texas. Ibid., 17(5): 476-517, pls. 77-83.

Triebel, E. 1940. Die Ostracoden der deutschen Kreide; 3 Cytherideinae und Cytherinae aus der Unteren Kreide. Ibid., 22: 160-227, pls. 1-10, 2 t-figs., 1 table.

Valentine, J.W. 1969. Patterns of taxonomic and ecological structure of the shelf benthos during Phanerozoic time. Palaeontology, 12: 684-709.

Vasilenko, V.P. 1954. (Fossil foraminifera of the U.S.S.R. Anomalinidae). Trudy vses neft. nauchno-issled. geol. rasv. Inst. n.s. 80: 1-383, pls. 1-36 (In Russian).

Voloshina, A.M. 1965. Sostoyanie izuchennosti nekotorikh rodov podsemeistva Ataxophragmiinae. Voprosi Mikropaleontologii, AN SSSR. vip. 9, pp. 147-156.

Walters, R. 1968. Investigations of the Albian foraminifera of southeast England. Unpublished Ph. D. thesis, University College of Wales, Aberystwyth.

Weaver, P.W. 1978. Cenomanian Ostracoda from southern England, their taxonomy, stratigraphy and palaeoecology. Unpublished Ph. D. thesis, Plymouth Polytechnic.

------- (In press) Ostracoda from the British Lower Chalk and Plenus Marls. Palaeontog. Soc. Monogr., 1982.

Weingeist, L. 1949. The ostracode genus Eucytherura and its species from the Cretaceous and Tertiary of the Gulf Coast. J. paleont., 23(4): 364-379, pl. 73.

Whatley, R.C. 1976. Association between podocopid Ostracoda and some Animal substrates. Abh. Verh. naturw. Ver. Hamburg (N.F.), 18/19 (suppl.): 191-200.

Whatley, R.C. & Wall, 1975. The relationship between Ostracoda and Algae in the littoral and sublittoral marine environments. Symposium on Biology and Paleobiology of Ostracoda, Delaware 1972. Bull. Amer. Paleont., 65: 173-204.

Wiel, A.M. Van der 1978. Ostracoda from the Albian of Petit Blanc nez. Proc. Kon. Ned., ser. B., 81: 248-262, 4 pls., 3 t-figs.

Williams-Mitchel, E. 1948. The zonal value of Foraminifera in the Chalk of England. Proc. Geol. Ass., 59: 91-112, pls. 8-10.

Williamson, W.C. 1847(8). On some microscopical objects found in the mud of Levant, and other deposits; with remarks on the mode of formation of calcareous and infusional siliceous rocks. Manchester Literary and Philosophical Society, 8: 1-128, pls. 1-4.

Wilson, H.H. 1974. Cretaceous sedimentation and orogeny in nuclear Central America. Bull. Am. Ass. Petrol. Geol., 58: 1348-1396.

Wonders, A. & Verbeek, J. 1977. Correlation of planktonic Foraminiferal and Calcareous Nannofossil zonations of late Albian, Cenomanian & Turonian. Koninklijki Nederlandse Akademie von Wetenschappen, Proc. B., 80B: 7-15.

Wood C.J. & Smith, E.G. 1978. Lithostratigraphic classification of the chalk in N. Yorkshire, Humberside and Lincolnshire. Proc. Yorks. geol. Soc., 42(2)14: 263-287, 12 pls.

Wright, C.A. & Murray, J.W. 1972. Comparison of modern and Palaeogene foraminiferid distributions and their environmental implications. Mém. B.R.G.M., 79: 87-96.

APPENDIX 1

Section	Planktonic Foraminifera	Benthonic Foraminifera	Ostracoda
GLYNDEBOURNE			
47.5-48m.	44	138	69
48.0-48.5	17	64	77
48.5-49.0	68	174	108
49.0-49.5	42	149	177
49.5-50.0	17	298	79
51.0-51.5	121	105	283
52.5-53.0	93	250	355
53.5-54.0	119	325	98
54.5-55.0	30	166	148
55.5-56.0	104	276	124
56.5-57.0	46	248	318
57.5-58.0	23	281	69
58.5-59.0	29	303	65
59.5-60.0	130	254	33
60.5-61.0	72	304	106
61.5-62.0	105	243	138
62.5-63.0	44	199	68
63.5-64.0	70	249	35
64.5-65.0	5	245	18
65.5-66.0	17	344	100
66.5-67.0	165	207	61
67.5-68.0	112	318	79
68.5-69.0	108	318	88
69.5-70.0	141	306	52
70.5-71.0	164	275	114
71.5-72.0	203	220	107
72.5-73.0	151	286	57
73.5-74.0	140	293	118
74.5-75.0	131	251	156
75.5-76.0	90	225	32
76.5-77.0	3	311	41
77.5-78.0	57	294	15
78.5-79.0	45	316	14
79.5-80.0	19	345	19
80.5-81.0	64	265	28
81.5-82.0	33	150	19
82.5-83.0	27	212	15
83.5-84.0	22	262	13
84.5-85.0	86	284	31
85.5-86.0	62	375	30
86.5-87.0	64	275	42
87.5-88.0	29	337	25
88.5-89.0	71	182	54
89.5-90.0	90	259	46
90.5-91.0	126	268	32
91.5-92.0	144	235	116
92.5-93.0	96	234	195
93.5-94.0	152	332	133
94.5-95.0	118	382	280
95.5-96.0	86	409	157
96.5-97.0	83	260	213
97.5-98.0	116	301	137

98.5-99.0m.	102	301	145
99.5-100.0	57	424	132
100.5-101.0	133	292	191
101.5-102.0	45	292	114
102.5-103.0	62	362	171
103.5-104.0	122	417	188
104.5-105.0	44	325	247
105.5-106.0	86	362	225
106.5-107.0	51	350	197
107.5-108.0	16	320	162
108.5-109.0	80	416	170
109.5-110.0	18	262	140
110.5-111.0	83	288	95
111.5-112.0	67	261	178
112.5-113.0	98	320	276
113.5-114.0	110	380	313
114.0-114.5			254
114.5-116.0	119	281	187
116.0-116.5			170
116.5-117.0	119	407	91
117.0-117.5			83
117.5-118.0	50	304	129
118.0-118.5			57
118.5-119.0	80	443	197
119.0-119.5			194
119.5-120.0	80	436	148
120.0-120.5			126
120.5-121.0	67	279	186
121.0-121.5			120
121.5-122.0	140	462	77
122.0-122.5			
122.5-123.0	60	455	65
123.0-123.5			60
123.5-124.0	140	191	38
124.0-124.5			46
124.5-125.0	94	221	63
125.0-125.5			
125.5-126.0	26	287	19
126.0-126.5			21
126.5-127.0	136	275	63
127.0-127.5			59
127.5-128.0	14	356	33
128.5-129.0			71
129.5-130.0	93	259	29
130.5-131.0			103
131.5-132.0	20	317	12
132.0-132.5			15
132.5-133.0	5	255	19
133.0-133.5			35
133.5-134.0	14	245	26
134.0-134.5			21
134.5-135.0	43	279	67
135.0-135.5			71
135.5-136.0	3	215	83
136.0-136.5			101
136.5-137.0	5	273	98
137.0-137.5			274
137.5-138.0	3	204	267
138.0-138.5			103
138.5-139.0		241	115

139.0-139.5			91
139.5-140.0		386	140
140.0-140.5			155
140.5-141.0	48	322	134
141.0-141.5			104
141.5-142.0	9	325	123
142.0-142.5			95
142.5-143.0		292	72
143.0-143.5			51
143.5-144.0		410	65
144.0-144.5			40
144.5-145.0		224	76
145.0-145.5			59
145.5-146.0		287	62
146.0-146.5			69
146.5-147.0		268	35
147.0-147.5			5
147.5-148.0		231	13
148.5-149.0		98	6
148.5-149.0		30	
149.0-149.5		127	
149.5-150.0		31	
150.0-150.5			
150.5-151.0			

FOLKESTONE

IIA

37.0ft.	40	263	208
39.0	100	134	220
41.0	117	287	186
43.0	165	202	277
45.0	134	147	197
49.0	104	237	265
67.0	67	94	71

East Wear Bay

1	28	46	57
2	87	35	180
3	60	145	187
4	17	93	124
5	50	123	159
6	50	98	156
7	63	123	194
11	45	107	15
9	59	78	85
8	25	74	65
10	29	36	77

Copt Point

C.P.8	27	54	133
C.P.7	50	185	129
13/8/9	76	230	141
C.P.6	34	86	45

C.P.5	3	141	129
C.P.4	9	144	215
G.5	N/A	486	188
C.P.3	3	144	229
C.P.2	10	169	146
13/8/10	48	273	188
C.P.1	36	156	201
G.4	N/A	441	204
G.3	N/A	235	222
13/8/11	29	182	216
G.1	N/A	223	194
13/8/12	23	133	99
G.2	N/A	222	217
13/8/13	72	194	112
13/8/14	96	200	49
G.6	N/A	425	82
G.7	N/A	440	124
G.8	N/A	315	115
13/8/15	84	175	54
13/8/16	109	173	53
13/8/17	19	260	92
13/8/18	76	306	69
13/8/19	194	275	86
13/8/20	97	201	64
13/8/21	35	147	26
13/8/22	58	190	81
13/8/27	4	179	18
13/8/28	37	214	91
13/77		126	36
14			
15			
16			

SEVENOAKS

M.25 3/1

9ft.	0ins.	25	256	301
10	6	12	159	282
13	6	79	185	259
16	6	40	248	140
21	0	43	179	42
24	6	2	152	67
27	0		114	68
30	0		123	98
32	0		155	93
36	6		157	107
40	0	3	151	2
42	0		142	1
44	6		162	96
48	0	1	87	185
52	6		209	152
56	0		219	98
60	6		217	152
66	0		99	98
74	0		18	113

M.25 1967/1

7ft.	6ins.			
12	0		204	21
15	0		126	7
16	6		102	18
21	0		220	
24	0	59	207	
27	0	34	205	115
31	0	4	251	86
33	0	27	216	87
38	0	25	123	91
42	0		126	74
46	0		278	38
48	0		205	150
52	6	103	164	45
64	0	8	122	93
66	0		185	176
68	6		168	91
72	0	1	323	49
76	6	18	306	87
80	0	1		46
84	0		295	166
86	0		232	141
90	0	1		126
94	0	10		140
98	0	9	305	125
104	0		284	107
108	6	96		93
111	0	11	168	184
114	0	18	164	193
116	6	116	189	216
121	3	33	193	219
123	0		166	131
126	6		85	63
128	6		145	55
131	6	41	239	59
136	6		174	125
138	6		105	79
141	6		114	67
144	6		158	30

M.25 113/2

13	6	3	198	174
21	6	52	176	71
23	0	39	197	19
27	0	78	210	128
29	6	36	93	172
31	0	70	112	173
35	6	72	172	178
39	0	53	173	117
42	0	25	280	153
46	0	4	267	173
50	0			141
54	0	10	264	210
60	6	1	339	223
62	0		252	170

92ft.	6ins.	6	226	220
98	0	54	302	48
102	0	32	187	103
108	6		152	69
112	0	1	232	85
114	0	14	140	73

M.25 16/3

9	6		105	
11	0	158	169	110
12	6	137	231	167
14	0	401	130	120
17	0	48	160	160
18	6	197	255	203
20	0	168	243	116
21	6	136	233	138
24	6		352	181
26	0		304	230
29	0	94	126	144
33	0	131	327	247
35	0	119	291	242
37	0	100	243	135
41	0	65	340	152
43	6	131	236	159
49	0	102	210	83
51	6	83	215	231
53	0	93	283	247
57	0	41	183	114
59	6	132	168	106
65	0	145	121	55
69	0		164	
73	0		164	
75	6		194	
81	0		160	
83	6		18	179
90	0	71	45	46

WISSANT

W 12	5	216	66
W 9	8	185	142
W 14	64	317	306
W 8	66	375	315
W 10	23	255	292
W 15	37	290	314
W 11	1	313	223
W 16	19	88	161
W 10	23	255	292
W 17	31	191	367
W 7	31	331	316
W 5	163	179	223
W 6	28	255	228
W 4	111	309	130
W 3		214	
W 2			
W 1			

CAUVILLE		
5	111	27
6	95	57
7	161	89
8	127	141
9	64	
10	93	9
11		
12	31	
13	86	9
4		
3		
2		
1		
COMPTON BAY		
C.B. 1	32	
C.B. 2	72	
C.B. 3	91	
C.B.10	99	7
C.B.11	42	
C.B.12		
C.B.13	17	
C.B.14	31	1
C.B.15	106	
C.B.16	92	5
C.B.17	117	24
C.B.18	60	
C.B.19	9	
C.B.37	61	
C.B.38	26	
C.B.39	32	
C.B.40	24	
C.B.41	34	
C.B.42		
C.B.43		
SEATON BAY		
6	48	143
5	70	219
4	20	
7	17	
3	1	1
2	7	1
1	21	
COURCELLES		
Upper	181	186
Lower	298	105
BOIS DE PERCHOIS		
1	320	164

VILLEMOYENNE

1		260	97

SPEETON

1	90	142	175
2	170	271	180
3	100	172	179
4	50	131	193
5	164	88	191
6	50	151	77
7	64	117	41
8	35	141	117
9	34	75	43

MELTON

1	114	211	61
2	40	174	155
3	112	133	76

HUNSTANTON

1	64	36	27
2	17	60	1
3		47	
4		66	27
5		94	40
6		78	23

49/19-1

2970ft.	10	43	
2980	25	34	
2990	120	81	22
3000	100	58	12
3010	440	69	5
3020	120	131	34
3030	227	138	13
3040	281	130	16
3050	164	102	15
3060	157	88	13
3070	191	143	57
3090	192	120	17
3100	253	169	39
3110	333	153	24
3120	183	128	9
3140	300	217	21
3150	150	92	
3160	213	141	16
3170	124	107	7
3180	142	180	4
3190	102	89	13
3200	71	126	
3210	85	109	
3230	120	161	
3240	218	129	10
3250	147	161	9
3310	176	85	11

3340ft.	42	175	6
3350	83	159	16
49/24-1			
4280	93	76	20
4280	170	40	
4300	105	71	2
4310	96	136	2
4320	110	71	
4350	75	45	
4370	52	67	
4400	15	76	6
4430	16	36	
4460	24	104	4
VÖHRUM			
S5		211	11
S4		221	3
S3		174	16
ALTWARMBÜCHEN			
S2			
S1		309	3

PLATE 1

Fig. 1. Patellina sp. A.;umbilical view (x136); number 75 ; Shell/Esso 49/19-1 3340'.

Fig. 2. Ammodiscus cretaceus (Reuss); umbilical view (x95); number 1 ; Shell/Esso 49/24-1 4290'.

Fig. 3. Glomospira gaultina (Berthelin); umbilical view (x89); number 3 ; Glyndebourne 148-148.5 m.

Fig. 4. Nodobacularia nodulosa (Chapman) ; side view (x84); number 55 ; Folkestone 13/8/22.

Fig. 5. Quinqueloculina antiqua (Franke) ; side view (x165); number 56 ; Glyndebourne 51.5-52 m.

Fig. 6. Ammodiscus cretaceus (Reuss) ; umbilical view (x77);deformed; number 2 ; Lower Albian, Germany.

Fig. 7. Glomospira gaultina(Berthelin); umbilical view (x130); deformed ; number 4 ; Lower Albian, Germany.

Fig. 8. Quinqueloculina antiqua (Franke) ; side view (x87); number 57 ; East Wear Bay 2.

Fig. 9. Quinqueloculina antiqua (Franke) ; side view (x87) ; number 58 ; Glyndebourne 110.5-111m.

Fig. 10. Spiroloculina papyracea Burrows, Sherborn & Bailey ; umbilical view (x68) ; number 59 ; Glyndebourne 49-49.5 m.

Fig. 11. Spiroloculina papyracea Burrows, Sherborn & Bailey ; umbilical view (x103) ; number 60 ; Glyndebourne 49-49.5m.

Fig. 12. Conorboides lamplughi (Sherlock) ; umbilical view (x141) ; number 130 ; Lower Albian, Germany.

Fig. 13. Conorboides lamplughi (Sherlock) ; spiral view (x148) ; number 131 ; Lower Albian, Germany.

Fig. 14. Spiroloculina papyracea Burrows, Sherborn & Bailey ; side view (x102); number 61 ; Glyndebourne 49-49.5 m.

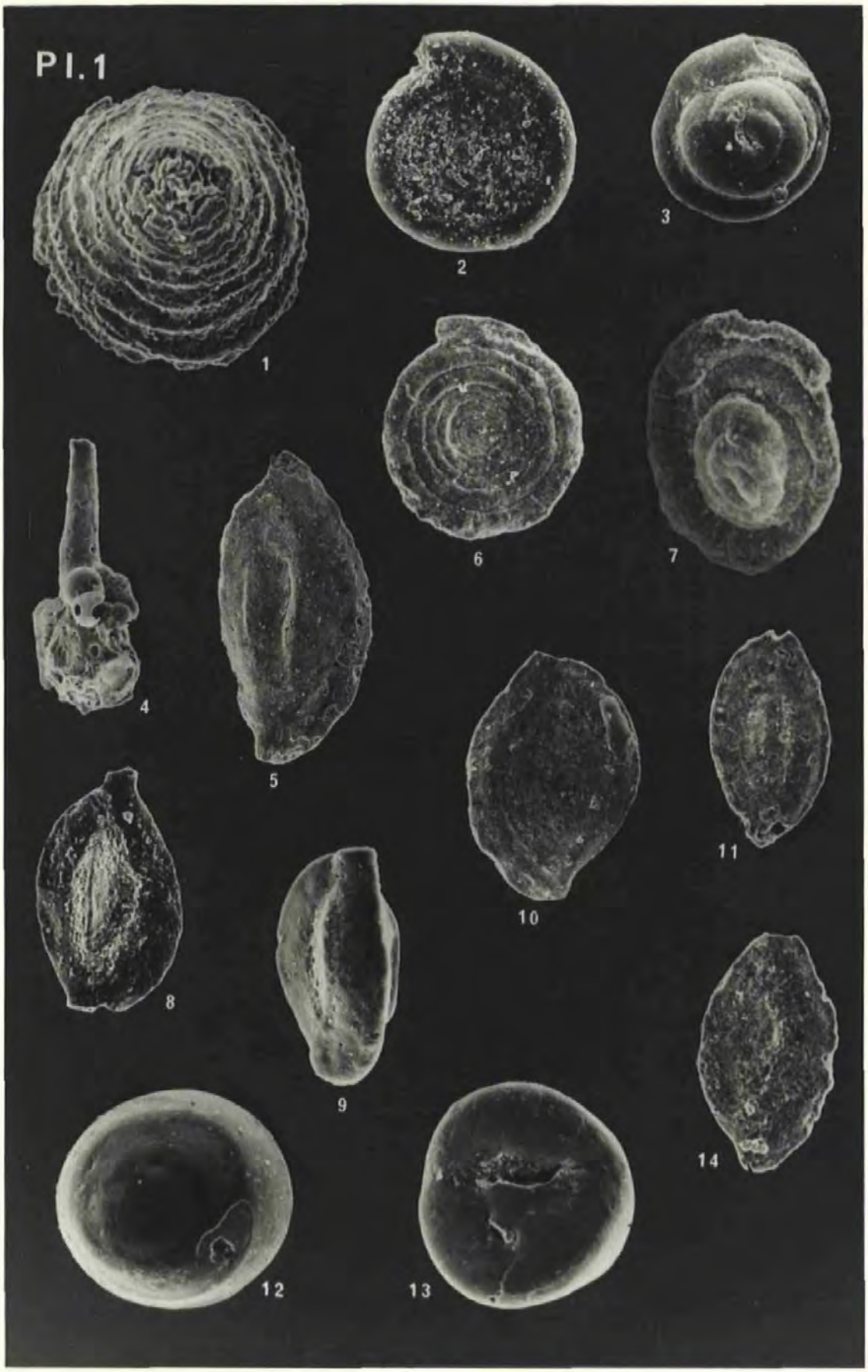

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PLATE 2

Fig. 1. Reophax minutus Tappan ; side view (x59) ; number 5 ; Shell/Esso 49/19-1 , 3340'.

Fig. 2. Textularia minuta Berthelin ; side view (x91) ; number 12 ; Villemoyenne, lowest.

Fig. 3. Gaudryina filiformis Berthelin ; side view (x90) ; number 21 ; Glyndebourne 146.5-147 m.

Fig. 4. Gaudryina filiformis Berthelin ; side view (x95) ; number 20 ; Glyndebourne 146.5-147 m.

Fig. 5. Textularia chapmani Lalicker ; apertural view (x143) ; number 11a ; Glyndebourne 112.5-113 m.

Fig. 6. Textularia chapmani Lalicker ; side view (x98) ; number 11a ; Glyndebourne 112.5-113 m.

Fig. 7. Textularia chapmani Lalicker ; side view (x87) ; number 11b ; Borehole 16/3, 41'0".

Fig. 8. Haplophragmoides chapmani Morozova ; umbilical view (x66) ; number 7a ; Glyndebourne 148-148.5 m.

Fig. 9. Haplophragmoides chapmani Morozova ; umbilical/apertural view (x67) ; number 7b ; Glyndebourne 148-148.5.

Fig. 10. Eggerellina mariae Ten Dam ; side view (x111) ; number 53 ; East Wear Bay 6.

Fig. 11. Haplophragmoides chapmani Morozova ; number 8a ; apertural view (x91) ; Glyndebourne 148-148.5 m.

Fig. 12. Eggerellina mariae Ten Dam ; side view (x85) ; number 52 ; East Wear Bay 6.

Fig. 13. Belorussiella textilarioides (Reuss) ; side view (x93) ; number 15 ; Glyndebourne 138.5-139 m.

Fig. 14. Haplophragmoides chapmani Morozova ; side view (x112) ; number 8b ; Glyndebourne 148-148.5 m.

Fig. 15. Uvigerammina alta Magniez-Jannin ; side view (x95) ; number 27 ; Glyndebourne 93.5-94 m.

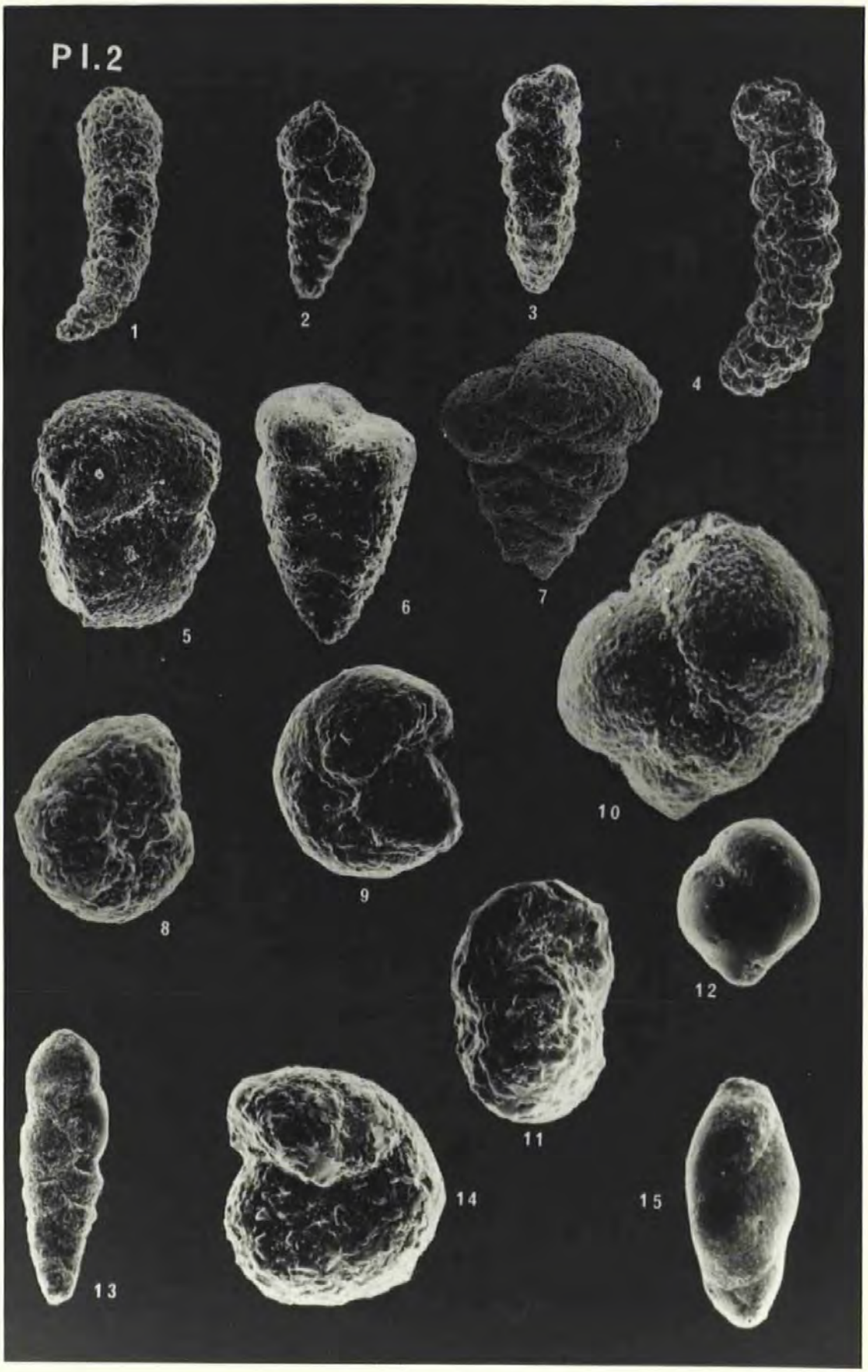
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PLATE 3

Fig. 1. Haplophragmoides nonioninoides (Reuss) ; side view (x61) ; number 9 ; Glyndebourne 61.5-62 m.

Fig. 2. Tritaxia pyramidata Reuss ; side view (x68) ; number 26b ; Glyndebourne 148-148.5 m.

Fig. 3. Tritaxia pyramidata Reuss ; side view (x38) ; number 25 ; Glyndebourne 51.5-52 m.

Fig. 4. Dorothia trochus (d'Orbigny) ; side view (x77) ; number 51 ; Glyndebourne 102.5-103 m.

Fig. 5. Pseudotextulariella cretosa (Cushman) ; side view (x56) ; number 54; Hunstanton 5.

Fig. 6. Dorothia ozawai (Cushman) ; side view (x56) ; number 50 ; Borehole 16/3, 14'0".

Fig. 7. Textularia sp. A. sp.nov. ; side view (x69) ; number 13 ; Lower Albian, Germany.

Fig. 8. Textularia sp. A. sp.nov. ; side view (x59) ; deformed ; number 14 ; Lower Albian, Germany.

Fig. 9. Gaudryina gradata Berthelin ; side view (x91) ; number 18 ; Glyndebourne 140.5-144 m.

Fig. 10. Tritaxia pyramidata Reuss ; side view (x26) ; number 26a ; Glyndebourne 74.5-75 m.

Fig. 11. Spiroplectinata annectens (Parker & Jones) ; side view (x31); number 23 ; Glyndebourne 116-116.5 m.

Fig. 12. Spiroplectinata annectens (Parker & Jones) ; side view (x45) ; number 24 ; Glyndebourne 116-116.5 m.

Fig. 13. Sprioplectinata annectens (Parker & Jones) ; side view (x40) ; number 22 ; Glyndebourne 116-116.5 m.

Fig. 14. Textularia anceps Reuss ; side view (x98) ; number 10 ; Glyndebourne 55.5-56 m.

Fig. 15. Gaudryina gradata Berthelin ; side view (x104) ; number 19: Glyndebourne 55.5-56 m.

Fig. 16. Cribratina cylindracea (Chapman) ; side view (x22) ; number 6 ; East Wear Bay 3.


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PLATE 4

Fig. 1. Arenobulimina macfadyeni Cushman ; side view (x47) ; number 28a ; Melton 3.

Fig. 2. Arenobulimina macfadyeni Cushman ; side view (x82) ; number 29 ; Glyndebourne 126.5-127 m.

Fig. 3. Arenobulimina macfadyeni Cushman ; side view (x65) ; number 30 ; Glyndebourne 126.5-127 m.

Fig. 4. Arenobulimina chapmani Cushman ; side view (x83) ; number 39 ; Glyndebourne 105.5-106 m.

Fig. 5. Arenobulimina chapmani Cushman ; side view (x86) ; number 40 ; Glyndebourne 105.5-106 m.

Fig. 6. Arenobulimina chapmani Cushman ; side view (x64) ; number 41 ; Glyndebourne 75.5-76 m.

Fig. 7. Arenobulimina chapmani Cushman ; side view (x42) ; number 42 ; Glyndebourne 58.5-59 m.

Fig. 8. Arenobulimina chapmani Cushman ; side view (x43) ; number 43 ; Glyndebourne 58.5-59 m.

Fig. 9. Arenobulimina chapmani Cushman ; inclined apertural view (x65) ; number 44 ; Glyndebourne 105.5-106 m.

Fig. 10. Arenobulimina advena (Cushman) ; side view (x98) ; number 46 ; East Wear Bay 5.

Fig. 11. Arenobulimina.sp.cf.A. anglica Cushman ; side view (x72) ; number 45 ; East West Bay 6 (not included in text).

Fig. 12. Arenobulimina chapmani Cushman ; side view (x68) ; number 44 ; Glyndebourne 105.5-106 m.

Fig. 13. Arenobulimina advena (Cushman) ; side view (x65) ; number 36 ; East Wear Bay 3.

Fig. 14. Arenobulimina sp.A. side view (x42) ; number 35 ; East Wear Bay 6 (not included in text).

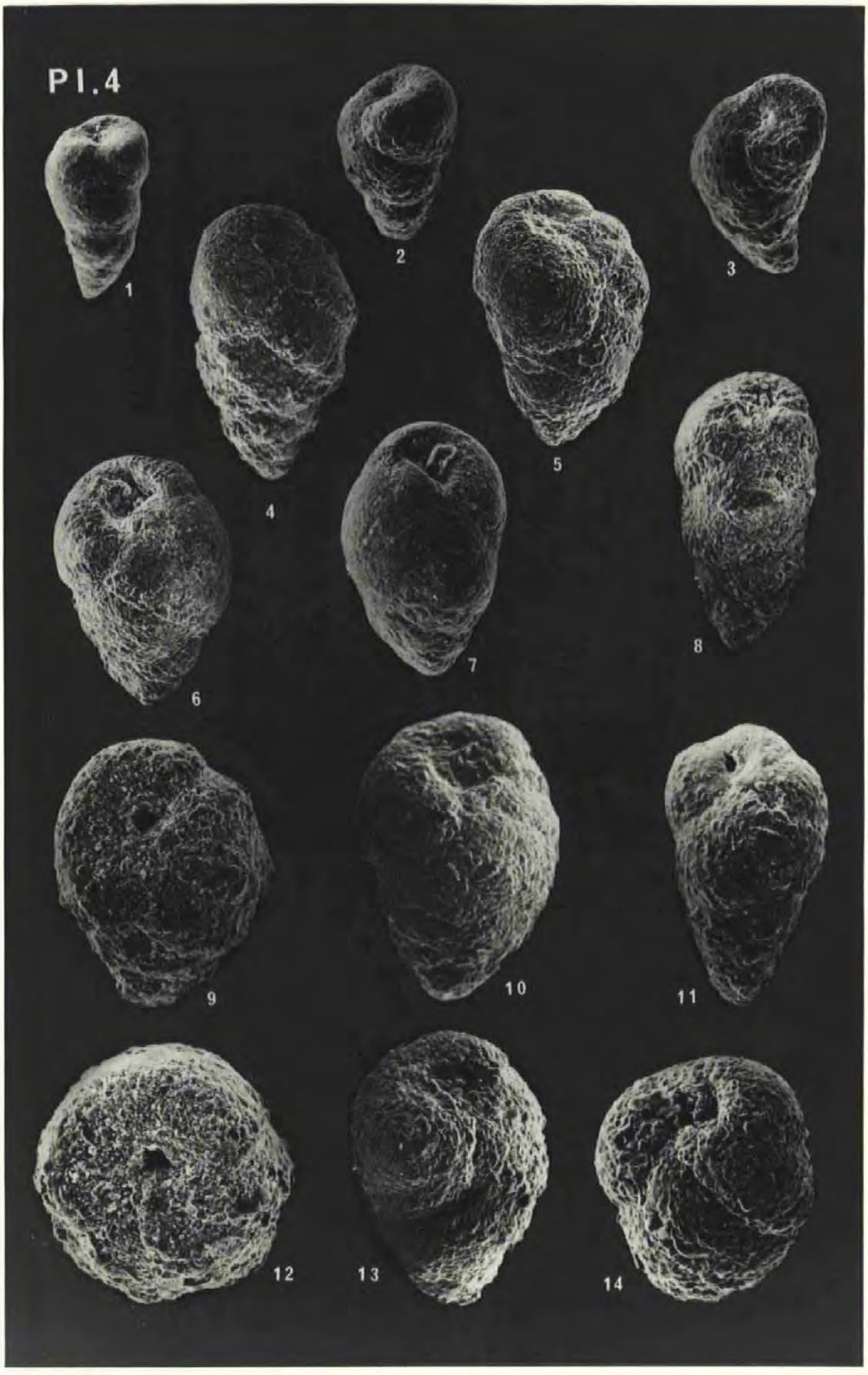
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PLATE 5

Fig. 1. Flourensina intermedia Ten Dam ; side view (x40) ; number 16 ; East Wear Bay 3.

Fig. 2. Arenobulimina sp.cf.A.frankei Cushman ; side view (x41) ; number 37 ; Glyndebourne 65.5-66 m.

Fig. 3. Arenobulimina sp.cf.A.frankei Cushman ; side view (x47) ; number 38a ; Glyndebourne 65.5-66 m.

Fig. 4. Arenobulimina sp.cf.A.frankei Cushman ; side view (x47) ; number 38b ; Glyndebourne 65.5-66 m.

Fig. 5. Flourensina intermedia Ten Dam ; side view (x39) ; number 16 ; East Wear Bay 3.

Fig. 6. Flourensina intermedia Ten Dam ; side view (x49) ; number 176 ; East Wear Bay 3.

Fig. 7. Flourensina intermedia Ten Dam ; side view (x47) ; number 17a ; East Wear Bay 4.

Fig. 8. Arenobulimina frankei Cushman ; side view (x60) ; number 36a ; Speeton 3.

Fig. 9. Arenobulimina sabulosa (Chapman) ; umbilical view (x43) ; number 32 ; Glydebourne 60.5-61 m.

Fig. 10. Arenobulimina sabulosa (Chapman) ; side view (x55) ; number 32 ; Glyndebourne 60.5-61 m.

Fig. 11. Arenobulimina sabulosa (Chapman) ; side view (x63) ; number 33 ; Glyndebourne 60.5-61 m.

Fig. 12. Arenobulimina sp.cf.A.truncata (Reuss) ; side view (x63) ; number 49 ; Copt Point 3.

Fig. 13. Lingulogavelinella albiensis Malapris ; umbilical view (x130) ; number 125 ; Wissant 11.

Fig. 14. Lingulogavelinella albiensis Malapris ; umbilical view (x133) ; number 126 ; Wissant 11.

Fig. 15. Lingulogavelinella albiensis Malapris ; spiral view (x130) ; number 125 ; Wissant 11.

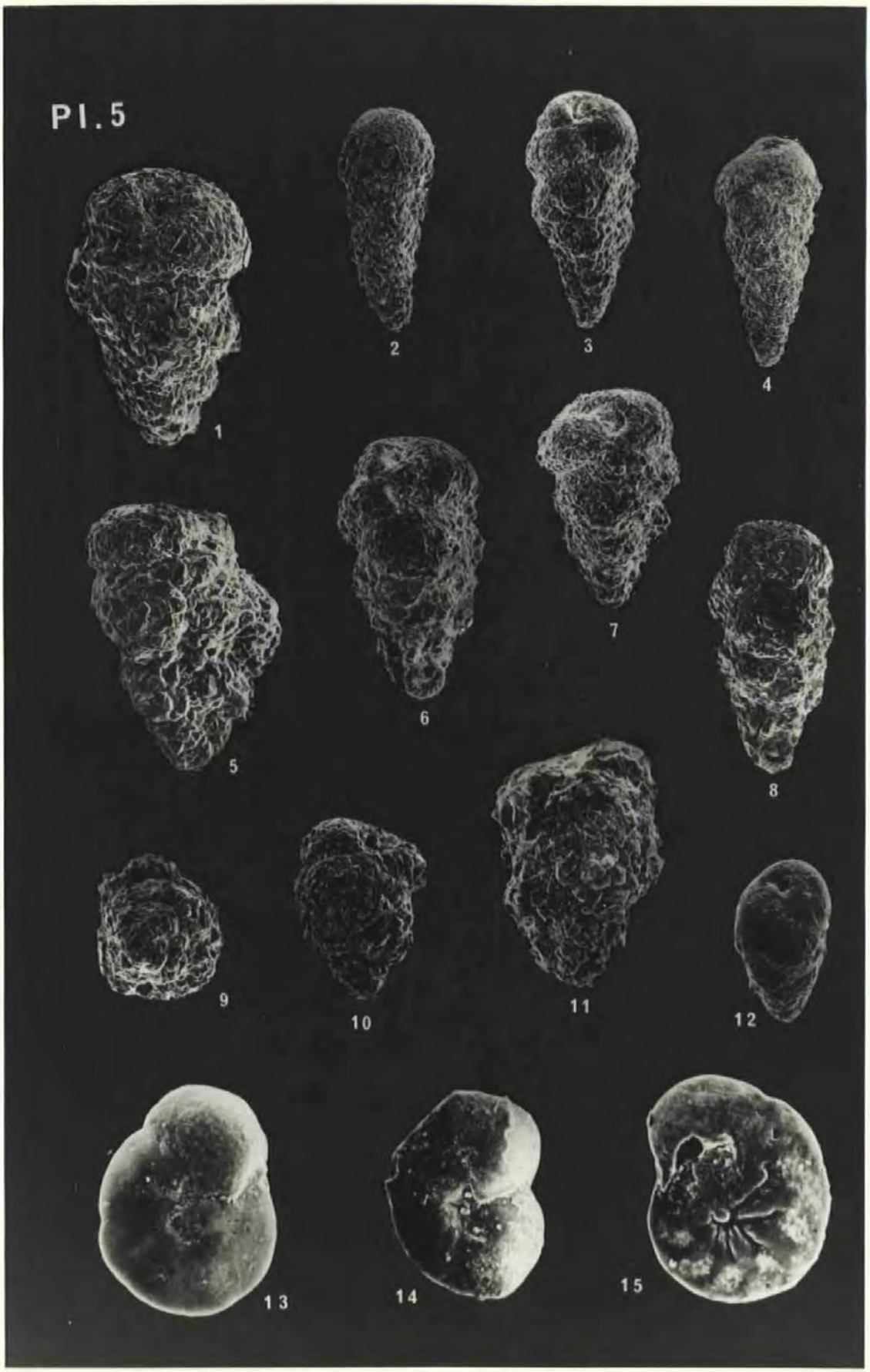
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PLATE 6

Fig. 1. Frondicularia filocinta Reuss ; side view (x17) ; number 64 ; Glyndebourne 61.5-62 m.

Fig. 2. Vaginulina ex.gr. V.Kochii Roemer ; side view (x46) ; number 65 ; Glyndebourne 63.5-64 m.

Fig. 3. Vaginulina robusta (Berthelin) ; side view (x39) ; number 67 ; Glyndebourne 63.5-64 m.

Fig. 4. Citharinella pinnaeformis (Chapman) ; side view (x19) ; number 61a; Glyndebourne 100.5-101 m.

Fig. 5. Citharinella laffitei Marie ; side view (x21) ; number 62 ; Borehole 16/3, 51'6".

Fig. 6. Vaginulina mediocarinata Ten Dam ; side view (x33) ; number 68 ; Glyndebourne 67.5-68 m.

Fig. 7. Vaginulina ex. gr. V.Kochii Roemer ; side view (x25) ; number 66 ; Glyndebourne 60.5-61 m.

Fig. 8. Ramulina sp. A. side view (x180) ; number 45 : Glyndebourne 62.5-63 m.

Fig. 9. Citharina d'Orbignyi Marie ; side view (x18); number 63 ; Glyndebourne 140.5-141 m.

Fig. 10. Planularia ex.gr.P.complanata (Reuss) ; side view (x49) ; number 71 ; Glyndebourne 59.5-60 m.

Fig. 11. Siphogenerina asperula (Chapman) ; side view (x85) : number 69 ; Glyndebourne 131.5-132 m.

Fig. 12. Pleurostomella reussi Berthelin ; side view (x86) ; number 115 ; Glyndebourne 91.5-92 m.

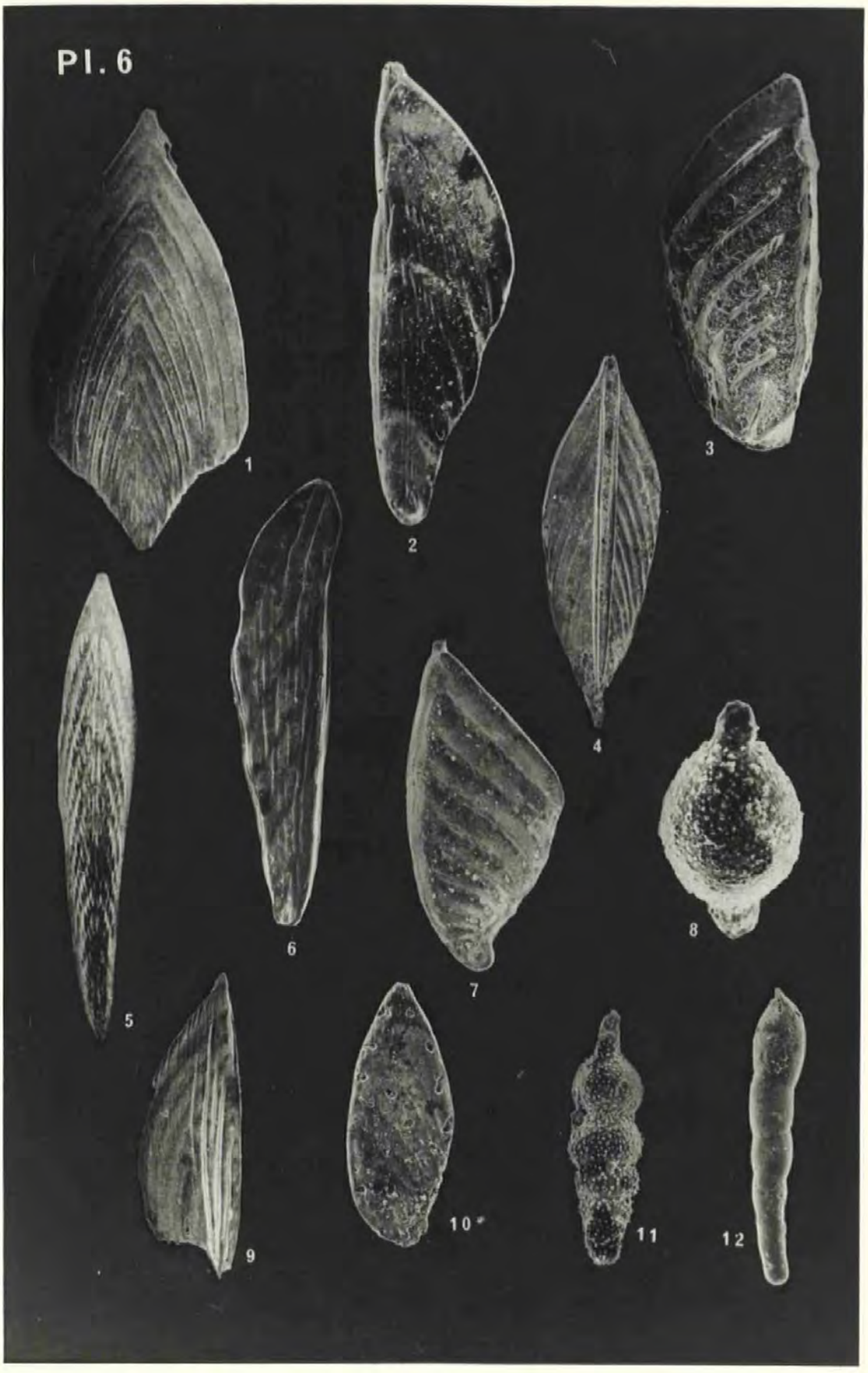
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PLATE 7

Fig. 1. Globigerinelloides bentonensis (Morrow) ; umbilical view (x173) ; number 81 ; Glyndebourne 54.5-55 m.

Fig. 2. Globigerinelloides bentonensis (Morrow) ; spiral view (x142) ; number 82 ; Glyndebourne 54.5-55 m.

Fig. 3. Heterohelix moremani (Cushman) ; side view (x143) ; number 76 ; Glyndebourne 59.5-60 m.

Fig. 4. Globigerinelloides bentonensis (Morrow) ; apertural view (x155) ; number 83 ; Glyndebourne 54.5-55 m.

Fig. 5. Heterohelix moremani (Cushman) ; apertural view (x199) ; number 76 ; Glyndebourne 59.5-60 m.

Fig. 6. Heterohelix moremani (Cushman) ; side view (x150) ; number 77 ; Glyndebourne 59.5-60 m.

Fig. 7. Guembilitria harrisi Tappan ; apertural view (x271) ; number 79 ; Glyndebourne 54.5-55 m.

Fig. 8. Guembilitria harrisi Tappan ; side view (x267) ; number 80 ; Glyndebourne 54.5-55 m.

Fig. 9. Favusella washitensis (Carsey) ; umbilical view (x161) ; number 84 ; Glyndebourne 121.5-122 m.

Fig. 10. Heterohelix moremani (Cushman) ; side view (x191) ; number 78 ; Glyndebourne 59.5-60 m.

Fig. 11. Favusella washitensis (Carsey) ; umbilical view (x130) ; number 85 ; Glyndebourne 104.5-105 m.

Fig. 12. Favusella washitensis (Carsey) ; umbilical view (x121) ; number 86 ; Glyndebourne 104.5-105 m.

Fig. 13. Favusella washitensis (Carsey) ; spiral view (x129) ; number 87 ; Glyndebourne 104.5-105 m.

Fig. 14. Favusella washitensis (Carsey) ; umbilical view (x122) ; number 88 ; Glyndebourne 121.5-122 m.

Fig. 15. Favusella washitensis (Carsey) ; umbilical view (x122) ; number 89 ; Glyndebourne 104.5-105 m.

Fig. 16. Favusella washitensis (Carsey) ; side view (x102) ; number 90 ; Glyndebourne 104.5-105 m.

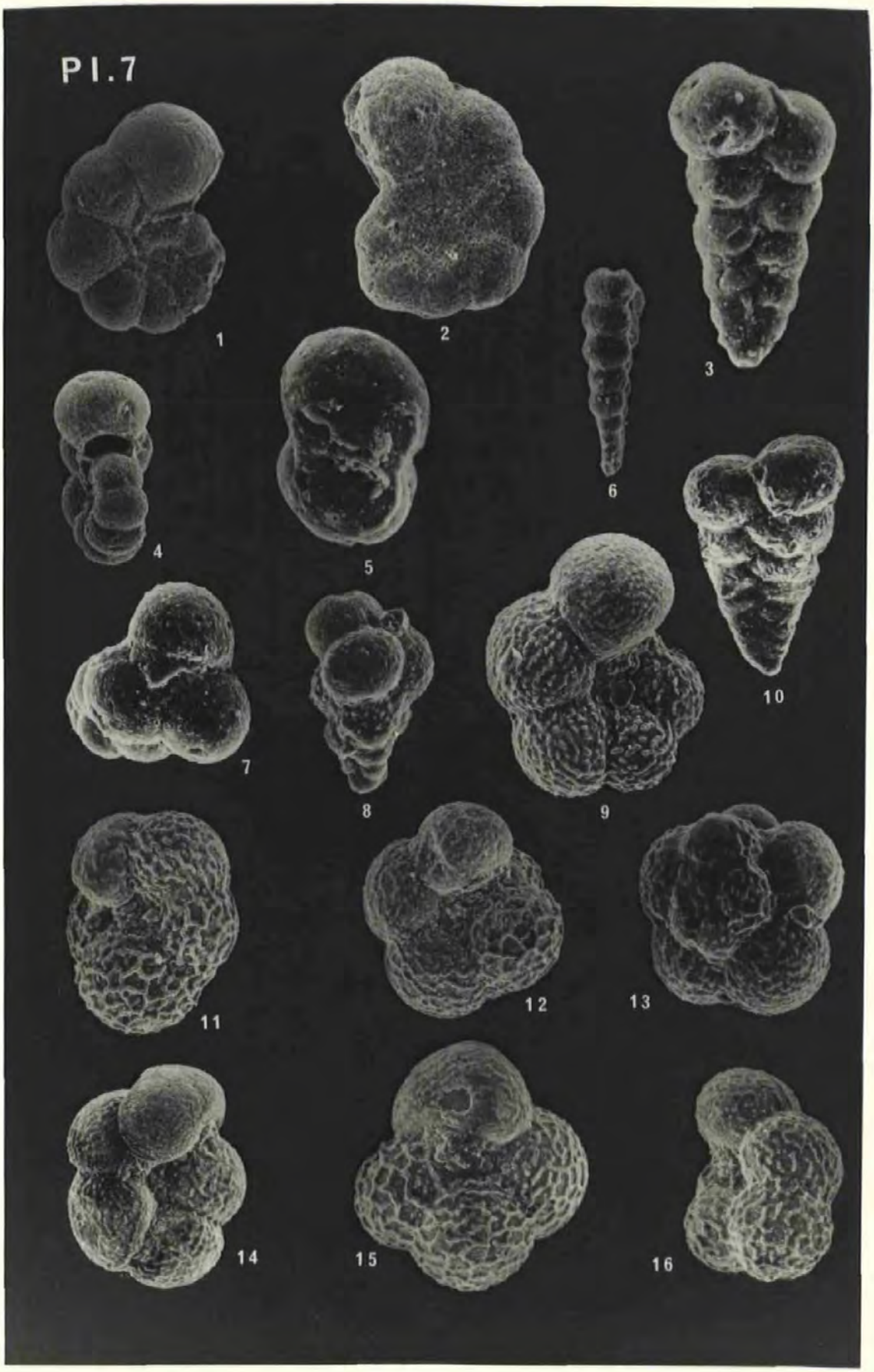
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PLATE 8

Fig. 1. Hedbergella planispira (Tappan) ; apertural view (x186) ; number 92 ; Glyndebourne 130.5-131 m.

Fig. 2. Hedbergella planispira (Tappan) ; spiral view (x196) ; number 93 ; Glyndebourne 121.5-122 m.

Fig. 3. Hedbergella planispira (Tappan) ; umbilical view (x192) ; number 94 ; Glyndebourne 121.5-122 m.

Fig. 4. Hedbergella planispira (Tappan) ; umbilical view (x200) ; number 95 ; Glyndebourne 90.5-91 m.

Fig. 5. Hedbergella delrionensis (Carsey) ; umbilical view (x190) ; number 96 ; Glyndebourne 134.5-135 m.

Fig. 6. Hedbergella delrionensis (Carsey) ; umbilical view (x189) ; number 97 ; Glyndebourne 106.5-107 m.

Fig. 7. Hedbergella delrionensis (Carsey) ; umbilical view (x178) ; number 98 ; Glyndebourne 108.5-109 m.

Fig. 8. Hedbergella delrionensis (Carsey) ; umbilical view (x150) ; number 99 ; Glyndebourne 121.5-122 m.

Fig. 9. Hedbergella delrionensis (Carsey) ; umbilical view (x173) ; number 100 ; Glyndebourne 120.5-121 m.

Fig. 10. Hedbergella delrionensis (Carsey) ; spiral view (x169) ; number 101 ; Glyndebourne 114.5-115 m.

Fig. 11. Hedbergella delrionensis (Carsey) ; spiral view (x181) ; number 102 ; Glyndebourne 110.5-111 m.

Fig. 12. Hedbergella delrionensis (Carsey) ; umbilical view (x179) ; number 103 ; Glyndebourne 114.5-115 m.

Fig. 13. Hedbergella delrionensis (Carsey) ; umbilical view (x212) ; number 104 ; Glyndebourne 109.5-110 m.

Fig. 14. Hedbergella delrionensis (Carsey) ; umbilical view (x173) ; number 105 ; Glyndebourne 134.5-135 m.

Fig. 15. Hedbergella delrionensis (Carsey) ; spiral view (x173) ; number 106 ; Glyndebourne 112.5-113 m.

Fig. 16. Hedbergella delrionensis (Carsey) ; umbilical view (x140) ; number 107 ; Glyndebourne 125.5-126 m.

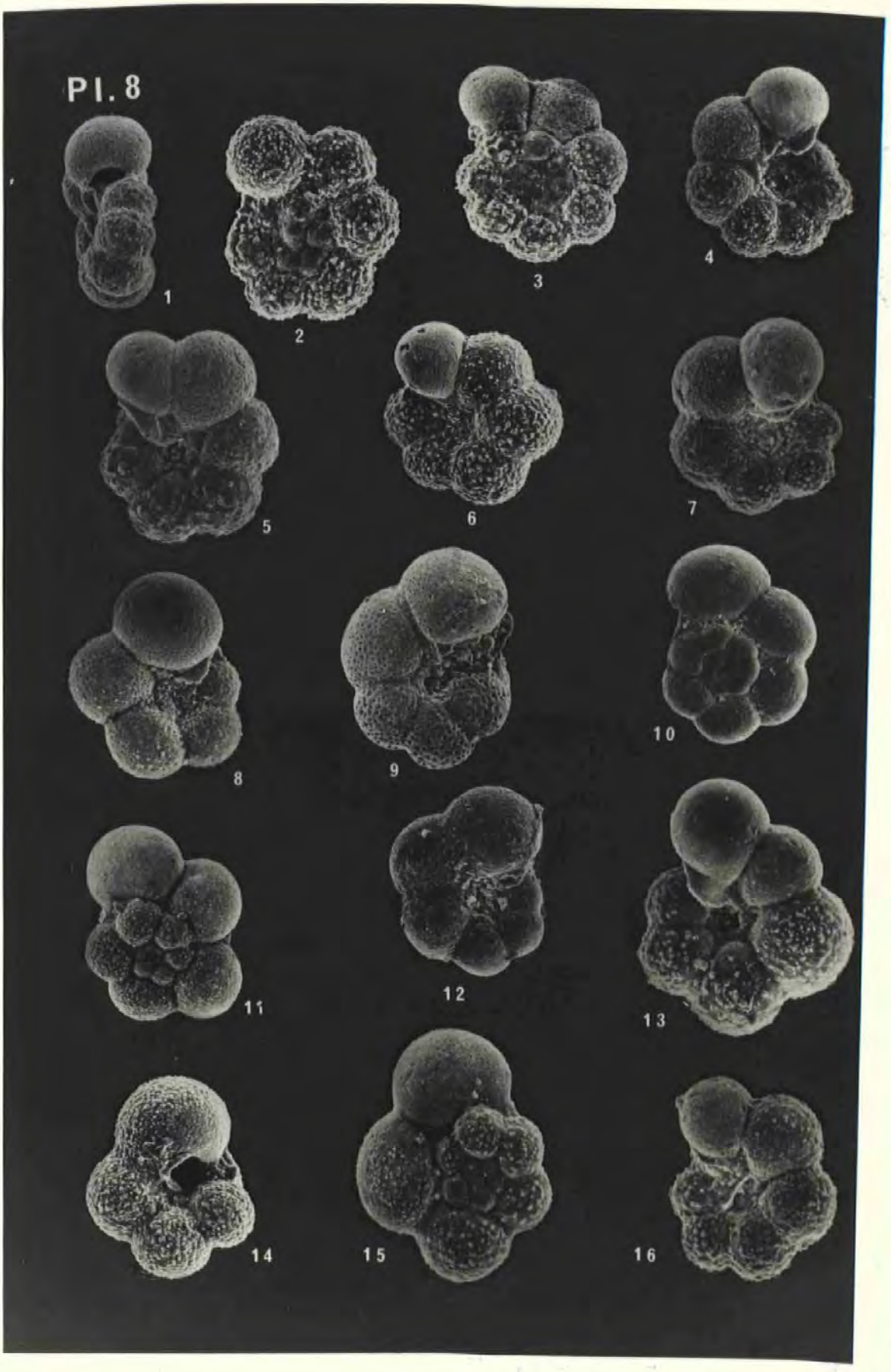
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PLATE 9

Fig. 1. Hedbergella delrionensis (Carsey) ; umbilical view, final two chambers (x660) ; number 110 ; Glyndebourne 68.5-69 m.

Fig. 2. Hedbergella delrionensis (Carsey) ; umbilical view with a broken apertural flap (x797) ; number 109 ; Glyndebourne 72.5-73 m.

Fig. 3. Hedbergella delrionensis (Carsey) ; umbilical view with a broken apertural flap (x660) ; number 108 ; Glyndebourne 72.5-73 m.

Fig. 4. Hedbergella delrionensis (Carsey) ; penultimate chamber (x729) ; number 112 ; Borehole 16/3, 17'0".

Fig. 5. Hedbergella delrionensis (Carsey) ; umbilical view (x108) ; number 108 ; Glyndebourne 72.5-73 m.

Fig. 6. Hedbergella delrionensis (Carsey) ; umbilical view (x111) ; number 109 ; Glyndebourne 72.5-73 m.

Fig. 7. Hedbergella delrionensis (Carsey) ; spiral view (x116) ; number 110 ; Glyndebourne 68.5-69 m.

Fig. 8. Hedbergella delrionensis (Carsey) ; umbilical view (x106) ; number 111 ; Glyndebourne 68.5-69 m.

Fig. 9. Hedbergella delrionensis (Carsey) ; umbilical view (x106) ; number 112 ; Borehole 16/3, 17'0".

Fig. 10. Hedbergella delrionensis (Carsey) ; umbilical view (x93) ; number 113 ; Borehole 16/3, 17'0".

Fig. 11. Hedbergella delrionensis (Carsey) ; umbilical view (x91) ; number 114 ; Speeton 2.

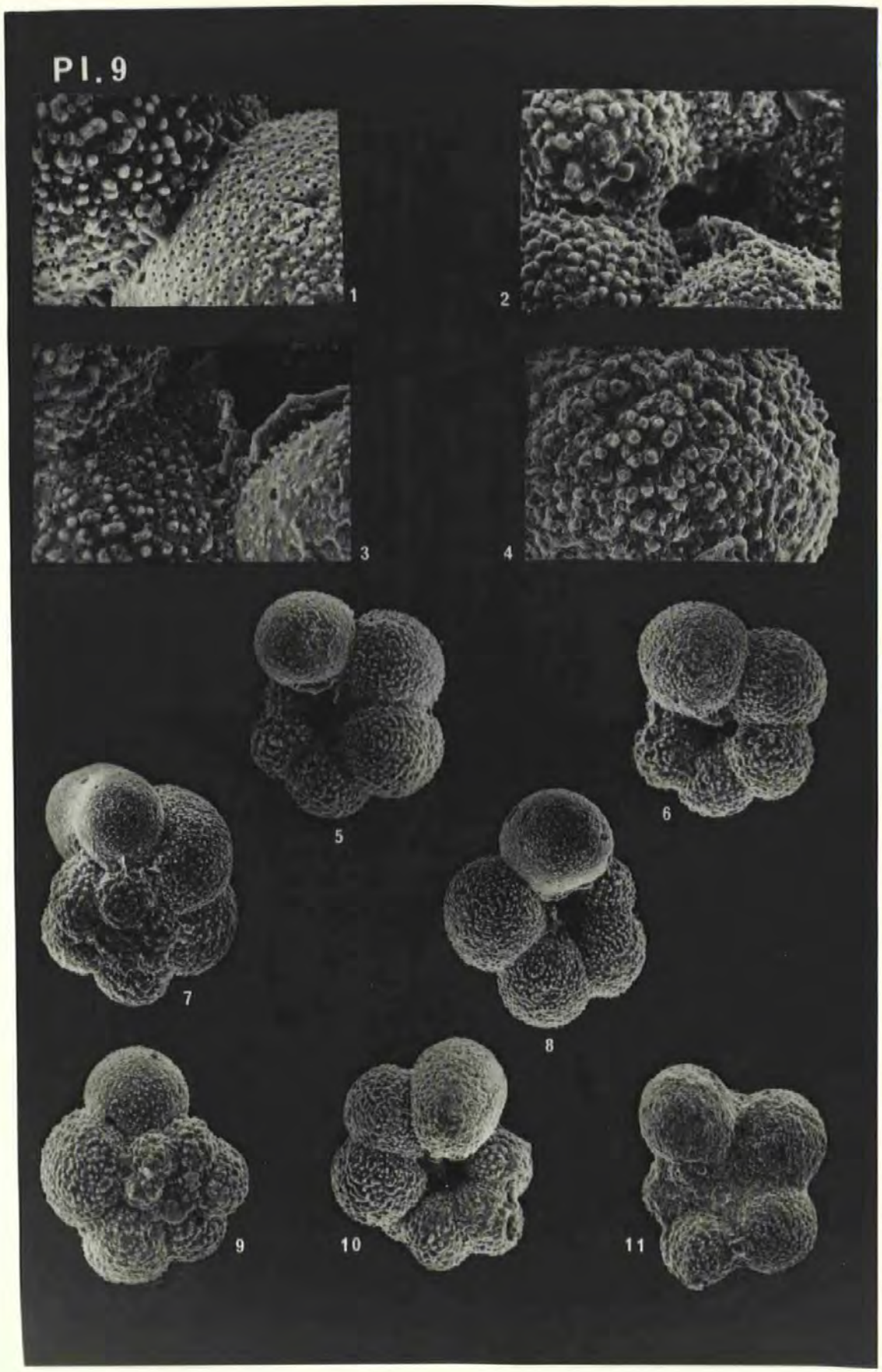
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PLATE 10

Fig. 1. *Hedbergella delrionensis* (Carsey) ; simple pores and coarse hispidity (x990) ; number 105 ; Glyndebourne 134.5-135 m.

Fig. 2. *Hedbergella delrionensis* (Carsey) ; umbilical view (x330) ; number 102 ; Glyndebourne 110.5-111 m.

Fig. 3. *Hedbergella delrionensis* (Carsey) ; simple pores and coarse hispidity ; number 95 ; Glyndebourne 90.5-91 m.

Fig. 4. *Hedbergella delrionensis* (Carsey) ; 'countersunk' pores (x520) ; number 100 ; Glyndebourne 120.5-121 m.

Fig. 5. *Hedbergella delrionensis* (Carsey) ; 'countersunk' pores (x2600) ; Glyndebourne 120.5-121 m.

Fig. 6. *Hedbergella delrionensis* (Carsey) ; 'countersunk' pores (x2600) ; number 100 ; Glyndebourne 120.5-121 m.

Fig. 7. *Favusella washitensis* (Carsey) ; coarse reticulation (x720) ; number 90 ; Glyndebourne 104.5-105 m.

Fig. 8. *Favusella washitensis* (Carsey) ; coarse reticulation (x720) ; number 84 ; Glyndebourne 121.5-122 m.

Fig. 9. *Favusella washitensis* (Carsey) ; coarse reticulation and small simple pores (x1100) ; number 89 ; Glyndebourne 104.5-105 m.

Fig. 10. *Favusella washitensis* (Carsey) ; coarse reticulation (x720) ; number 89 ; Glyndebourne 104.5-105 m.

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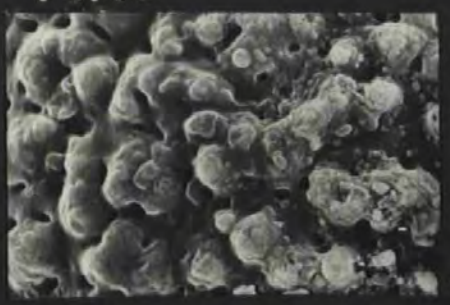
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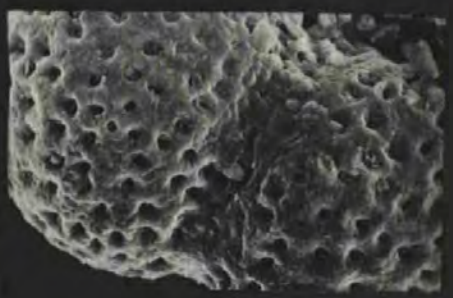
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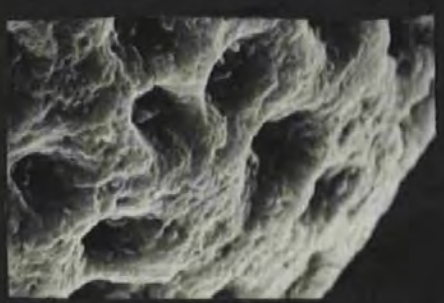
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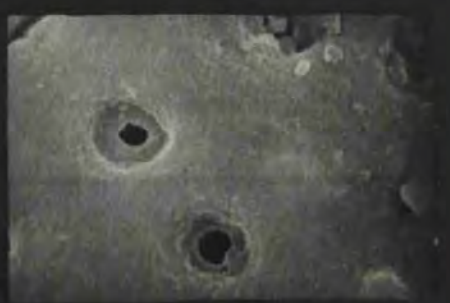
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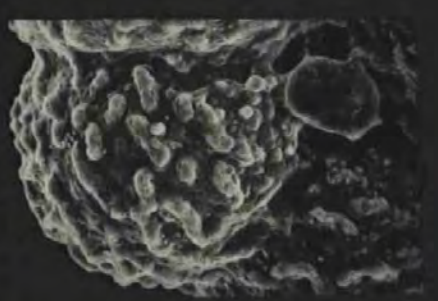
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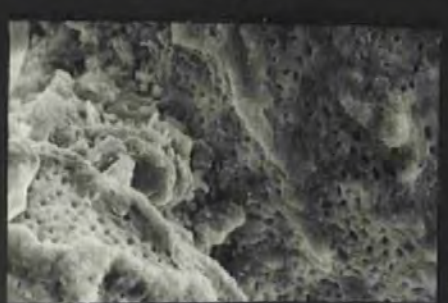
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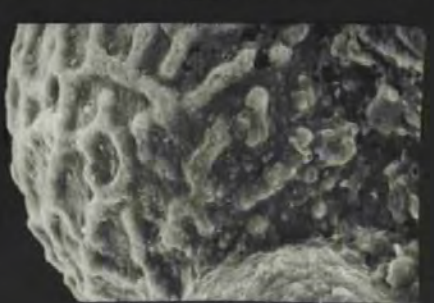
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PLATE 11

Fig. 1. Gavelinella intermedia (Berthelin) ; spiral view (x86) ; number 122 ; Glyndebourne 112.5-113 m.

Fig. 2. Gavelinella intermedia (Berthelin) ; umbilical view (x87) ; number 123 ; Glyndebourne 112.5-113 m.

Fig. 3. Gavelinella baltica Brotzen ; spiral view (x68) ; number 116 ; Glyndebourne 55.5-56 m.

Fig. 4. Gavelinella intermedia (Berthelin) ; apertural view (x87) ; number 124 ; Glyndebourne 112.5-113 m.

Fig. 5. Gavelinella cenomanica (Brotzen) ; apertural view (x90) ; number 121 ; Glyndebourne 50.5-51 m.

Fig. 6. Gavelinella cenomanica (Brotzen) ; apertural view (x68) ; number 119 ; Borehole 16/3, 14'0".

Fig. 7. Gavelinella baltica Brotzen ; apertural view (x84) ; number 117 ; Glyndebourne 102.5-103 m.

Fig. 8. Gavelinella cenomanica (Brotzen) ; spiral view (x91) ; number 119 ; Borehole 16/3. 14'0".

Fig. 9. Gavelinella intermedia (Berthelin) ; spiral view (x90) ; number 12a ; Glyndebourne 75.5-76 m.

Fig. 10. Gavelinella baltica Brotzen ; apertural view (x68) ; number 116 ; Glyndebourne 112.5-113 m.

Fig. 11. Lingulogavelinella jarzevae (Vasilenko) ; side view (x131) ; number 128 ; Glyndebourne 62.5-63 m.

Fig. 12. Gavelinella cenomanica (Brotzen) ; spiral view (x76) ; number 120 ; Borehole 16/3, 14'0".

Fig. 13. Gavelinella baltica Brotzen ; umbilical view (x72) ; number 118 ; Glyndebourne 78.5-79 m.

Fig. 14. Lingulogavelinella jarzevae (Vasilenko) ; umbilical view (x144) ; number 127 ; East Wear Bay 3.

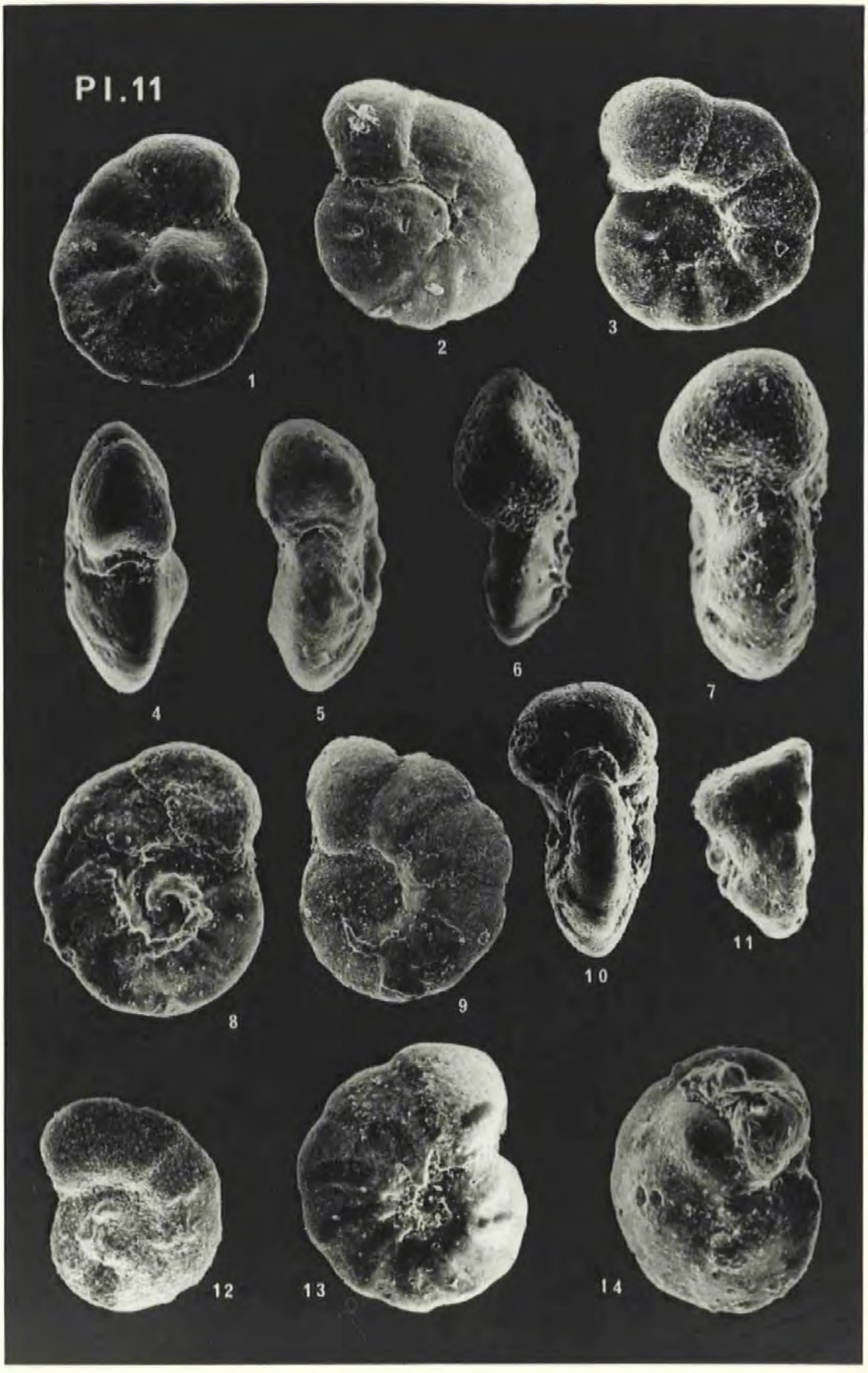
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PLATE 12

Fig. 1. Gavelinella intermedia (Berthelin) ; spiral view (x86) ; number 132 ; Glyndebourne 135.5-136 m.

Fig. 2. Gavelinella intermedia (Berthelin) ; spiral view (x93) ; number 133 ; Glyndebourne 135.5-136 m.

Fig. 3. Gavelinella intermedia (Berthelin) ; spiral view (x90) ; number 134 ; Glyndebourne 130.5-131 m.

Fig. 4. Gavelinella intermedia (Berthelin) ; spiral view (x86) ; number 135 ; Glyndebourne 130.5-131 m.

Fig. 5. Valvulineria parva Khan ; umbilical view (x87) ; number 72a ; Glyndebourne 140.5-141 m.

Fig. 6. Valvulineria parva Khan ; umbilical view (x118) ; number 72b ; Glyndebourne 140.5-141 m.

Fig. 7. Valvulineria parva Khan ; umbilical view (x111) ; number 72c ; Courcelles Lower.

Fig. 8. Valvulineria parva Khan ; umbilical view (x119) ; number 72d ; Courcelles Lower.

Fig. 9. Valvulineria praestans Magniez-Jannin ; umbilical view (x100) ; number 73b ; Glyndebourne 68.5-69 m.

Fig. 10. Valvulineria praestans Magniez-Jannin ; spiral view (x106) ; number 73c ; Glyndebourne 68.5-69 m.

Fig. 11. Valvulineria praestans Magniz-Jannin ; apertural view (x106) ; number 73d ; Borehole 16/3,21'6".

Fig. 12. Valvulineria praestans Magniez-Jannin ; apertural view (x110) ; number 73e ; Borehole 16/3, 21'6".

Fig. 13. Valvulineria praestans Magniez-Jannin ; umbilical view (x96) ; number 39 ; Borehole 16/3, 21'6".

Fig. 14. Valvulineria praestans Magniez-Jannin ; apertural view (x73f) ; Glyndebourne 48.5-49 m.

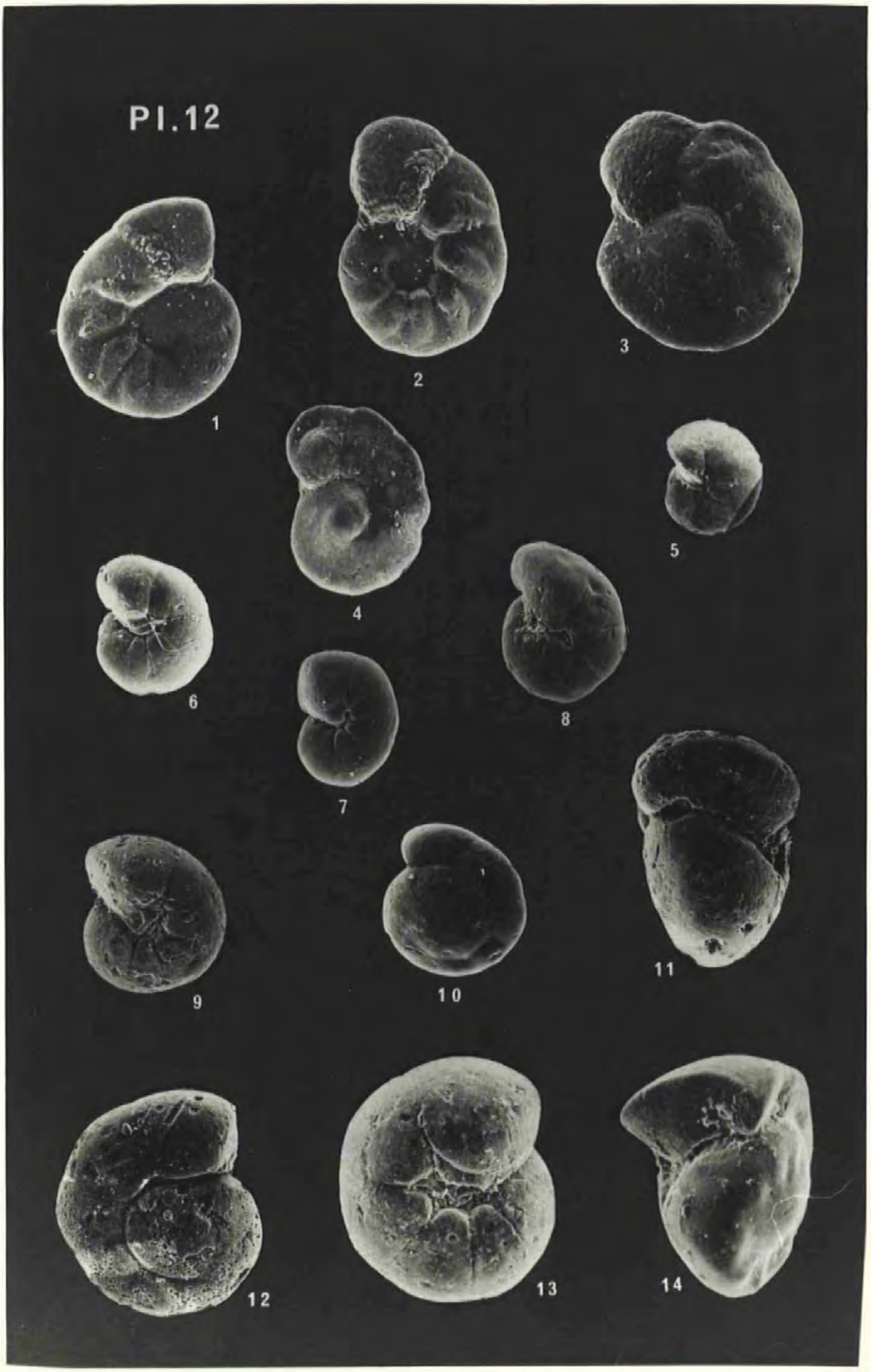
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PLATE 13

Fig. 1. Hoeglundina chapmani (Ten Dam) ; spiral view (x68) ; number 141 ; Glyndebourne 127.5-128 m.

Fig. 2. Hoeglundina chapmani (Ten Dam) ; umbilical view (x65) ; number 140 ; Glyndebourne 127.5-128 m.

Fig. 3. Hoeglundina chapmani (Ten Dam) ; apertural view (x63) ; number 142 ; Folkestone 13/8/22.

Fig. 4. Epistomina cretosa Ten Dam ; spiral view (x35) ; number 144 ; Wissant 4.

Fig. 5. Hoeglundina carpenteri (Reuss) ; umbilical view (x68) ; number 137 ; Glyndebourne 127.5-128 m.

Fig. 6. Hoeglundina carpenteri (Reuss) ; spiral view (x66) ; number 138 ; Glyndebourne 127.5-128 m.

Fig. 7. Hoeglundina carpenteri (Reuss) ; apertural view (x66) ; number 139 ; Glyndebourne 127.5-128 m.

Fig. 8. Epistomina cretosa Ten Dam ; spiral view (x43) ; number 145 ; Wissant 4.

Fig. 9. Epistomina cretosa Ten Dam ; umbilical view (x40) ; number 146 ; Wissant 4.

Fig. 10. Epistomina spinulifera (Reuss) ; umbilical view (x44) ; number 147 ; Glyndebourne 121.5-122 m.

Fig. 11. Epistomina spinulifera (Reuss) ; spiral view (x43) ; number 149 ; Glyndebourne 121.5-122 m.

Fig. 12. Epistomina spinulifera (Reuss) ; spiral view (x51) ; number 148 ; Glyndebourne 121.5-122 m.

Fig. 13 Epistomina sp.A. sp.nov.; umbilical view (x36) ; number 151 ; Glyndebourne 106.5-107 m.

Fig. 14. Epistomina sp.A. sp.nov.; apertural view (x37) ; number 152 ; Glyndebourne 106.5-107 m.

Fig. 15. Epistomina sp.A. sp.nov.; spiral view (x51) ; number 153 ; Glyndebourne 106.5-107 m.

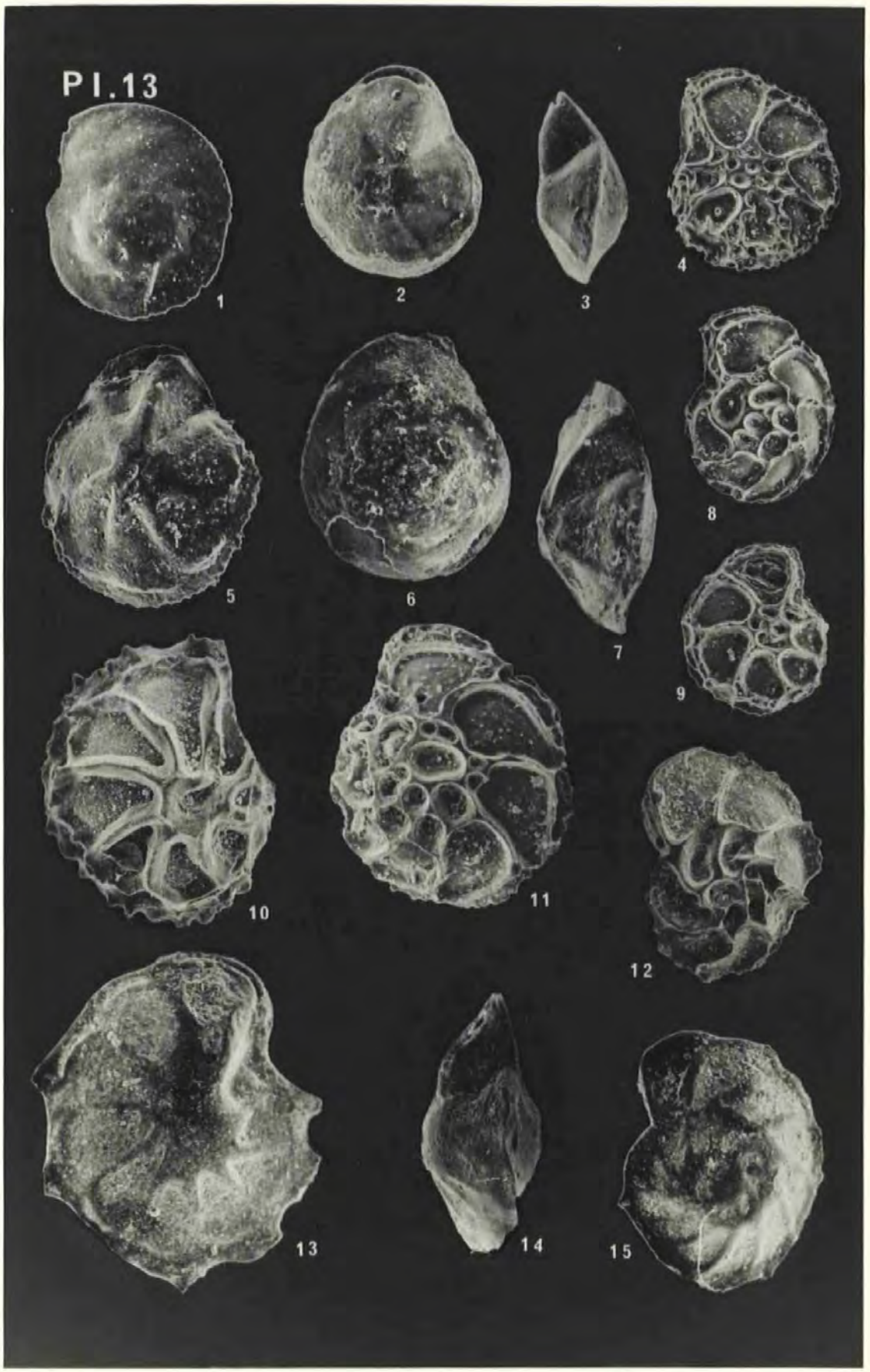
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PLATE 14

Fig. 1. Polycope oweni Kaye ; Female, carapace (x93) ; number 159 ; Glyndebourne 127.5-128 m.

Fig. 2. Cytherella speetonensis Kaye ; Right valve, female (x56) ; number 170 ; Speeton 4.

Fig. 3. Polycope nuda Kaye ; Female, carapace (x88) ; number 158 ; Glyndebourne 128-128.5.

Fig. 4. Cytherella ex.gr.C.ovata (Roemer) ; Left valve, male (x60) ; number 161 ; Glyndebourne 53.5-54 m.

Fig. 5. Cytherella ex.gr.C.ovata (Roemer) ; Right valve, male (x45) ; number 162 ; Glyndebourne 53.5-54 m.

Fig. 6. Cytherella speetonensis Kaye ; Right valve, female, distorted (x57) ; number 171 ; Speeton 5.

Fig. 7. Cytherella sp.cf.C.truncata (Bosquet) ; Left valve, female (x49) ; number 165 ; Speeton 7.

Fig. 8. Cytherella sp.cf.C.truncata (Bosquet) ; Left valve, female (x49) ; number 166 ; Glyndebourne 122.5-123 m.

Fig. 9. Cytherella ex.gr.C.ovata (Roemer) ; Right valve, female (x50) ; number 163 ; Glyndebourne 122.5-123 m.

Fig. 10. Cytherella ex.gr.C.ovata (Roemer); Left valve, female (x50); number 160; Glyndebourne 122.5-123 m.

Fig. 11. Cytherella sp.cf.C.truncata (Bosquet) ; Right valve, male (x49) ; number 167 ; Glyndebourne 119.5-120 m.

Fig. 12. Cytherella sp.cf.C.truncata (Bosquet) ; Right valve, female (x47) ; number 168 ; Glyndebourne 52.5-53 m.

Fig. 13. Cytherella sp.cf.C.truncata (Bosquet) ; Left valve, male (x45) ; number 169 ; Glyndebourne 52.5-53 m.

Fig. 14. Cytherella gründeli Weaver ; Right valve ; female (x59) ; number 164 ; Glyndebourne 52.5-53 m.

Fig. 15. Cytherelloidea globosa Kaye ; Left valve, female (x83) ; number 172 ; Borehole 16/3, 15'6".

Fig. 16. Cytherelloidea kayei Weaver ; Right valve, female (x70) ; number 469 ; Glyndebourne 49-49.5 m.

Fig. 17. Cytherella gründeli Weaver ; Dorsal, carapace, female (x59) ; number 164 ; Glyndebourne 52.5.-53 m.

Fig. 18. Cytherelloidea globosa Kaye ; Right valve, female (x83) ; number 173 ; Borehole 16/3, 5'6".

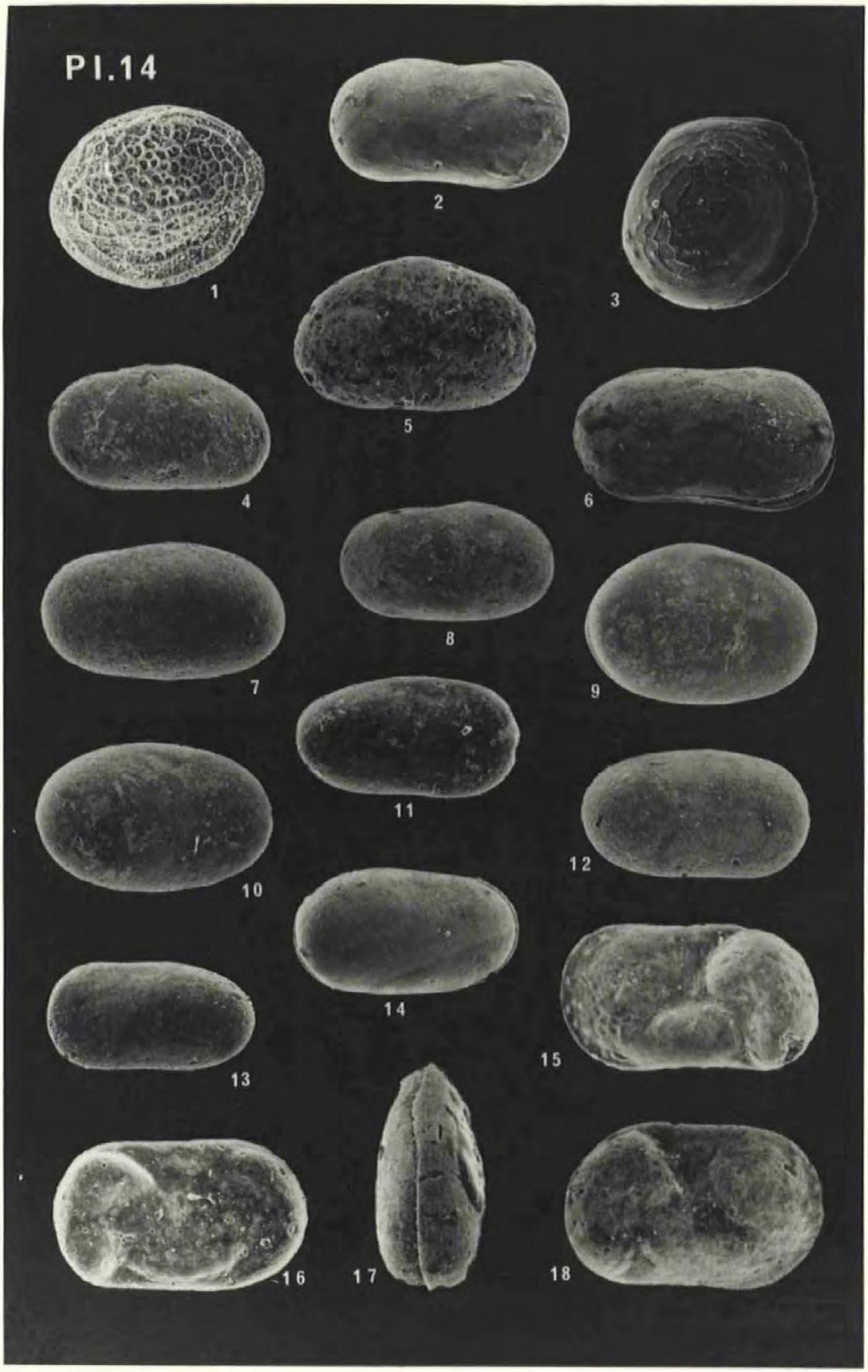
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PLATE 15

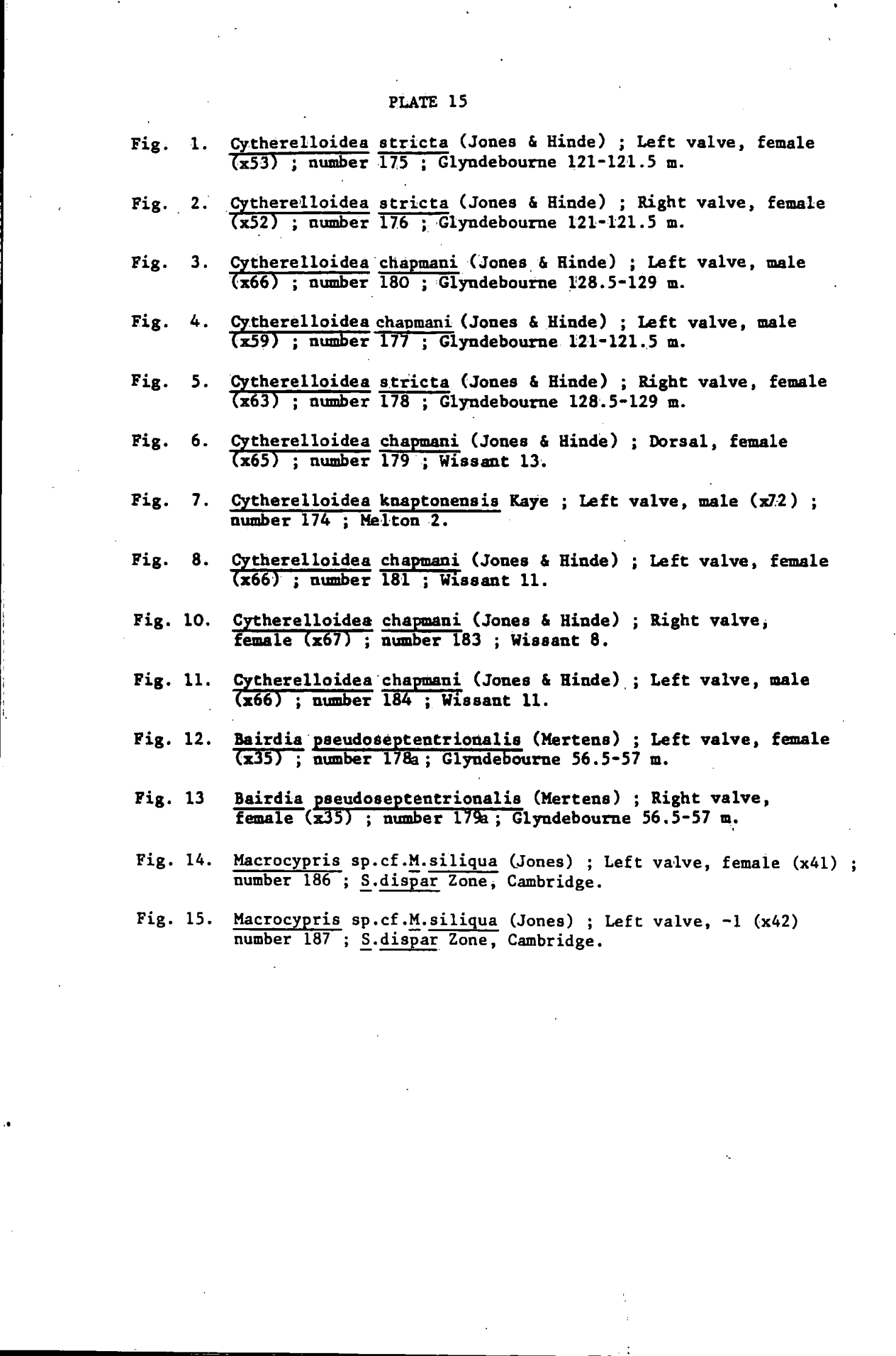

Fig. 1. *Cytherelloidea stricta* (Jones & Hinde) ; Left valve, female (x53) ; number 175 ; Glyndebourne 121-121.5 m.

Fig. 2. *Cytherelloidea stricta* (Jones & Hinde) ; Right valve, female (x52) ; number 176 ; Glyndebourne 121-121.5 m.

Fig. 3. *Cytherelloidea chapmani* (Jones & Hinde) ; Left valve, male (x66) ; number 180 ; Glyndebourne 128.5-129 m.

Fig. 4. *Cytherelloidea chapmani* (Jones & Hinde) ; Left valve, male (x59) ; number 177 ; Glyndebourne 121-121.5 m.

Fig. 5. *Cytherelloidea stricta* (Jones & Hinde) ; Right valve, female (x63) ; number 178 ; Glyndebourne 128.5-129 m.

Fig. 6. *Cytherelloidea chapmani* (Jones & Hinde) ; Dorsal, female (x65) ; number 179 ; Wissant 13.

Fig. 7. *Cytherelloidea knaptonensis* Kaye ; Left valve, male (x72) ; number 174 ; Melton 2.

Fig. 8. *Cytherelloidea chapmani* (Jones & Hinde) ; Left valve, female (x66) ; number 181 ; Wissant 11.

Fig. 10. *Cytherelloidea chapmani* (Jones & Hinde) ; Right valve, female (x67) ; number 183 ; Wissant 8.

Fig. 11. *Cytherelloidea chapmani* (Jones & Hinde) ; Left valve, male (x66) ; number 184 ; Wissant 11.

Fig. 12. *Bairdia pseudoseptentrionalis* (Mertens) ; Left valve, female (x35) ; number 178a ; Glyndebourne 56.5-57 m.

Fig. 13 *Bairdia pseudoseptentrionalis* (Mertens) ; Right valve, female (x35) ; number 179a ; Glyndebourne 56.5-57 m.

Fig. 14. *Macrocypris* sp.cf.*M.siliqua* (Jones) ; Left valve, female (x41) ; number 186 ; *S.dispar* Zone, Cambridge.

Fig. 15. *Macrocypris* sp.cf.*M.siliqua* (Jones) ; Left valve, -1 (x42) number 187 ; *S.dispar* Zone, Cambridge.

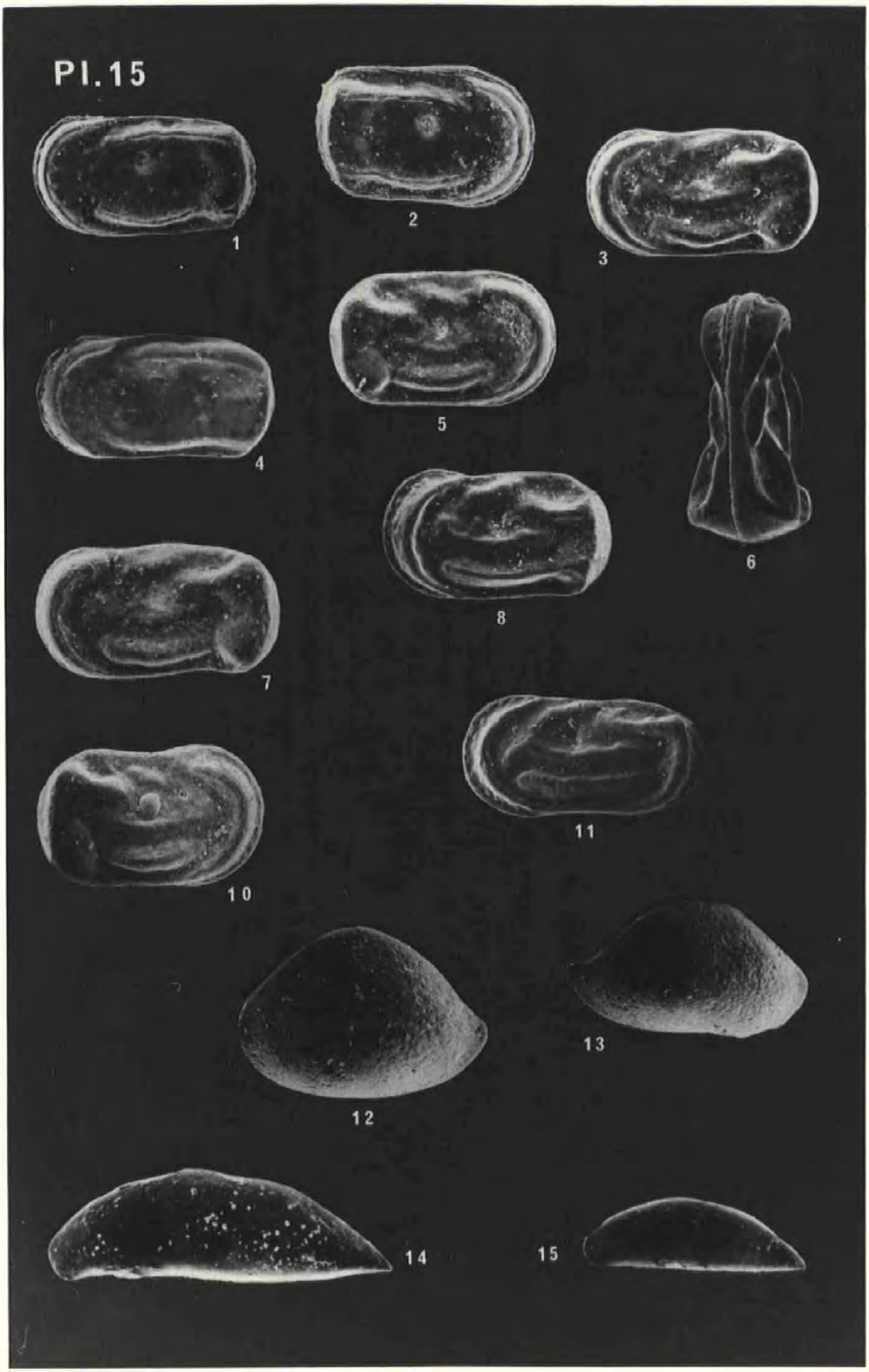
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PLATE 16

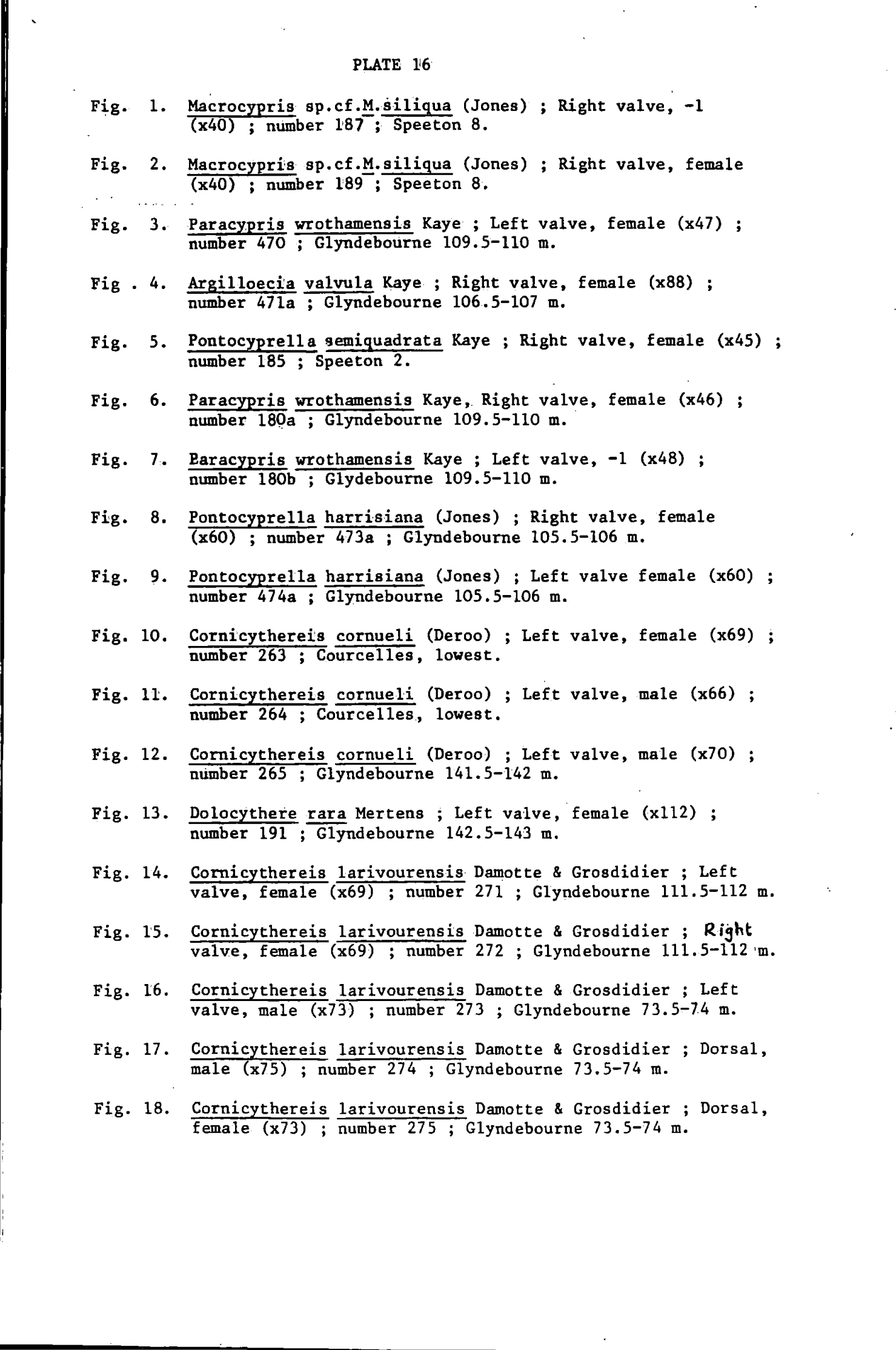

Fig. 1. Macrocypris sp.cf.M.siliqua (Jones) ; Right valve, -1 (x40) ; number 187 ; Speeton 8.

Fig. 2. Macrocypris sp.cf.M.siliqua (Jones) ; Right valve, female (x40) ; number 189 ; Speeton 8.

Fig. 3. Paracypris wrothamensis Kaye ; Left valve, female (x47) ; number 470 ; Glyndebourne 109.5-110 m.

Fig . 4. Argilloecia valvula Kaye ; Right valve, female (x88) ; number 471a ; Glyndebourne 106.5-107 m.

Fig. 5. Pontocyprella semiquadrata Kaye ; Right valve, female (x45) ; number 185 ; Speeton 2.

Fig. 6. Paracypris wrothamensis Kaye, Right valve, female (x46) ; number 180a ; Glyndebourne 109.5-110 m.

Fig. 7. Paracypris wrothamensis Kaye ; Left valve, -1 (x48) ; number 180b ; Glydebourne 109.5-110 m.

Fig. 8. Pontocyprella harrisiana (Jones) ; Right valve, female (x60) ; number 473a ; Glyndebourne 105.5-106 m.

Fig. 9. Pontocyprella harrisiana (Jones) ; Left valve female (x60) ; number 474a ; Glyndebourne 105.5-106 m.

Fig. 10. Cornicythereis cornueli (Deroo) ; Left valve, female (x69) ; number 263 ; Courcelles, lowest.

Fig. 11. Cornicythereis cornueli (Deroo) ; Left valve, male (x66) ; number 264 ; Courcelles, lowest.

Fig. 12. Cornicythereis cornueli (Deroo) ; Left valve, male (x70) ; number 265 ; Glyndebourne 141.5-142 m.

Fig. 13. Dolocythere rara Mertens ; Left valve, female (x112) ; number 191 ; Glyndebourne 142.5-143 m.

Fig. 14. Cornicythereis larivourensis Damotte & Grosdidier ; Left valve, female (x69) ; number 271 ; Glyndebourne 111.5-112 m.

Fig. 15. Cornicythereis larivourensis Damotte & Grosdidier ; Right valve, female (x69) ; number 272 ; Glyndebourne 111.5-112 m.

Fig. 16. Cornicythereis larivourensis Damotte & Grosdidier ; Left valve, male (x73) ; number 273 ; Glyndebourne 73.5-74 m.

Fig. 17. Cornicythereis larivourensis Damotte & Grosdidier ; Dorsal, male (x75) ; number 274 ; Glyndebourne 73.5-74 m.

Fig. 18. Cornicythereis larivourensis Damotte & Grosdidier ; Dorsal, female (x73) ; number 275 ; Glyndebourne 73.5-74 m.

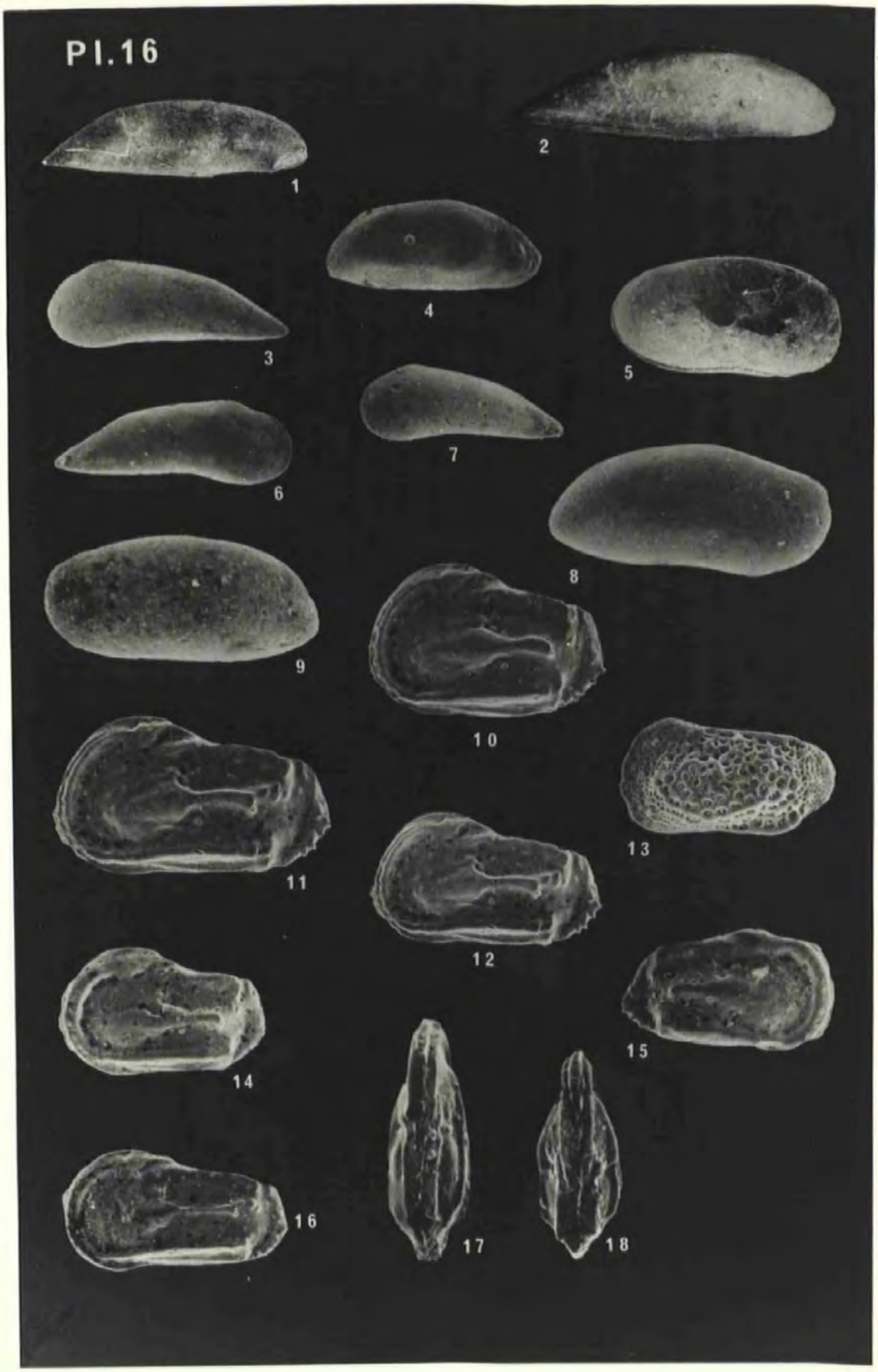
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PLATE 17

Fig. 1. Cornicythereis sp.aff.C.cornueli sp.nov. ; Left valve, female (x45) ; number 472a ; Beer 5.

Fig. 2. Cornicythereis gatyensis Damotte & Grosdidier ; Right valve female (x92) ; number 269 ; Glyndebourne 146.5-147.5 m.

Fig. 3. Cornicythereis bonnemai Triebel ; Right valve, male (x76) ; number 267 ; Speeton 4.

Fig. 4. Cornicythereis bonnemai Triebel ; Dorsal, male (x64) ; number 268 ; Speeton 4.

Fig. 5. Cornicythereis gatyensis Damotte & Grosdidier ; Left valve, female (x70) ; number 270 ; Glyndebourne 146.5-147.5 m.

Fig. 6. Cornicythereis bonnemai Triebel ; Left valve, female (x63) ; number 266 ; Speeton 4.

Fig. 7. Cythereis reticulata Jones & Hinde ; Left valve, female (x44) ; number 255 ; Glyndebourne 143.5-144.5 m.

Fig. 8. Cythereis hirsuta Damotte & Grosdidier ; Left valve, female (x45) ; number 231 ; Glyndebourne 131.5-132 m.

Fig. 9. Cythereis reticulata Jones & Hinde ; Right valve, female (x44) ; number 256 ; Glyndebourne 143.5-144.5 m.

Fig. 10. Cythereis hirsuta Damotte & Grosdidier ; Left valve, female (x46) ; number 232 ; Glyndebourne 73.5-74 m.

Fig. 11. Cythereis hirsuta Damotte & Grosdidier ; Left valve, dorsal (x44) ; number 233 ; Glyndebourne 73.5-74 m.

Fig. 12. Cythereis hirsuta Damotte & Grosdidier ; Right valve, -1 (x48) ; number 234 ; Glyndebourne 73.5-74 m.

Fig. 13. Cythereis hirsuta Damotte & Grosdidier ; Right valve, female (x45) ; number 235 ; Glyndebourne 73.5-74 m.

Fig. 14. Cythereis hirsuta Damotte & Grosdidier ; Left valve, male (x43) ; number 236 ; Glyndebourne 101.5-102 m.

Fig. 15. Cythereis hirsuta Damotte & Grosdidier ; Right valve, hinge (x64) ; number 237 ; Glyndebourne 73.5-74 m.

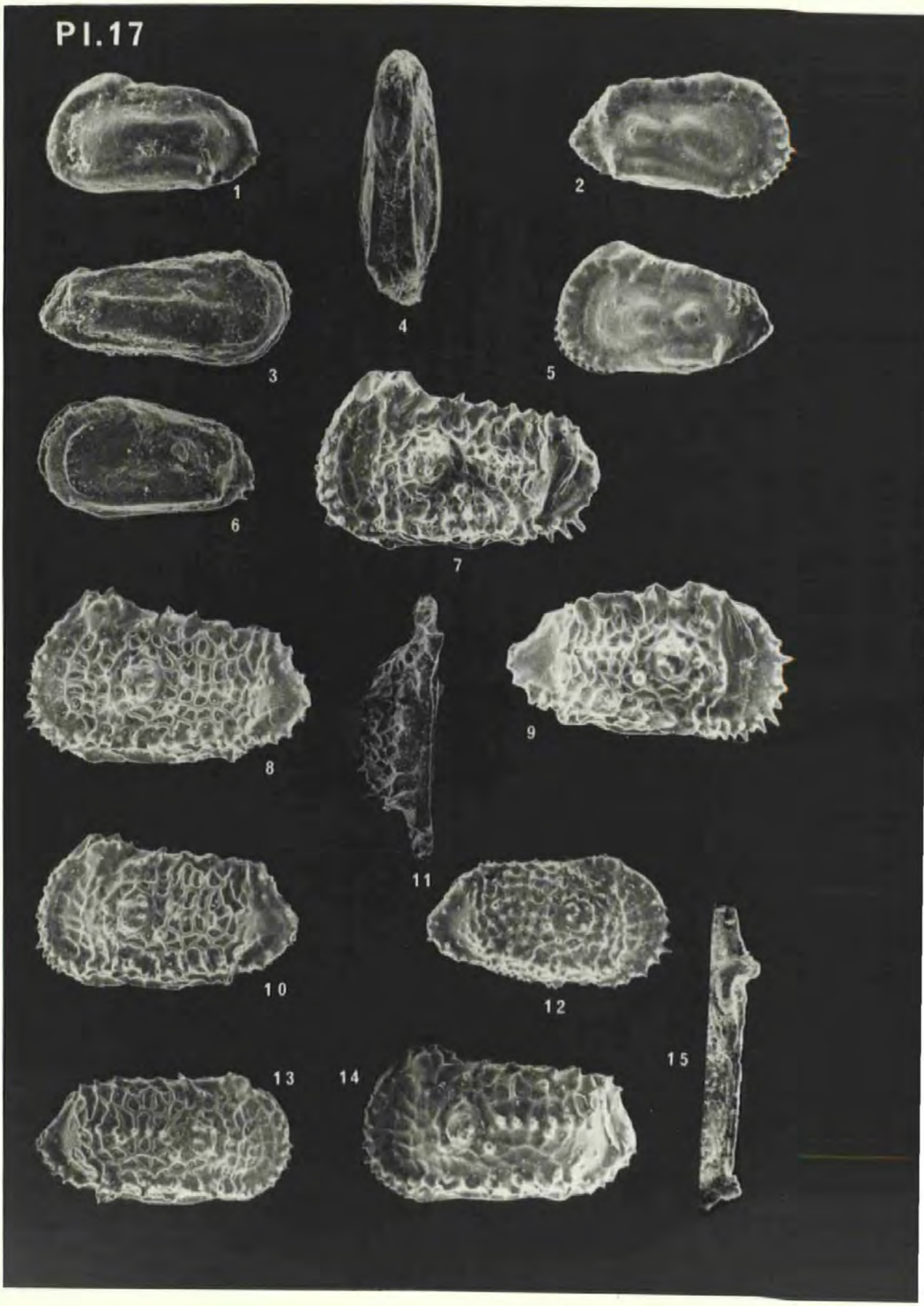
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PLATE 18

Fig. 1. Cythereis hirsuta Damotte & Grosdidier ; Left valve, female (x46) ; number 238 ; Glyndebourne 55.5-56 m.

Fig. 2. Cythereis hirsuta Damotte & Grosdidier ; Right valve, male (x48) ; number 239 ; Glyndebourne 55.5-56 m.

Fig. 3. Cythereis thoerenensis Triebel ; Left valve, male (x44) ; number 260 ; Glyndebourne 53.5-54 m.

Fig. 4. Cythereis hirsuta Damotte & Grosdidier ; reticulation (x140).

Fig. 5. Cythereis thoerenensis Triebel ; Right valve, female (x45) ; number 261 ; Glyndebourne 53.5-54 m.

Fig. 6. Cythereis thoerenensis Triebel ; Dorsal, female (x48) ; number 262 ; Glyndebourne 131.5-132 m.

Fig. 7. Cythereis hirsuta Damotte & Grosdidier ; Dorsal, female (x45) ; number 240 ; Glyndebourne 131.5-132 m.

Fig. 8. Cythereis hirsuta Damotte & Grosdidier ; Dorsal, female (x45) ; number 241 ; Glyndebourne 131.5-132 m.

Fig. 9. Cythereis thoerenensis Triebel ; Right valve, male (x46) ; number 263 ; Glyndebourne 53.5-54 m.

Fig. 10. Cythereis sp.aff.C.folkstonensis Kaye ; Right valve, female (x51) ; number 224 ; Glyndebourne 94.5-95 m.

Fig. 11. Cythereis folkstonensis Kaye ; Left valve, male (x46) ; number 222 ; Glyndebourne 94.5-95 m.

Fig. 12. Cythereis pinhayensis Kaye ; Left valve, female (x48) ; number 254 ; Beer 6.

Fig. 13. Cythereis folkstonensis Kaye ; Dorsal, female (x51) ; L.V., number 223 ; Glyndebourne 94.5-95 m.

Fig. 14. Cythereis glabrella Triebel ; Left valve, male (x40) ; number 226a; Speeton 6.

Fig. 15. Cythereis glabrella Triebel ; Left valve, female (x42) ; number 225 ; Speeton 6.

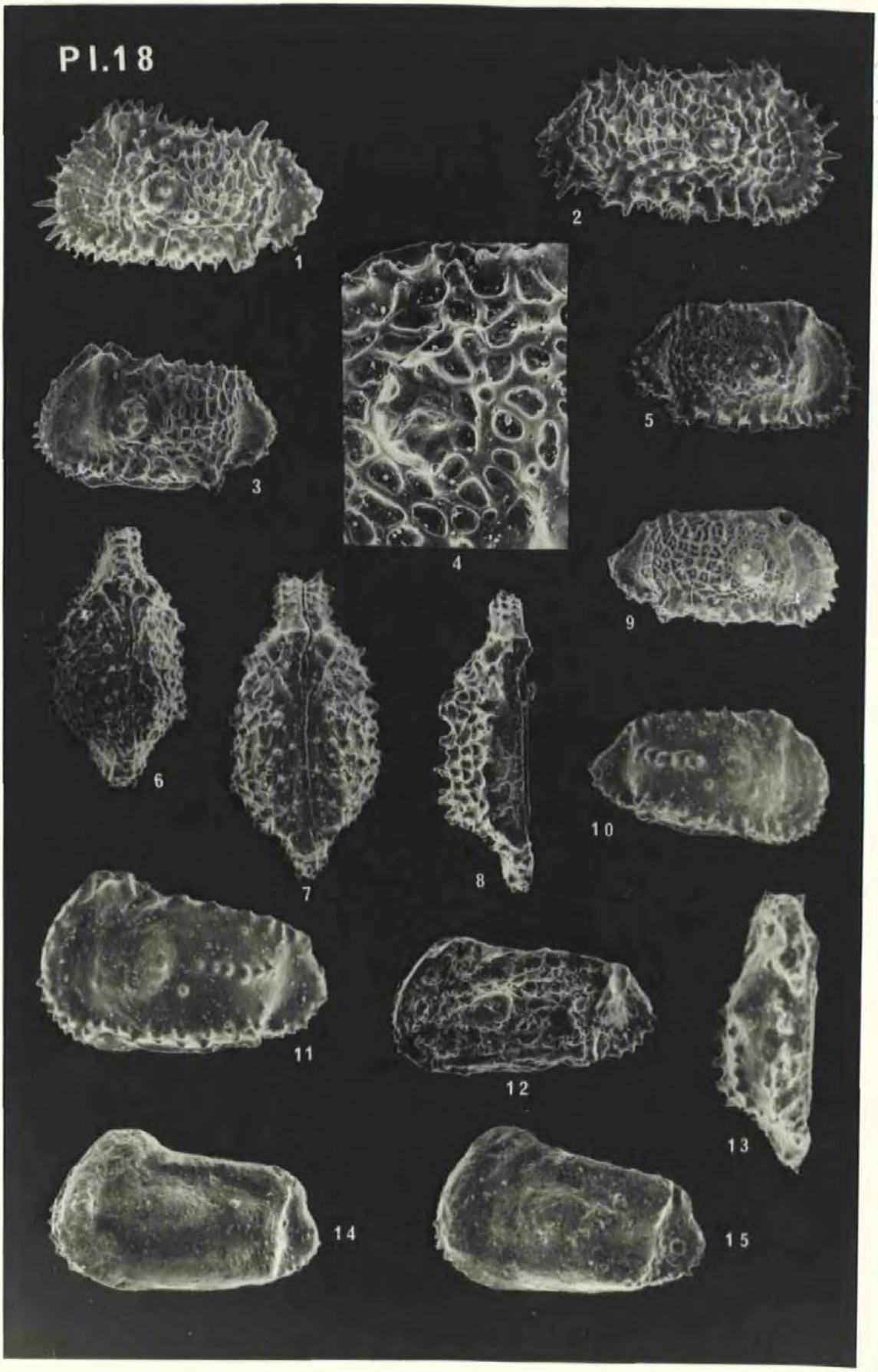
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PLATE 19

Fig. 1. Cythereis hindei hindei Weaver ; Left valve, female (x71) ; number 227 ; Glyndebourne 66.5-67 m.

Fig. 2. Cythereis hindei hindei Weaver ; Right valve, male (x73) ; number 228 ; Glyndebourne 66.5-67 m.

Fig. 3. Cythereis hindei hindei Weaver ; Left valve, male (x71) ; number 229 ; Glyndebourne 66.5-67 m.

Fig. 4. Cythereis hindei hindei Weaver ; Right valve, female (x70) ; number 230 ; Glyndebourne 66.5-67 m.

Fig. 5. Cythereis ex.gr.C.lurmannae Triebel ; Left valve, female (x48) ; number 250 ; Glyndebourne 122.5-123.0 m.

Fig. 6. Cythereis ex.gr.C.lurmannae Triebel ; Left valve, male (x53) ; number 242 ; Glyndebourne 122.5-123.0 m.

Fig. 7. Cythereis ex.gr.C.lurmannae Triebel ; Left valve, male (x45) ; number 243 ; Glyndebourne 122.5-123.0 m.

Fig. 8. Cythereis ex.gr.C.lurmannae Triebel ; Right valve, female (x45) ; number 244 ; Glyndebourne 101.5-102 m.

Fig. 9. Cythereis ex.gr.C.lurmannae Triebel ; Left valve, female (x47) ; number 245 ; Glyndebourne 101.5-102 m.

Fig. 10. Cythereis ex.gr.C.lurmannae Triebel ; Left valve, female (x45) ; number 246 ; Glyndebourne 71.5-72 m.

Fig. 11. Cythereis ex.gr.C.lurmannae Triebel ; Left valve, male (x45) ; number 247 ; Speeton 6.

Fig. 12. Cythereis ex.gr.C.lurmannae Triebel ; Right valve, male (x45) ; number 248 ; Speeton 6.

Fig. 13. Cythereis ex.gr.C.lurmannae Triebel ; Left valve, male (x47) ; number 249 ; Borehole 16/3, 26'0".

Fig. 14. Planileberis sandersi Weaver ; Left valve, female (x60) ; number 471 ; Glyndebourne 55.5-56 m.

Fig. 15. Planileberis sandersi Weaver ; Dorsal, female (x64) ; number 472 ; Glyndebourne 55.5-56 m.

Fig. 16. Cythereis ex.gr.C.lurmannae Triebel ; Left valve, male (x48); number 251 ; Borehole 16/3, 26'0".

Fig. 17. Cythereis ex.gr.C.lurmannae Triebel ; Dorsal, female (x43) ; number 252 ; Borehole 16/3, 26'0".

Fig. 18. Planileberis chathamensis Weaver ; Left valve, female (x50) ; number 282 ; Glyndebourne 55.5-56 m.

Fig. 19. Planileberis chathamensis Weaver ; Right valve, female (x48) ; number 283 ; Glyndebourne 55.5-56 m.

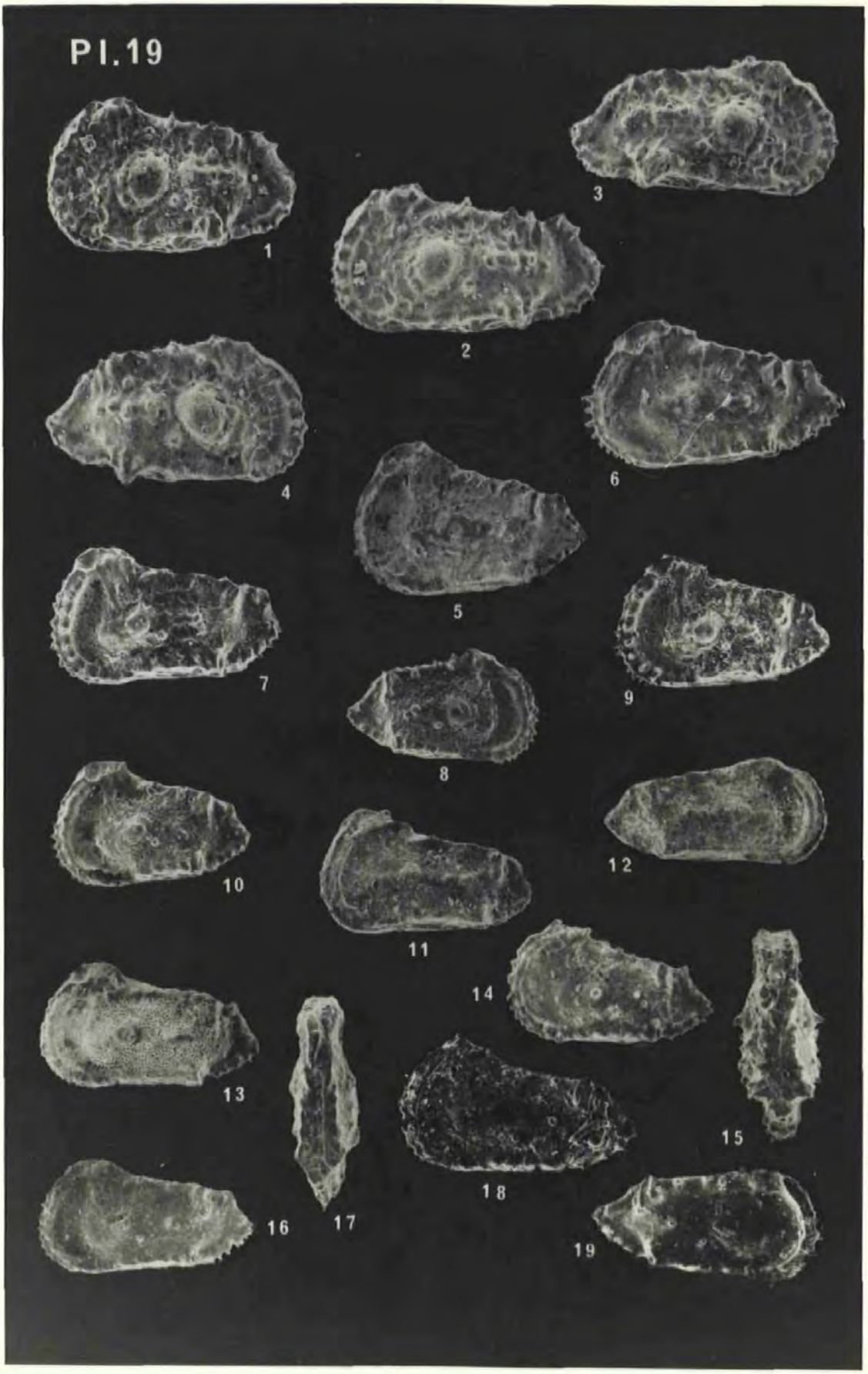
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PLATE 20

Fig. 1. Cythereis sp.A. sp.nov. ; Left valve, female (x69) ; number 264 ; Glyndebourne 50.5-51 m.

Fig. 2. Cythereis sp.A. sp.nov. ; Dorsal, female (x71) ; number 265 ; Glyndebourne 50.5-51 m.

Fig. 3. Cythereis ex.gr.C.lurmannae Triebel ; Dorsal, male (x49) ; number 251a ; Glyndebourne 71.5-72 m.

Fig. 4. Cythereis ex.gr.C.lurmannae Triebel ; Dorsal, female (x44) ; number 252a; Glyndebourne 71.5-72 m.

Fig. 5. Cythereis sp.A. sp.nov. ; Right valve, female (x74) ; number 266 ; Glyndebourne 50.5-51 m.

Fig. 6. Matronella ?durispinata (Gründel); Left valve, female (x43); number 280 ; Glyndebourne 120.5-121 m.

Fig. 7. Matronella matronae (Damotte & Grosdidier) ; Left valve, female (x48) ; number 278 ; Glyndebourne 141.5-142 m.

Fig. 8. Matronella matronae (Damotte & Grosdidier) ; internal, left valve (x52) ; number 279 ; Glyndebourne 141.5-142 m.

Fig. 9. Matronella ?durispinata (Gründel); Dorsal, female (x47); number 280; Glyndebourne 120.5-121 m.

Fig. 10. Isocythereis fortinodis Triebel ; Left valve, female (x90) ; number 215 ; Glyndebourne 131.5-132 m.

Fig. 11. Isocythereis fortinodis Triebel ; Right valve, female (x94) ; number 216 ; Glyndebourne 131.5-132 m.

Fig. 12. Matronella ?durispinata (Gründel) ; Right valve, female (x48) ; number 281 ; Glyndebourne 120.5-121 m.

Fig. 13. Isocythereis fortinodis Triebel ; Right valve, male (x87) ; number 217 ; Glyndebourne 63.5-64 m.

Fig. 14. Isocythereis fortinodis Triebel ; Left valve, female (x82) ; number 218 ; Glyndebourne 63.5-64 m.

Fig. 15. Cythereis ex.gr.C.lurmannae Triebel ; Left valve, internal (x67) ; Glyndebourne 122.5-123 m.

Fig. 16. Platycythereis gaultina (Jones) ; Left valve, female (x64) ; number 192 ; Glyndebourne 129.5-130 m.

Fig. 17. Platycythereis gaultina (Jones) ; Right valve, female (x65); number 193 ; Glyndebourne 129.5-130 m.

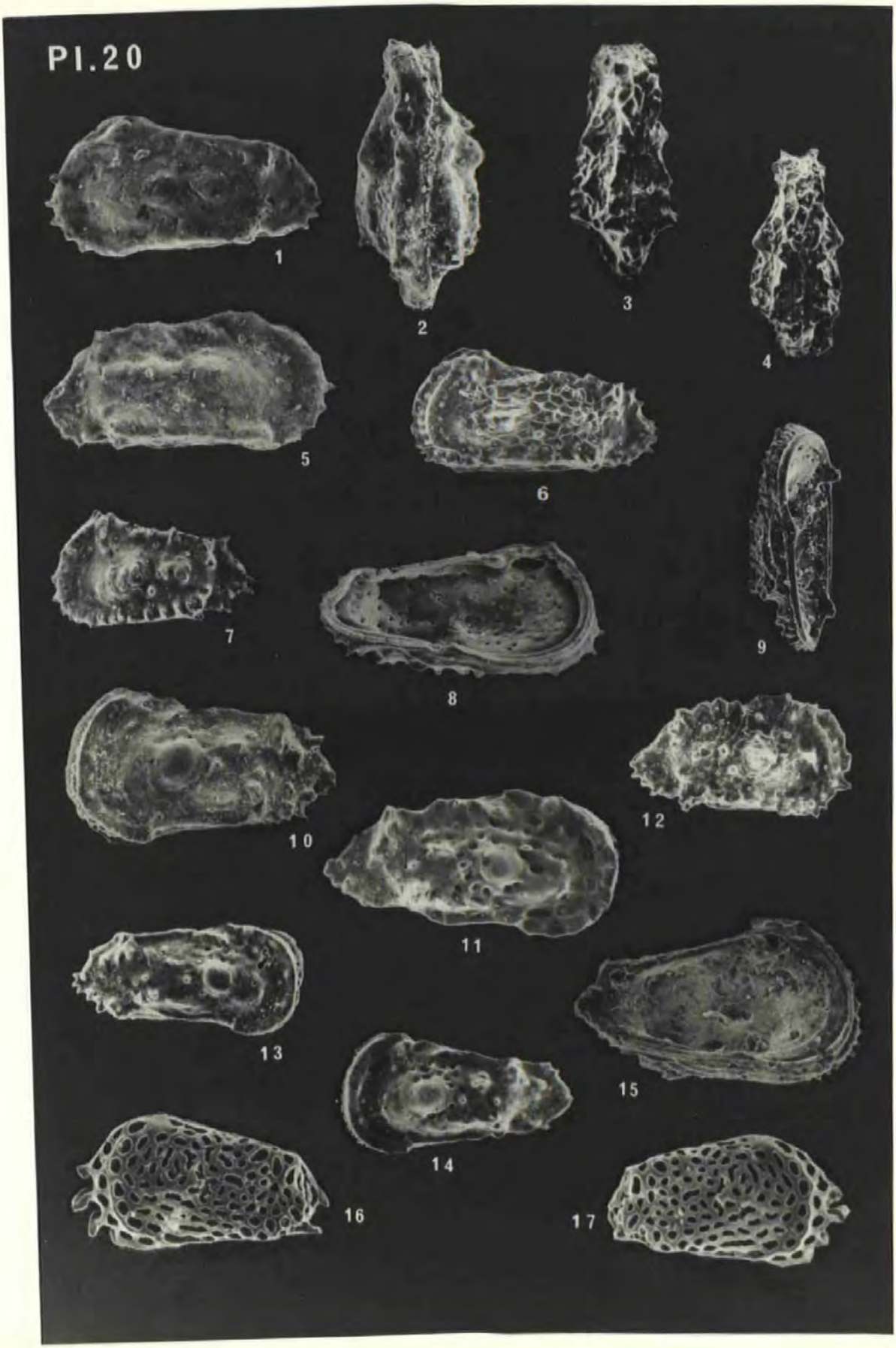
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PLATE 21

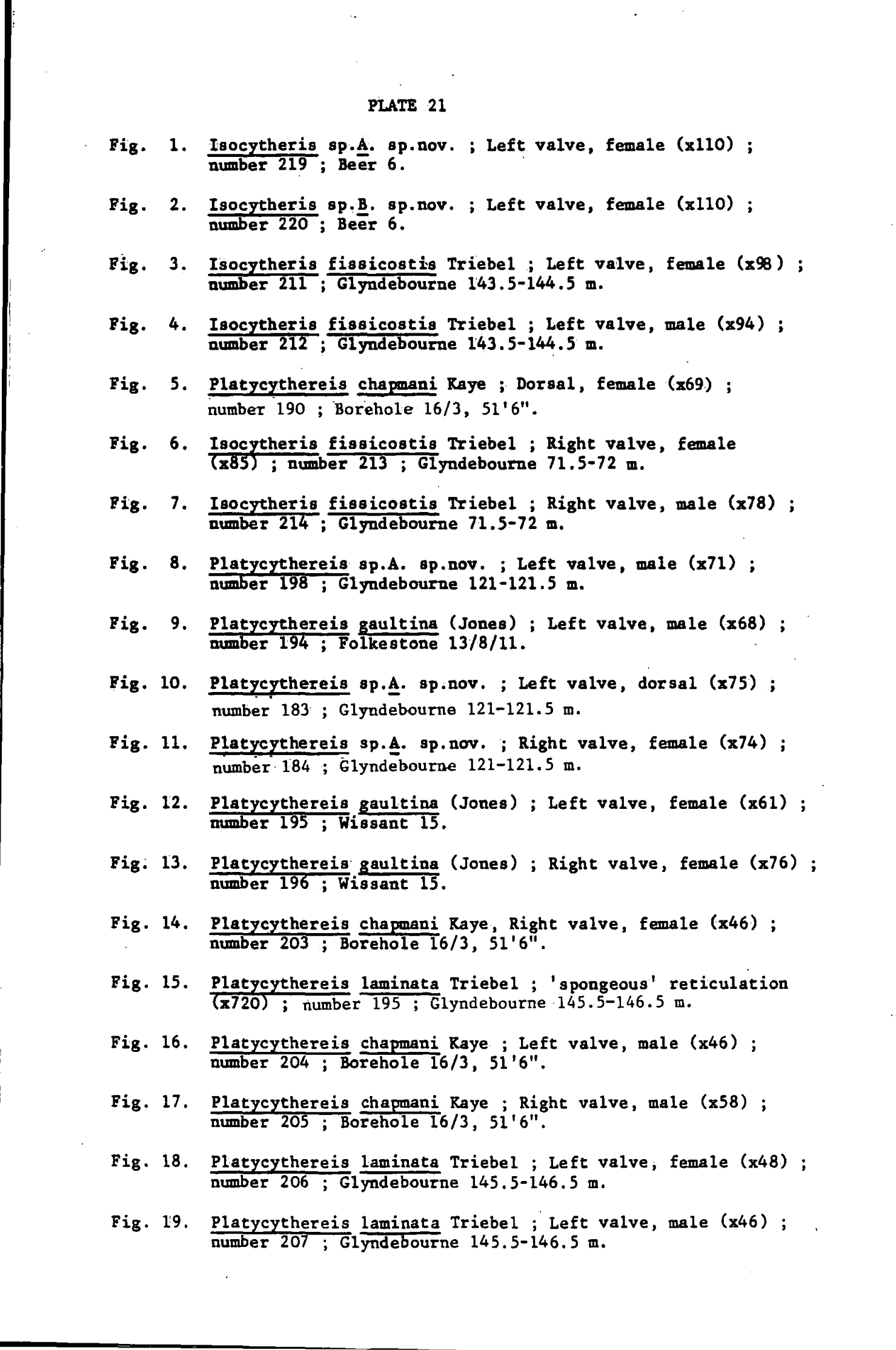

Fig. 1. Isocytheris sp.A. sp.nov. ; Left valve, female (x110) ; number 219 ; Beer 6.

Fig. 2. Isocytheris sp.B. sp.nov. ; Left valve, female (x110) ; number 220 ; Beer 6.

Fig. 3. Isocytheris fissicostis Triebel ; Left valve, female (x98) ; number 211 ; Glyndebourne 143.5-144.5 m.

Fig. 4. Isocytheris fissicostis Triebel ; Left valve, male (x94) ; number 212 ; Glyndebourne 143.5-144.5 m.

Fig. 5. Platycythereis chapmani Kaye ; Dorsal, female (x69) ; number 190 ; Borehole 16/3, 51'6".

Fig. 6. Isocytheris fissicostis Triebel ; Right valve, female (x85) ; number 213 ; Glyndebourne 71.5-72 m.

Fig. 7. Isocytheris fissicostis Triebel ; Right valve, male (x78) ; number 214 ; Glyndebourne 71.5-72 m.

Fig. 8. Platycythereis sp.A. sp.nov. ; Left valve, male (x71) ; number 198 ; Glyndebourne 121-121.5 m.

Fig. 9. Platycythereis gaultina (Jones) ; Left valve, male (x68) ; number 194 ; Folkestone 13/8/11.

Fig. 10. Platycythereis sp.A. sp.nov. ; Left valve, dorsal (x75) ; number 183 ; Glyndebourne 121-121.5 m.

Fig. 11. Platycythereis sp.A. sp.nov. ; Right valve, female (x74) ; number 184 ; Glyndebourne 121-121.5 m.

Fig. 12. Platycythereis gaultina (Jones) ; Left valve, female (x61) ; number 195 ; Wissant 15.

Fig. 13. Platycythereis gaultina (Jones) ; Right valve, female (x76) ; number 196 ; Wissant 15.

Fig. 14. Platycythereis chapmani Kaye, Right valve, female (x46) ; number 203 ; Borehole 16/3, 51'6".

Fig. 15. Platycythereis laminata Triebel ; 'spongeous' reticulation (x720) ; number 195 ; Glyndebourne 145.5-146.5 m.

Fig. 16. Platycythereis chapmani Kaye ; Left valve, male (x46) ; number 204 ; Borehole 16/3, 51'6".

Fig. 17. Platycythereis chapmani Kaye ; Right valve, male (x58) ; number 205 ; Borehole 16/3, 51'6".

Fig. 18. Platycythereis laminata Triebel ; Left valve, female (x48) ; number 206 ; Glyndebourne 145.5-146.5 m.

Fig. 19. Platycythereis laminata Triebel ; Left valve, male (x46) ; number 207 ; Glyndebourne 145.5-146.5 m.

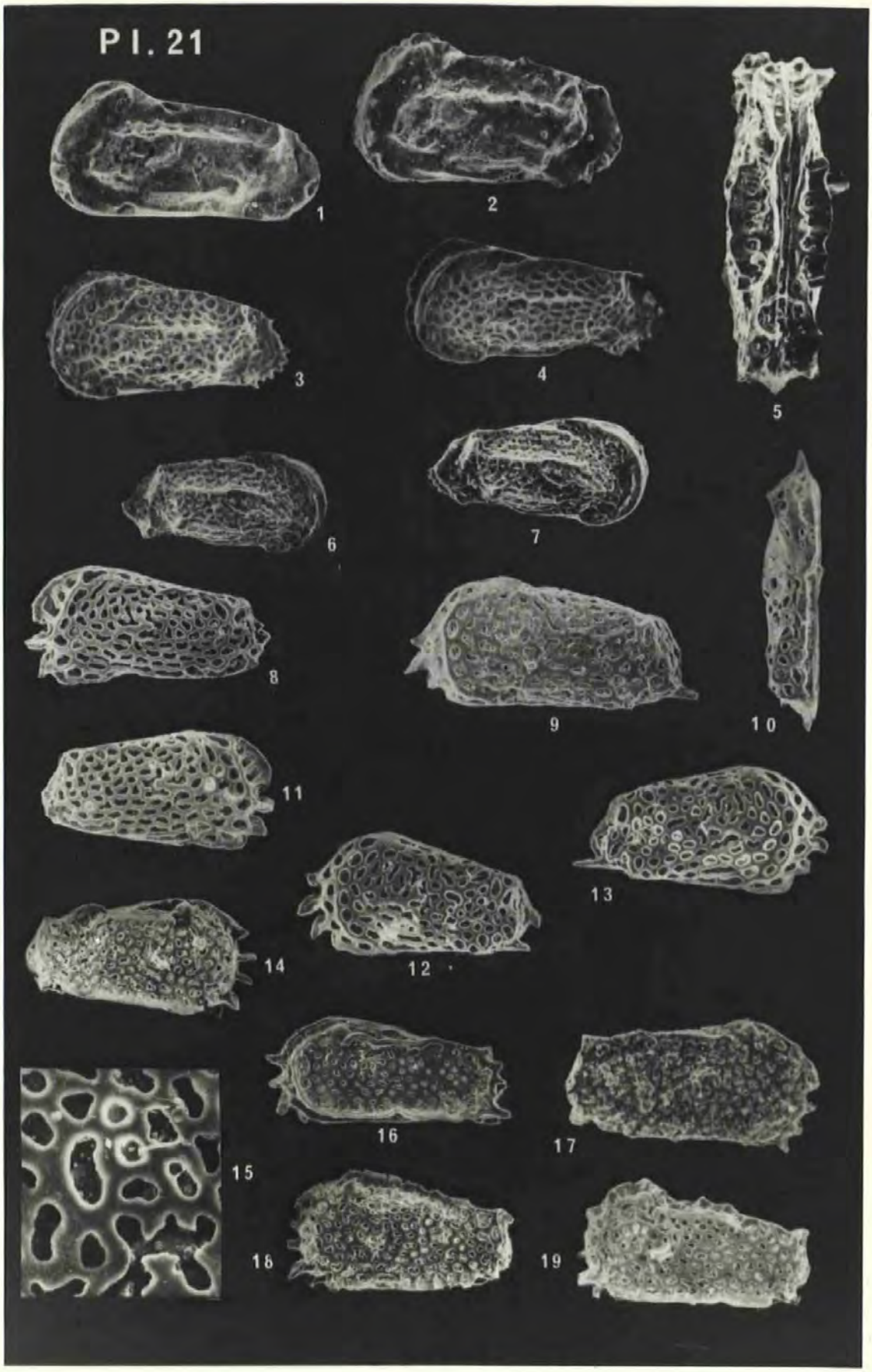
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PLATE 22

Fig. 1. Platycythereis sp.A. sp.nov. ; Left valve, male (x76) ; number 199 ; Glyndebourne 74.5-75 m.

Fig. 2. Platycythereis sp.A. sp.nov. ; Left valve, female (x77) ; number 200 ; Glyndebourne 74.5-75 m.

Fig. 3. Platycythereis sp.A. sp.nov. ; Left valve, female (x69) ; number 201 ; Glyndebourne 74.5-75 m.

Fig. 4. Cythereis rudispinata (Chapman & Sherborn) ; Left valve, female (x71) ; number 257 ; Glyndebourne 139.5-140.5 m.

Fig. 5. Cythereis rudispinata (Chapman & Sherborn) ; Dorsal, female (x58) ; number 259 ; Glyndebourne 139.5-140.5 m.

Fig. 6. Platycythereis sp.A. sp.nov. ; Dorsal, female (x68) ; Glyndebourne 74.5-75 m, (not numbered).

Fig. 7. Platycythereis sp.A. sp.nov. ; Right valve, female (x71) ; number 202 ; Glyndebourne 74.5-75 m.

Fig. 8. Cythereis rudispinata (Chapman & Sherborn) ; Right valve, female (x81) ; number 258 ; Glyndebourne 139.5-140.5 m.

Fig. 9. Protocythere siddiqui Weaver ; Left valve, female (x45) ; number 322 ; Cauville 5.

Fig. 10. Protocythere derooi Oertli ; Right valve, female, carapace (x70) ; number 317 ; Glyndebourne 146.5-147.5 m.

Fig. 11. Protocythere siddiqui Weaver ; Left valve, male (x45) ; number 323 ; Cauville 5.

Fig. 12. Protocythere lineata (Chapman & Sherborn) ; Right valve, male (x47) ; number 318 ; Glyndebourne 131.5-132.

Fig. 13. Protocythere lineata (Chapman & Sherborn) ; Right valve, hinge (x80) ; Glyndebourne 131.5-132 m.

Fig. 14. Protocythere lineata (Chapman & Sherborn) ; Left valve, male (x46) ; number 319 ; Glyndebourne 131.5-132 m.

Fig. 15. Protocythere lineata (Chapman & Sherborn) ; Left valve, female (x46) ; number 321b ; Glyndebourne 123.5-124 m.

Fig. 16. Protocythere lineata (Chapman & Sherborn) ; Right valve, male (x46) ; number 321c ; Glyndebourne 131.5-132 m.

Fig. 17. Protocythere lineata (Chapman & Sherborn) ; Dorsal,male (x46) ; number 321d ; Glyndebourne 146.5-147.5 m.

Fig. 18. Protocythere lineata (Chapman & Sherborn) ; Left valve, female (x50) ; number 321e ; Glyndebourne 123.5-124 m.

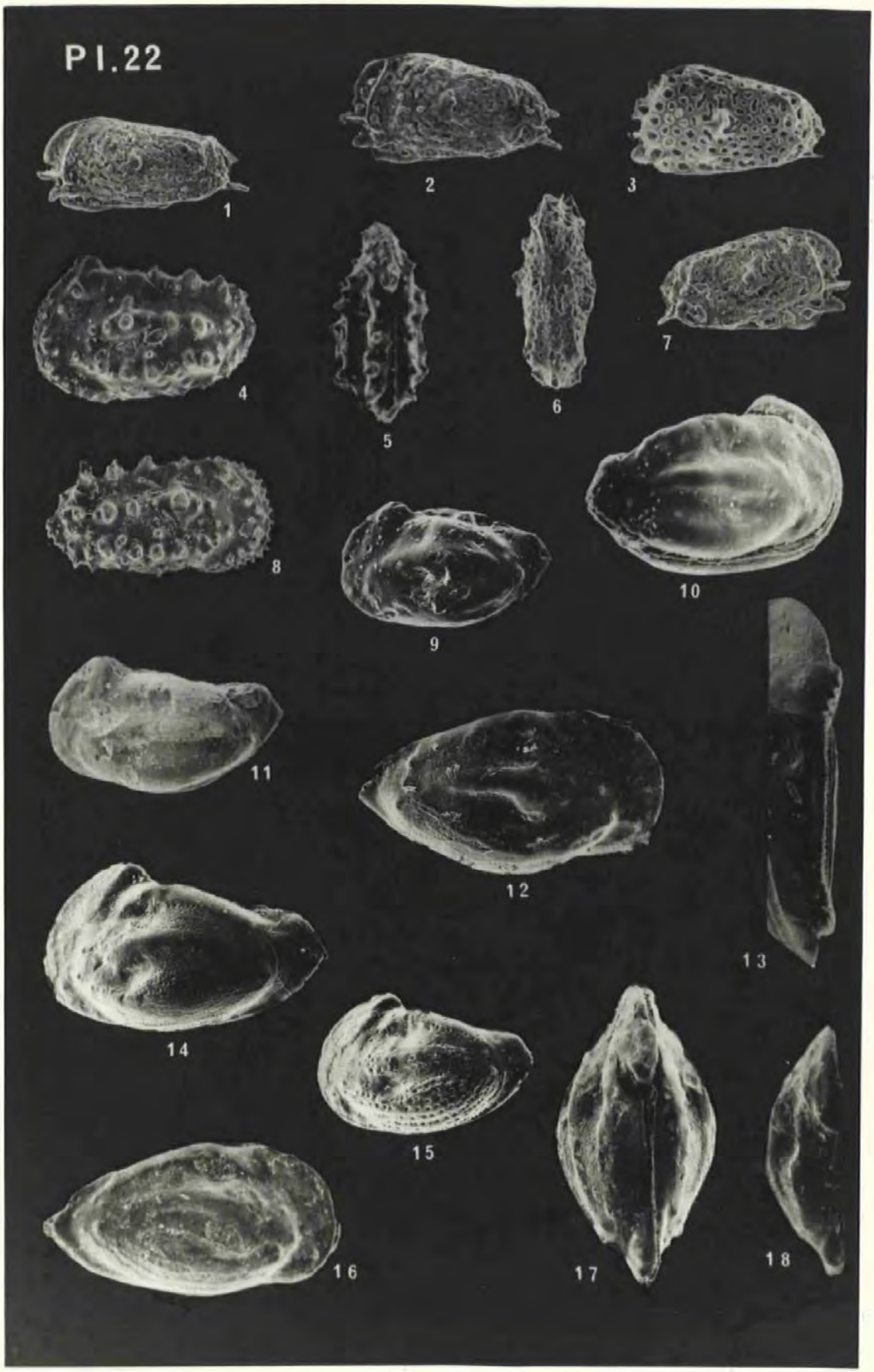
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PLATE 23

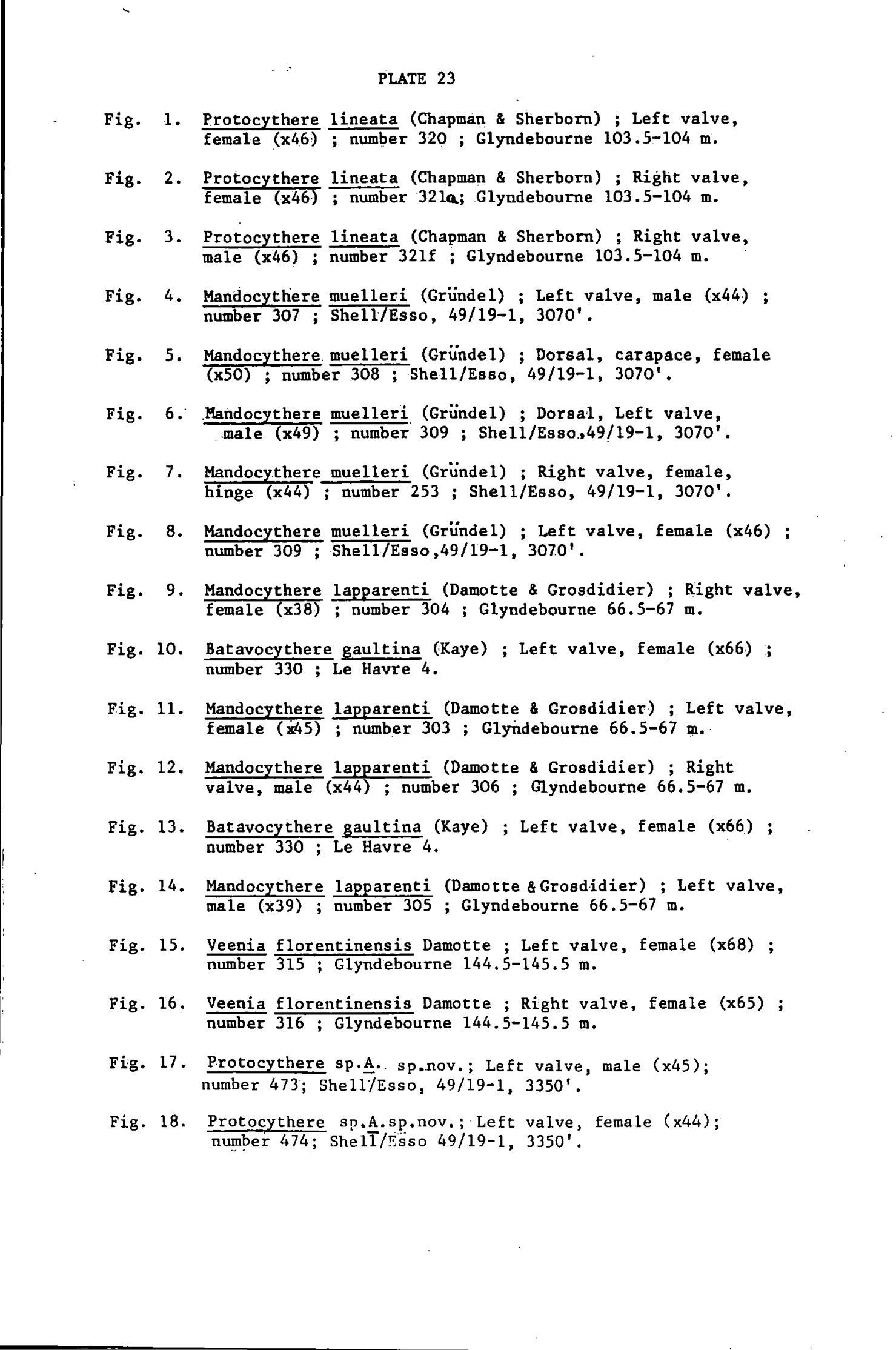

Fig. 1. Protocythere lineata (Chapman & Sherborn) ; Left valve, female (x46) ; number 320 ; Glyndebourne 103.5-104 m.

Fig. 2. Protocythere lineata (Chapman & Sherborn) ; Right valve, female (x46) ; number 321a; Glyndebourne 103.5-104 m.

Fig. 3. Protocythere lineata (Chapman & Sherborn) ; Right valve, male (x46) ; number 321f ; Glyndebourne 103.5-104 m.

Fig. 4. Mandocythere muelleri (Gründel) ; Left valve, male (x44) ; number 307 ; Shell/Esso, 49/19-1, 3070'.

Fig. 5. Mandocythere muelleri (Gründel) ; Dorsal, carapace, female (x50) ; number 308 ; Shell/Esso, 49/19-1, 3070'.

Fig. 6. Mandocythere muelleri (Gründel) ; Dorsal, Left valve, male (x49) ; number 309 ; Shell/Esso,49/19-1, 3070'.

Fig. 7. Mandocythere muelleri (Gründel) ; Right valve, female, hinge (x44) ; number 253 ; Shell/Esso, 49/19-1, 3070'.

Fig. 8. Mandocythere muelleri (Gründel) ; Left valve, female (x46) ; number 309 ; Shell/Esso,49/19-1, 3070'.

Fig. 9. Mandocythere lapparenti (Damotte & Grosdidier) ; Right valve, female (x38) ; number 304 ; Glyndebourne 66.5-67 m.

Fig. 10. Batavocythere gaultina (Kaye) ; Left valve, female (x66) ; number 330 ; Le Havre 4.

Fig. 11. Mandocythere lapparenti (Damotte & Grosdidier) ; Left valve, female (x45) ; number 303 ; Glyndebourne 66.5-67 m.

Fig. 12. Mandocythere lapparenti (Damotte & Grosdidier) ; Right valve, male (x44) ; number 306 ; Glyndebourne 66.5-67 m.

Fig. 13. Batavocythere gaultina (Kaye) ; Left valve, female (x66) ; number 330 ; Le Havre 4.

Fig. 14. Mandocythere lapparenti (Damotte & Grosdidier) ; Left valve, male (x39) ; number 305 ; Glyndebourne 66.5-67 m.

Fig. 15. Veenia florentinensis Damotte ; Left valve, female (x68) ; number 315 ; Glyndebourne 144.5-145.5 m.

Fig. 16. Veenia florentinensis Damotte ; Right valve, female (x65) ; number 316 ; Glyndebourne 144.5-145.5 m.

Fig. 17. Protocythere sp.A. sp.nov.; Left valve, male (x45); number 473; Shell/Esso, 49/19-1, 3350'.

Fig. 18. Protocythere sp.A.sp.nov.; Left valve, female (x44); number 474; Shell/Esso 49/19-1, 3350'.

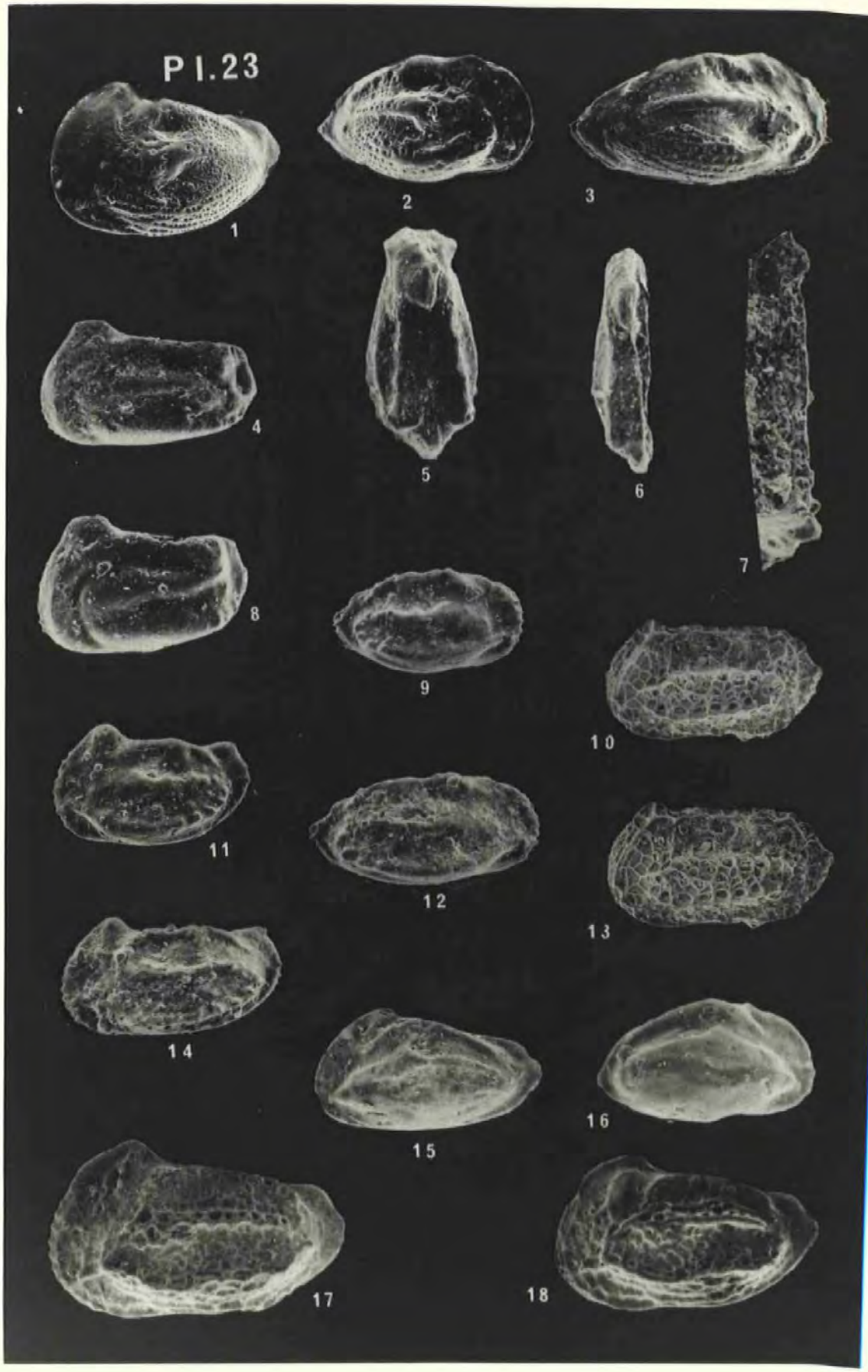
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PLATE 24

Fig. 1. Protocythere striata (Gründel) ; Left valve, female (x47) ; number 324 ; Glyndebourne 72.5-73 m.

Fig. 2. Protocythere striata (Gründel) ; Right valve, female (x47) ; number 325 ; Glyndebourne 72.5-73 m.

Fig. 3. Protocythere striata (Gründel) ; Right valve, female (x50) ; number 326 ; East Wear Bay 3.

Fig. 4. Protocythere striata (Gründel) ; Left valve, female (x47) ; East Wear Bay 3 (not numbered).

Fig. 5. Protocythere striata (Gründel) ; Dorsal, male (x50) ; Speeton 6 (not numbered).

Fig. 6. Protocythere striata (Gründel) ; Left valve, male (x52) ; number 328 ; East Wear Bay 3.

Fig. 7. Protocythere striata (Gründel) ; Left valve, male (x47) ; number 327 ; Glyndebourne 72.5-73 m.

Fig. 8. Protocythere striata (Gründel) ; Dorsal, female (x47) ; Speeton 6 (not numbered).

Fig. 9. Neocythere (Centrocythere) denticulata Mertens ; Left valve, female (x65) ; number 350 ; Glyndebourne 109.5-110 m.

Fig. 10. Protocythere striata (Gründel) ; Right valve, female (x49) ; number 329 ; East Wear Bay 3.

Fig. 11. Neocythere (Centrocythere) denticulata Mertens ; Right valve, female (x65) ; number 351 ; Glyndebourne 109.5-110 m.

Fig. 12. Neocythere (Centrocythere) denticulata Mertens ; Left valve, male (x64) ; number 352 ; Glyndebourne 109.5-110 m.

Fig. 13. Neocythere (Centrocythere) denticulata Mertens ; Right valve, male (x64) ; number 353 ; Glyndebourne 109.5-110 m.

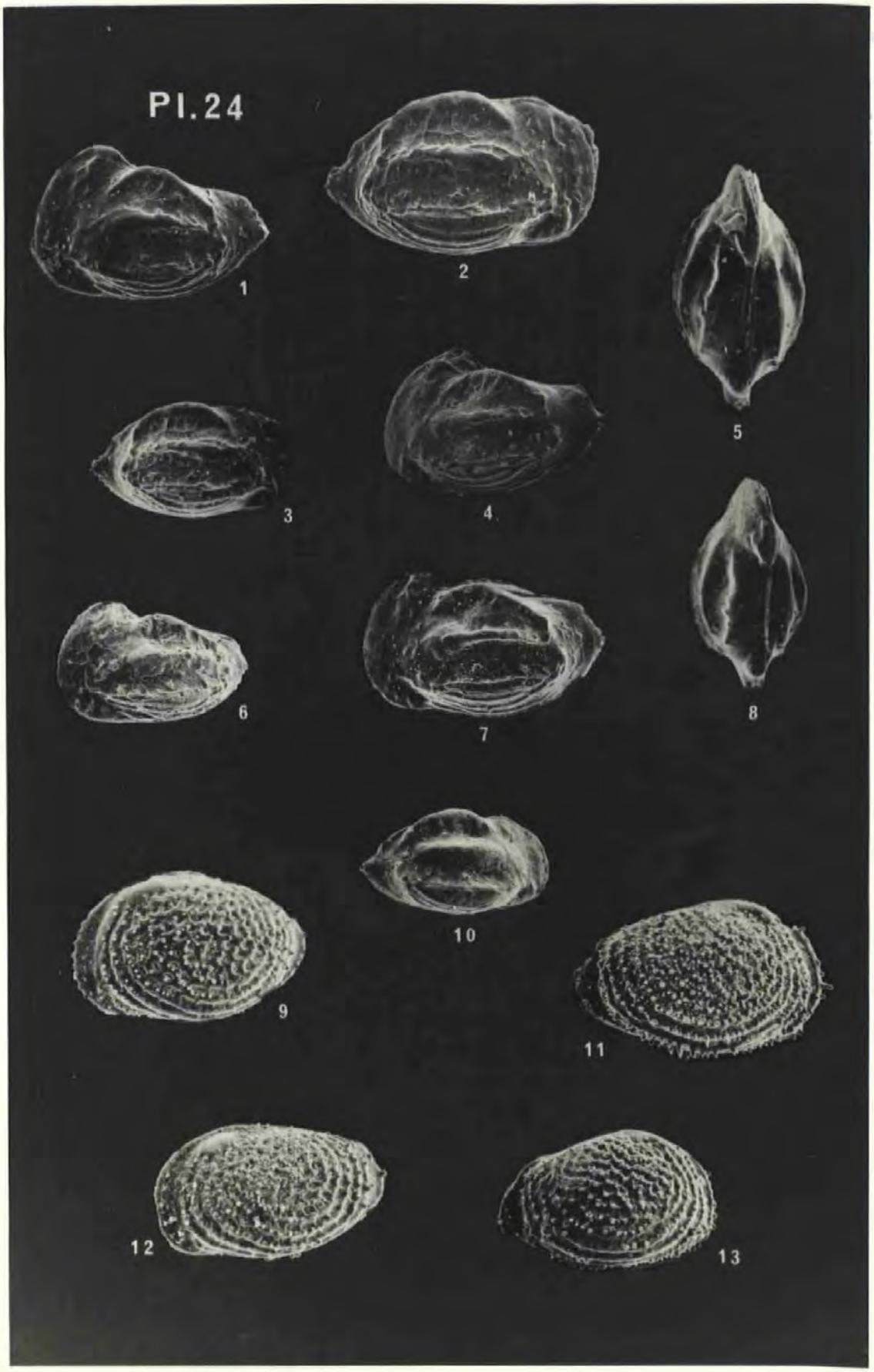
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PLATE 25

Fig. 1. Mandocythere ex.gr.M.harrisiana (Jones) ; Left valve, female (x43) ; number 286 ; Glyndebourne 120.5-121.0 m.

Fig. 2. Mandocythere ex.gr.M.harrisiana (Jones) ; Left valve, male (x45) ; number 287 ; Glyndebourne 140.5-141.5 m.

Fig. 3. Mandocythere ex.gr.M.harrisiana (Jones) ; Left valve, male (x48) ; number 288 ; Glyndebourne 140.5-141.5 m.

Fig. 4. Mandocythere ex.gr.M.harrisiana (Jones) ; Left valve, female (x49) ; number 289 ; Glyndebourne 131.5-132 m.

Fig. 5. Mandocythere ex.gr.M.harrisiana (Jones) ; Right valve, male (x38) ; number 290 ; Glyndebourne 140.5-141.5 m.

Fig. 6. Mandocythere ex.gr.M.harrisiana (Jones) ; Dorsal, carapace, male (x46) ; number 291 ; Glyndebourne 120.5-121 m.

Fig. 7. Mandocythere ex.gr.M.harrisiana (Jones) ; Left valve, male (x44) ; number 292 ; Glyndebourne 101.5-102 m.

Fig. 8. Mandocythere ex.gr.M.harrisiana (Jones) ; Left valve, female (x47) ; number 293 ; Glyndebourne 101.5-102 m.

Fig. 9. Mandocythere ex.gr.M.harrisiana (Jones) ; pitted, anterior margin, right valve, female (x165) ; number 297 ; Glyndebourne 101.5-102 m.

Fig. 10. Mandocythere ex.gr.M.harrisiana (Jones) ; Dorsal, carapace, female (x47) ; number 295 ; Glyndebourne 120.5-121 m.

Fig. 11. Mandocythere ex.gr.M.harrisiana (Jones) ; Left valve, male, (x44) ; number 296 ; Borehole 16/3, 17'0".

Fig. 12. Mandocythere ex.gr.M.harrisiana (Jones) ; Right valve, female (x43) ; number 297 ; Glyndebourne 101.5-102 m.

Fig. 13. Mandocythere ex.gr.M.harrisiana (Jones) ; Left valve, female (x44) ; number 298 ; Melton 2.

Fig. 14. Mandocythere ex.gr.M.harrisiana (Jones) ; Left valve, -1 (x62) ; number 294 ; Glyndebourne 63.5-64 m.

Fig. 15. Mandocythere ex.gr.M.harrisiana (Jones) ; Left valve, female (x48) ; number 300 ; Borehole 16/3, 17'0".

Fig. 16. Mandocythere ex.gr.M.harrisiana (Jones) ; Left valve, male (x48) ; number 301 ; Borehole 16/3, 26'0".

Fig. 17. Mandocythere ex.gr.M.harrisiana (Jones) ; Left valve, -1 (x49) ; number 302 ; Speeton 6.

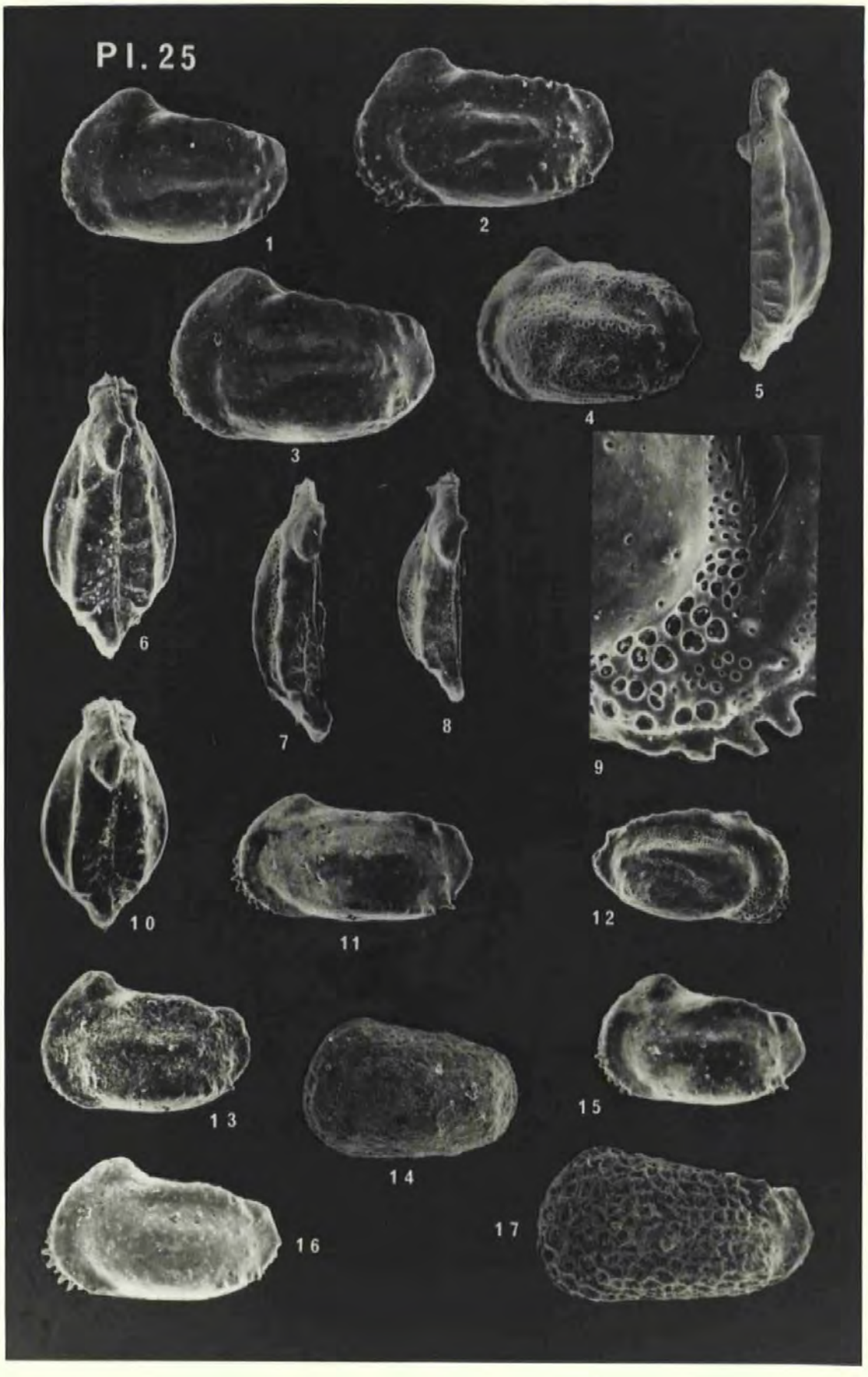
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PLATE 26

Fig. 1. Neocythere (Physocythere) semiconcentrica (Mertens) ; Left valve, female (x68) ; number 338 ; Glyndebourne 91.5-92 m.

Fig. 2. Neocythere (Physocythere) semiconcentrica (Mertens) ; Right valve, female (x68) ; number 339 ; Glyndebourne 91.5-92 m.

Fig. 3. Neocythere (Physocythere) semiconcentrica (Mertens) ; Dorsal, carapace, female (x72) ; number 340 ; Glyndebourne 91.5-92 m.

Fig. 4. Neocythere (Neocythere) vanveeni Mertens ; Left valve, female (x68) ; number 330 ; Glyndebourne 53.5-54 m.

Fig. 5. Neocythere (Neocythere) vanveeni Mertens ; Left valve, male (x62) ; number 331 ; Glyndebourne 53.5-54 m.

Fig. 6. Neocythere (Neocythere) vanveeni Mertens ; Dorsal, carapace, female (x67) ; number 333 ; Glyndebourne 53.5-54 m.

Fig. 7. Neocythere (Physocythere) semiconcentrica (Mertens) ; Left valve, male (x68) ; number 336 ; Glyndebourne 91.5-92 m.

Fig. 8. Neocythere (Neocythere) vanveeni Mertens ; Right valve, female (x67) ; number 332 ; Glyndebourne 53.5-54 m.

Fig. 9. Neocythere (Physocythere) tenuis Kaye ; Right valve, female (x93) ; number 344 ; Glyndebourne 142.5-143.5 m.

Fig. 10. Neocythere (Physocythere) semiconcentrica (Mertens) ; Left valve, female (x71) ; number 337 ; Glyndebourne 91.5-92 m.

Fig. 11. Neocythere (Centrocythere) posterospinosa Weaver ; Left valve, female (x66) ; number 355 ; Cauville 6.

Fig. 12. Neocythere (Centrocythere) posterospinosa Weaver ; Right valve, female (x64) ; number 356 ; Cauville 6.

Fig. 13. Neocythere (Physocythere) hieroglyphica Kaye ; Right valve, female (x67) ; number 343 ; Melton 3.

Fig. 14. Neocythere (Physocythere) sp.A. Weaver ; Left valve, female (x63) ; number 345 ; Glyndebourne 95.5-96 m.

Fig. 15. Neocythere (Physocythere) steghausi (Mertens) ; Left valve, female (x68) ; number 340a; Glyndebourne 58.5-59 m.

Fig. 16. Neocythere (Physocythere) sp.A. Weaver ; Right valve, female (x56) ; number 346 ; Glyndebourne 95.5-96 m.

Fig. 17. Neocythere (Physocythere) sp.A. Weaver ; Right valve, male (x59) ; number 347 ; Glyndebourne 95.5-96 m.

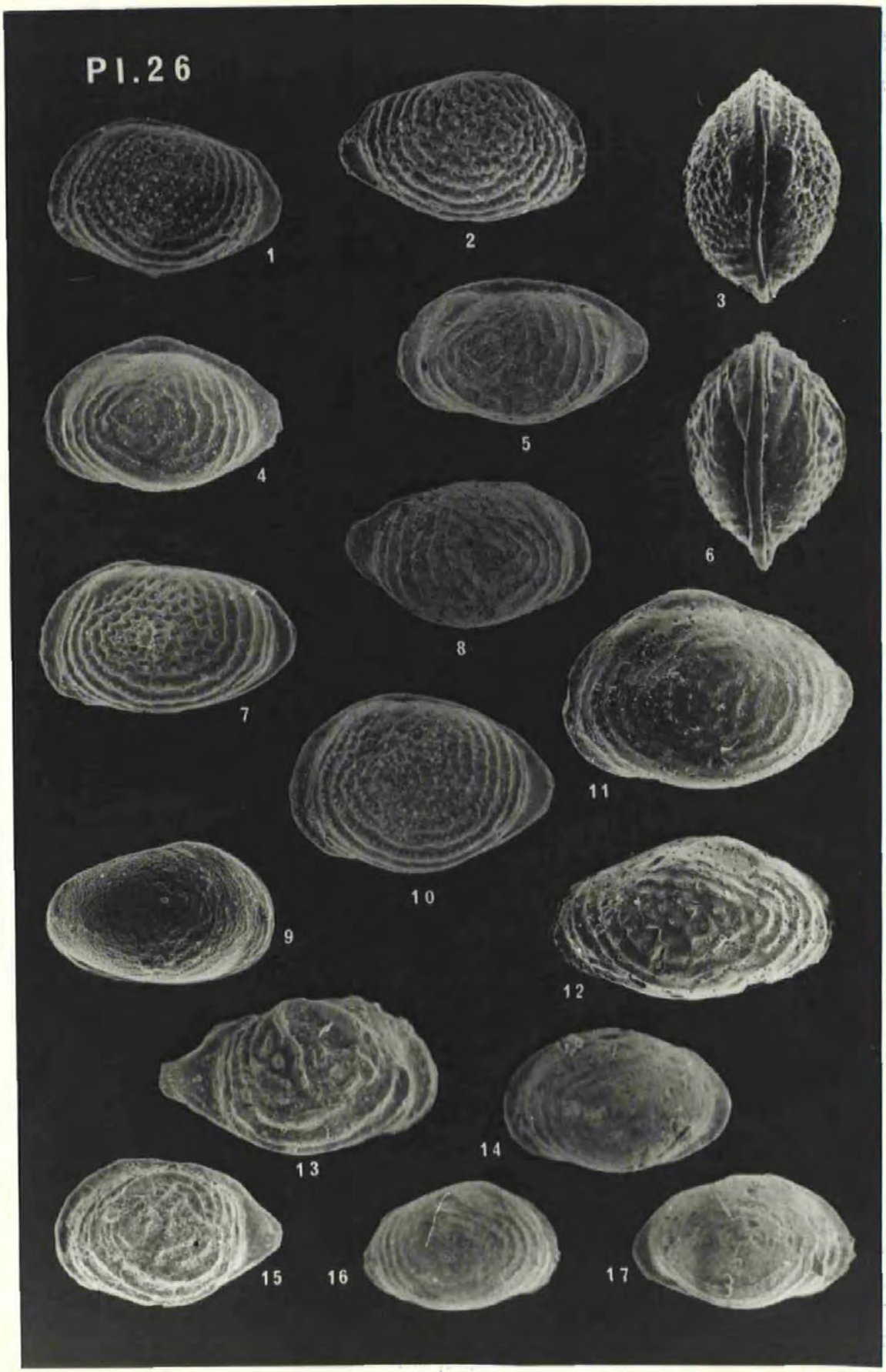
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PLATE 27

Fig. 1. Neocythere (Neocythere) vanveeni Mertens ; Right valve, hinge (x145) ; Glyndebourne 120.5-121 m.(not numbered).

Figs. 2,3. Neocythere (Physocythere) steghausi (Mertens) ; Right valve hinge ; Fig. 2 (x122) Fig. 3 (x146) ; Glyndebourne 58.5-59 m.(neither numbered).

Fig. 4. Neocythere (Physocythere) sp.C.sp.nov. ; Right valve, hinge (x203) ; Beer 6 (not numbered).

Figs. 5-7, 11-18 Neocythere (Centrocythere) denticulata Mertens ; Right valve hinge ; Fig. 5 (x161) Glyndebourne 92.5-93 m ; Fig. 6 (x178) Glyndebourne 97.5-98 m ; Fig. 7 (x170) Folkestone 13/8/22 ; Fig. 11 (x145) Glyndebourne 53.5-54 m ; Fig. 12 (x143) Glyndebourne 91.5-92 ; Fig. 13 (x148) Glyndebourne 91.5-92.0 m ; Fig. 14 (x145) Glyndebourne 91.5-92 m ; Fig. 15 (x135) Glyndebourne 97.5-98 m ; Fig. 16 (x148) Glyndebourne 56.5-57 m ; Fig. 17 (x119) Glyndebourne 97.5-98 m ; Fig. 18 (x130) Glyndebourne 115.5-116 m.(none numbered).

Fig. 8. Neocythere (Centrocythere) posterospinosa Weaver ; Right valve hinge (x126) ; Cauville C6 (not numbered).

Figs.9,10. Neocythere (Physocythere) semiconcentrica (Mertens) ; Right valve hinge ; Fig. 9 (x156) Glyndebourne 88.5-89 m ; Fig. 10 (x153) Glyndebourne 88.5-89 m. (neither numbered).

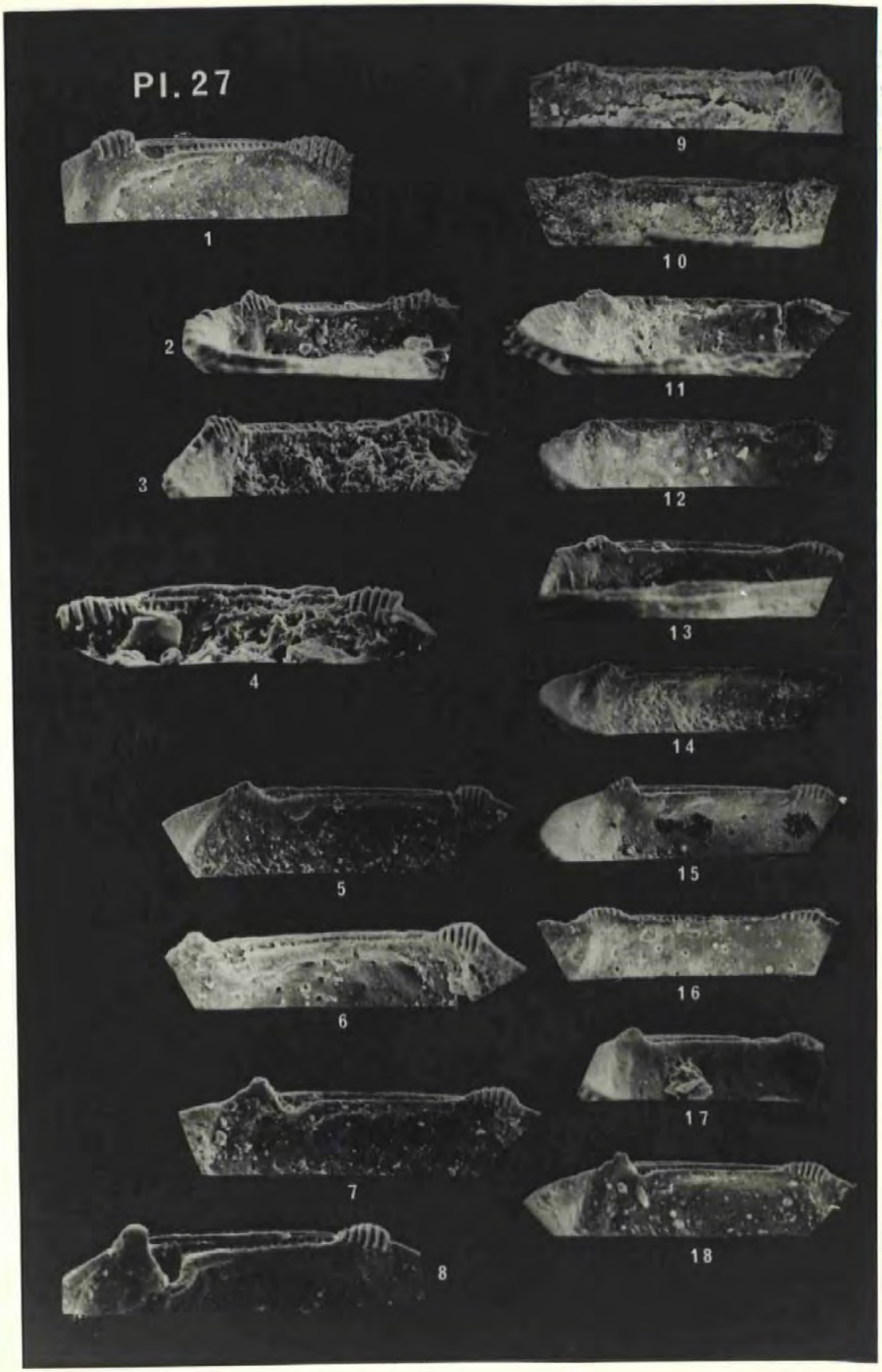
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PLATE 28

Fig. 1. Neocythere sp.C. sp.nov. ; Left valve, female (x105) ; number 348 ; Beer 6.

Fig. 2. Clithrocytheridea heslertonensis Kaye ; Right valve, female, internal (x47) ; number 370a; Glyndebourne 138.5-139 m.

Fig. 3. Neocythere sp.C.sp.nov. ; Right valve, female (x97) ; number 349 ; Beer 6.

Fig. 4. Clithrocytheridea aff. Haplocytheridea nana (Triebel) ; Left valve, female (x106) ; number 475 ; Glyndebourne 141.5-142 m.

Fig. 5. Clithrocytheridea aff. Haplocytheridea nana (Triebel) ; Left valve, female (x89) ; number 476 ; Glyndebourne 53.5-54 m.

Fig. 6. Clithrocytheridea heslertonensis Kaye ; Right valve, female, hinge (x89) ; number 370b; Glyndebourne 138.5-139 m.

Fig. 7. Acrocythere hauteriviana (Bartenstein) ; Left valve (x67) ; number 457 ; Shell/Esso 49/19-1, 3350'.

Fig. 8. Clithrocytheridea aff. Haplocytheridea nana (Triebel) ; Right valve, male (x78) ; number 477 ; Glyndebourne 141.5-142 m.

Fig. 9. Clithrocytheridea aff. Haplocytheridea nana (Triebel) ; Dorsal, female, left valve (x69) ; number 478 ; Glyndebourne 141.5-142 m.

Fig. 10. Clithrocytheridea aff. Haplocytheridea nana (Triebel) ; Left valve, dorsal, male (x70) ; number 479 ; Glyndebourne 141.5-142 m.

Fig. 11. Acrocythere striata Kaye ; Left valve, female (x95) ; number 378 ; Beer 6.

Fig. 12. Hemicytherura euglyphea Kaye ; Right valve, female (x136) ; number 458 ; Glyndebourne 53.5-54 m.

Fig. 13. Clithrocytheridea aff.Haplocytheridea nana (Triebel) ; Right valve, female (x89) ; number 480 ; Glyndebourne 53.5-54 m.

Fig. 14. Gen.A.sp.nov. ; Dorsal, female (x108) ; number 466 ; Glyndebourne 123.5-124 m.

Fig. 15. Hemicytherura euglyphea Kaye ; Right valve, female (x146) ; number 459 ; Glyndebourne 105.5-106 m.

Fig. 16. Gen.A.sp.nov. ; Left valve, female (x110) ; number 467 ; Glyndebourne 123.5-124 m.

Fig. 17. Gen.A.sp.nov. ; Left valve, male (x102) ; number 468 ; Glyndebourne 99.5-100 m.

Fig. 18. Hemicytherura euglyphea Kaye ; Dorsal, carapace, female (x142) ; number 460 ; Glyndebourne 53.5-54 m.

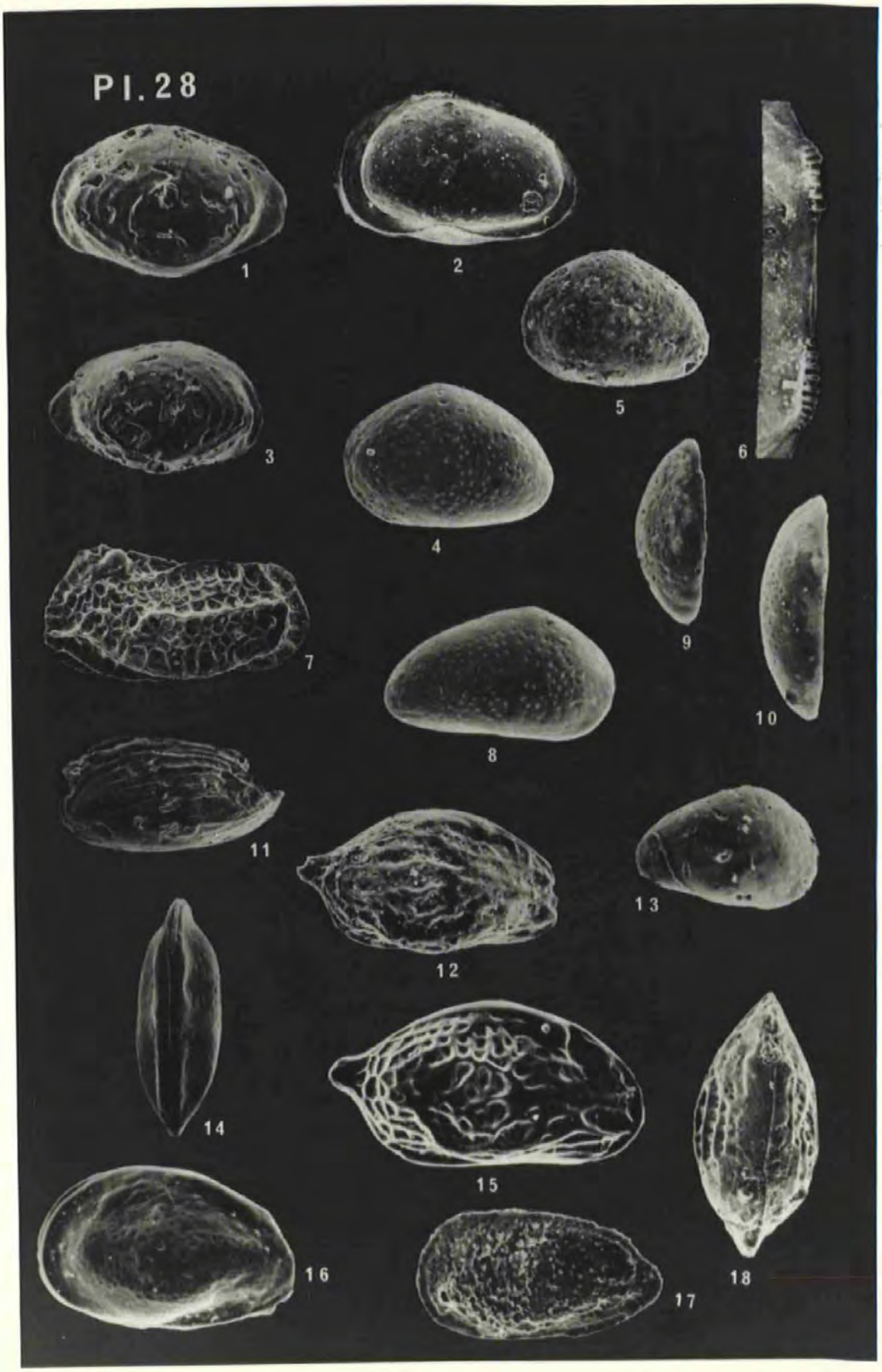
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PLATE 29

Fig. 1. Schuleridea jonesiana (Bosquet) ; Left valve, female (x45) ; number 379 ; Glyndebourne 95.5-96 m.

Fig. 2. Schuleridea jonesiana (Bosquet) ; Left valve, male (x41) ; number 380 ; Glyndebourne 95.5-96 m.

Fig. 3. Schuleridea jonesiana (Bosquet) ; Right valve, female (x49) ; number 381 ; Glyndebourne 95.5-96 m.

Fig. 4. Schuleridea jonesiana (Bosquet) ; Dorsal, carapace, female (x49) ; number 382 ; Glyndebourne 95.5-96 m.

Fig. 5. Schuleridea jonesiana (Bosquet) ; Left valve, female (x50) ; number 383 ; Beer 6.

Fig. 6. Habrocythere fragilis Triebel ; Right valve, male (x88) ; number 390 ; Glyndebourne 92.5-93 m.

Fig. 7. Habrocythere fragilis Triebel ; Dorsal, carapace, male (x80) ; number 391 ; Glyndebourne 92.5-93 m.

Fig. 8. Schuleridea jonesiana (Bosquet) ; Right valve, male (x45) ; number 384 ; Beer 6.

Fig. 9. Habrocythere fragilis Triebel ; Left valve, female (x81) ; number 392 ; Glyndebourne 92.5-93 m.

Fig. 10. Habrocythere fragilis Triebel ; Left valve, female (x84) ; number 393 ; Glyndebourne 92.5-93 m.

Fig. 11. Habrocythere fragilis Triebel ; Right valve, female (x85) ; number 394 ; Glyndebourne 92.5-93 m.

Fig. 12. Schuleridea dimorphica Kaye ; Right valve, male (x72) ; number 385 ; Glyndebourne 115.5-116 m.

Fig. 13. Schuleridea dimorphica Kaye ; Left valve, male (x69) ; number 386 ; Glyndebourne 115.5-116 m.

Fig. 14. Schuleridea dimorphica Kaye ; Right valve, female (x77) ; number 387 ; Glyndebourne 115.5-116 m.

Fig. 15. Schuleridea dimorphica Kaye ; Left valve, dorsal, female (x69) ; number 388 ; Glyndebourne 115.5-116 m.

Fig. 16. Schuleridea dimorphica Kaye ; Left valve, male (x73) ; number 389 ; Glyndebourne 115.5-116 m.

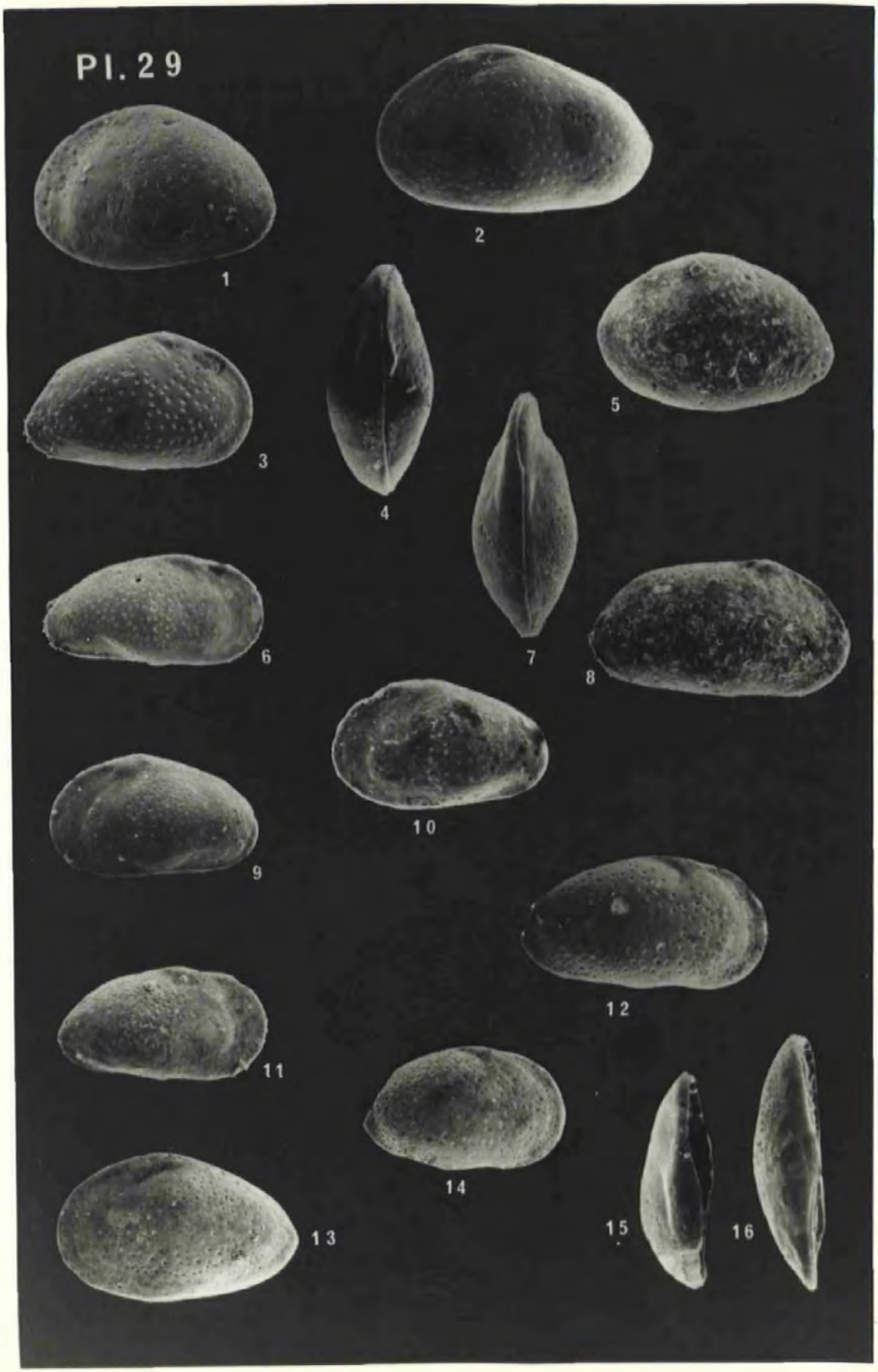
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PLATE 30

Fig. 1. Eucythere trigonalis (Jones & Hinde) ; Left valve, male (x66) ; number 395 ; Glyndebourne 121-121.5 m.

Fig. 2. Eucythere trigonalis (Jones & Hinde) ; Left valve, female (x67) ; number 396 ; Glyndebourne 121-121.5 m.

Fig. 3. Eucythere trigonalis (Jones & Hinde) ; Right valve, female (x68) ; number 397 ; Glyndebourne 121-121.5 m.

Fig. 4. Dolocytheridea typica Kaye ; Right valve, female (x80) ; number 376 ; Beer 6.

Fig. 5. Dolocytheridea bosquetiana (Jones & Hinde) ; Right valve, male (x59) ; number 373 ; Glyndebourne 108.5-109 m.

Fig. 6. Eucythere trigonalis (Jones & Hinde) ; Dorsal, carapace, female (x74) ; number 398 ; Glyndebourne 121-121.5 m.

Fig. 7. Dolocytheridea bosquetiana (Jones & Hinde) ; Left valve, male (x66) ; number 374 ; Glyndebourne 108.5-109 m.

Fig. 8. Dolocytheridea bosquetiana (Jones & Hinde) ; Left valve, female (x59) ; number 375 ; Glyndebourne 108.5-109 m.

Fig. 9. Clithrocytheridea heslertonensis Kaye ; Right valve, female (x45) ; number 370b ; Glyndebourne 138.5-139 m.

Fig. 10. Alatacythere sp.A. sp.nov. ; Left valve, male (x42) ; number 440 ; Glyndebourne 54.5-55 m.

Fig. 11. Alatacythere robusta langi (Jones & Hinde) ; Right valve, female (x48) ; number 442 ; Beer 6.

Fig. 12. Alatacythere sp.A. sp.nov. ; Right valve female (x43) ; number 441 ; Glyndebourne 54.5-55 m.

Fig. 13. Pedicythere sp.A. sp.nov. ; Left valve, female (x133); number 463; Folkestone 15/8/7.

Fig. 14. Pedicythere sp.A. sp.nov. ; Left valve, female (x129); number 464; Glyndebourne 52.5-53 m.

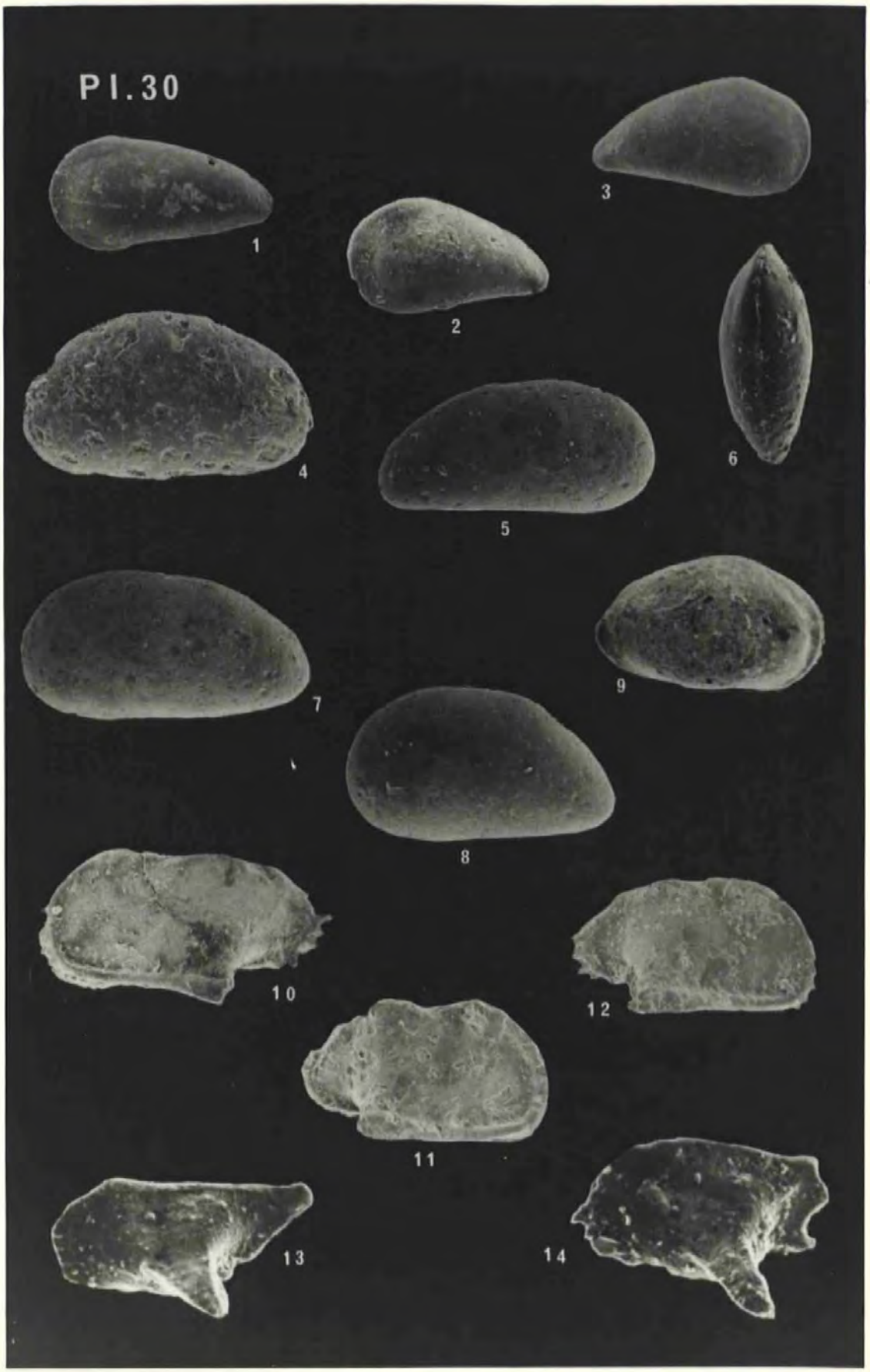
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PLATE 31

Fig. 1. Cytherura striatoides Bonnema ; Left valve, female (x141) ; East Wear Bay 4 ; number 434.

Fig. 2. Saidia nettgauensis Gründel ; Right valve, female (x117) ; number 452 ; Glyndebourne 68.5-69 m.

Fig. 3. Saidia nettgauensis Gründel ; Left valve, female (x114) ; number 453 ; Glyndebourne 68.5-69 m.

Fig. 4. Orthonotacythere fordensis Kaye ; Right valve, female (x89) ; number 415 ; Glyndebourne 139.5-140.5 m.

Fig. 5. Eucytherura sp.A. sp.nov. ; Right valve, female (x143) ; number 413 ; Glyndebourne 52.5-53 m.

Fig. 6. Orthonotacythere fordensis Kaye ; Right valve, hing (x91) ; number 415 ; Glyndebourne 52.5-53 m.

Fig. 7. Eucytherura sp.A. sp.nov. ; Left valve, female (x138) ; number 410 ; Glyndebourne 52.5-53 m.

Fig. 8. Eucytherura sp.A. sp.nov. ; Dorsal, carapace, female (x140) ; number 411 ; Glyndebourne 52.5-53 m.

Fig. 9. Eucytherura sp.A. sp.nov. ; Right valve, female (x132) ; number 412 ; Glyndebourne 52.5-53 m.

Fig. 10. Hemiparacytheridea minutissima (Kaye) ; Left valve, female (x127) ; number 465a ; Folkestone 13/8/6.

Fig. 11. Eucytherura multituberculata Gründel ; Right valve, female (x164) ; number 406 ; Glyndebourne 114.5-115 m.

Fig. 12. Hemiparacytheridea minutissima(Kaye) ; Right valve, female (x127) ; number 465b ; Folkestone 13/8/6.

Fig. 13. Eucytherura gründeli Weaver ; Left valve, female (x135) ; number 404a ; Glyndebourne 52.5-53 m.

Fig. 14. Pseudobythocythere goerlichi Mertens ; Left valve, female (x70) ; number 416 ; Shell/Esso 49/19-1, 3350'.

Fig. 15. Eucytherura multituberculata Gründel ; Left valve, female (x164) ; number 407 ; Glyndebourne 114.5-115 m.

Fig. 16. Eucytherura multituberculata Gründel ; Right valve, internal, female (x146) ; number 408 ; Glyndebourne 114.5-115 m.

Fig. 17. Eucytherura sp.aff.E.nuda Kaye ; Left valve, female (x86) ; number 469 ; Folkestone 13/8/7.

Fig. 18. Eucytherura sp.aff.E.nuda Kaye ; Right valve, female (x86) ; number 470 ; Folkestone 13/8/7.

Fig. 19. Eucytherura kayei Weaver ; Left valve, female (x94) ; number 405 ; Folkestone 13/8/6.

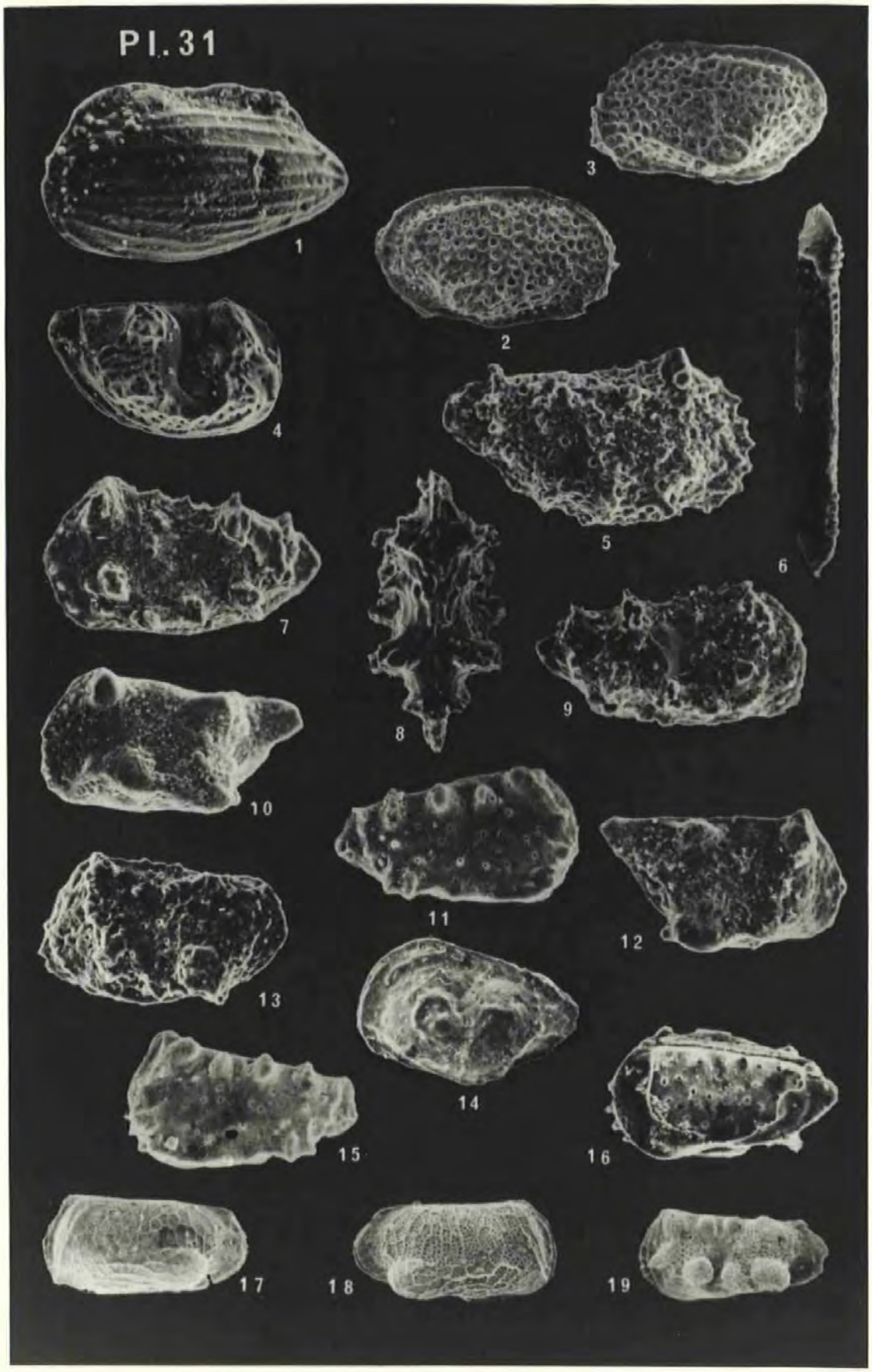
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PLATE 32

Fig. 1. Cytheropteron (C.) nanissimum Damotte & Grosdidier ; number 426; Left valve, female (x145) ; Folkestone 11(77).

Fig. 2. Cytheropteron (C.) milbournei Kaye ; Right valve, female (x124) ; number 420 ; Glyndebourne 130.5-131 m.

Fig. 3. Cytheropteron (C.) milbournei Kaye ; Left valve, female (x140) ; number 421 ; Glyndebourne 130.5-131 m.

Fig. 4. Cytheropteron (C.) nanissimum Damotte & Grosdidier ; Right valve, female (x127) ; number 424 ; Folkestone 11(77).

Fig. 5. Cytheropteron (C.) fenestrata Kaye Right valve, female (x138) ; number 427 ; Glyndebourne 140.5-141.5 m.

Fig. 6. Cytheropteron sp.A. sp.nov. ; Right valve, female (x146) ; Shell/Esso, 49/19-1, 3350'. (not included in text).

Fig. 7. Cytheropteron (C.) nanissimum Damotte & Grosdidier ; Dorsal, carapace, female (x133) ; number 425 ; Folkestone 11(77).

Fig. 8. Eucytherura longisculpta Weaver ; Dorsal, carapace, female (x135) ; number 422 ; Glyndebourne 53.5-54 m.

Fig. 9. Cytheropteron (C.) nanissimum Damotte & Grosdidier ; Right valve, female (x424) ; Folkestone 11(77).

Fig. 10. Eucytherura longiculpta Weaver ; Left valve, carapace, female (x140) ; number 423 ; Folkestone 11(77).

Fig. 11. Cytheropteron (Eocytheropteron) protonsa Kaye ; Right valve, female (x64) ; number 428 ; Borehole 113/2, 92'6".

Fig. 12. Cytheropteron (Infracytheropteron) obscura Kaye ; Left valve, female (x90) ; number 431 ; Glyndebourne 94.5-95 m.

Fig. 13. Cytheropteron (Eocytheropteron) protonsa Kaye ; Left valve, female (x65) ; number 429 ; Borehole 113/2, 52'0".

Fig. 14. Cytheropteron (Eocytheropteron) protonsa Kaye ; Left valve, hinge (x152) ; number 429 ; Borehole 113/2, 52'0".

Fig. 15. Cytheropteron (C.) arguta Kaye; Left valve, female (x95); number 417; Borehole 16/3, 12'6".

Fig. 16. Cytheropteron (C.) arguta Kaye ; Left valve, female (x92) ; number 418 ; Borehole 16/3, 12'6".

Fig. 17. Cytheropteron (C.) arguta Kaye ; Right valve, female (x90) ; number 419 ; Borehole 16/3, 12'6"

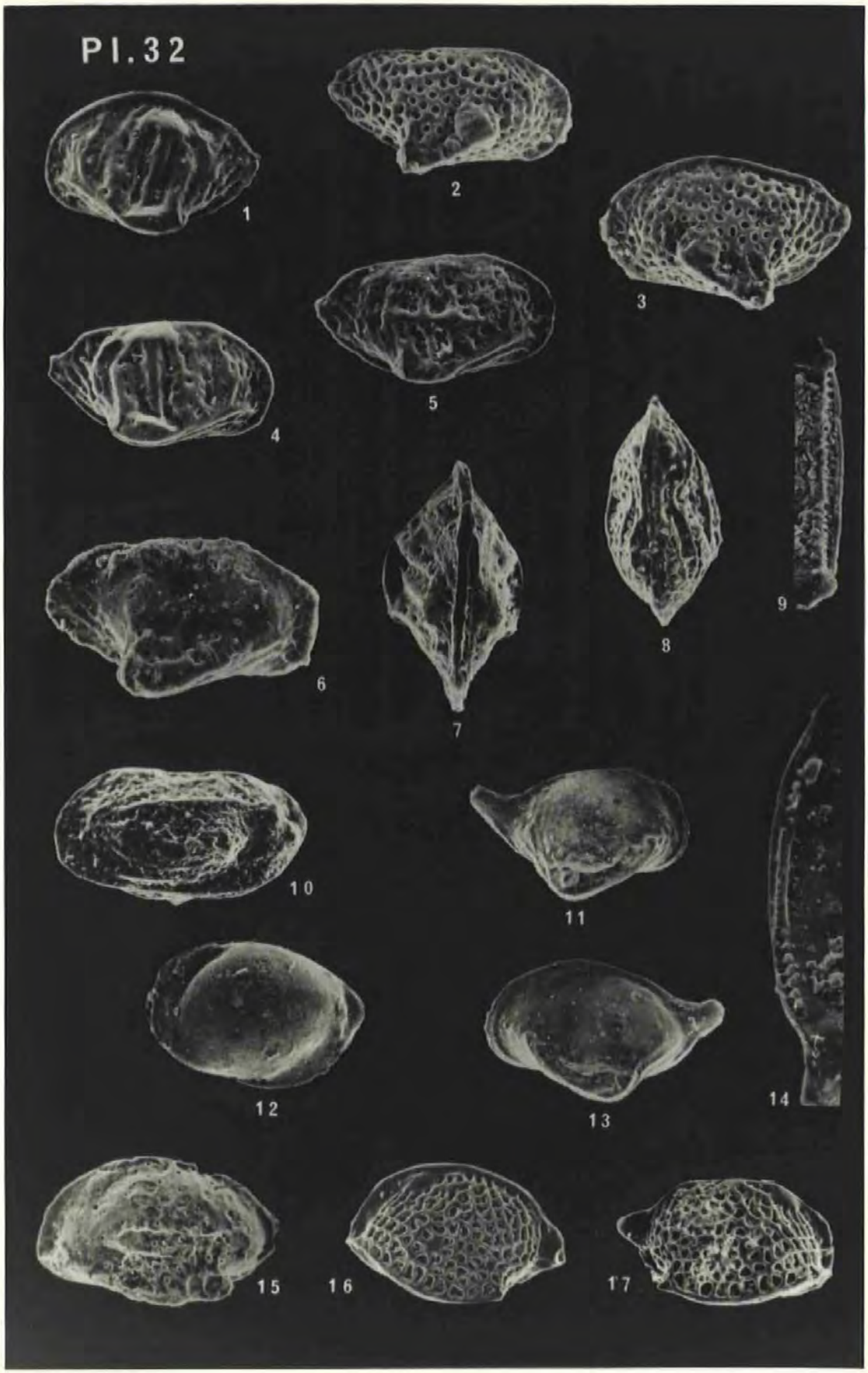
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PLATE 33

Fig. 1. Loxoconcha?icknieldensis Weaver ; Left valve, male, internal (x106) ; number 435 ; Borehole 16/3, 14'0".

Fig. 2. Loxoconcha?icknieldensis Weaver ; Left valve, female, (x84) ; number 436 ; Borehole 16/3, 14'0".

Fig. 3. Loxoconcha?icknieldensis Weaver ; Left valve, female, (x91) ; number 437 , Borehole 16/3, 14'0".

Fig. 4. Loxoconcha?icknieldensis Weaver ; Right valve, male (x82) ; number 438 ; Borehole 16/3, 14'0".

Fig. 5. Loxoconcha?icknieldensis Weaver ; Left valve male (x81) ; number 439 ; Borehole 16/3 14'0".

Fig. 6. Monoceratina bonnenai Kaye ; Right valve, female, carapace (x64) ; number 443 ; Folkestone 1(77).

Fig. 7. Loxoconcha?icknieldensis Weaver ; Right valve, hinge (x186);number 438 ; Borehole 16/3, 14'0".

Fig. 8. Monoceratina bonnemai Kaye ; Dorsal, carapace, female (x65) ; number 443 ; Folkestone 1(177).

Fig. 9. Monoceratina umbonata (Williamson) ; Left valve, female (x60) ; number 445 ; Glyndebourne 109.5-110 m.

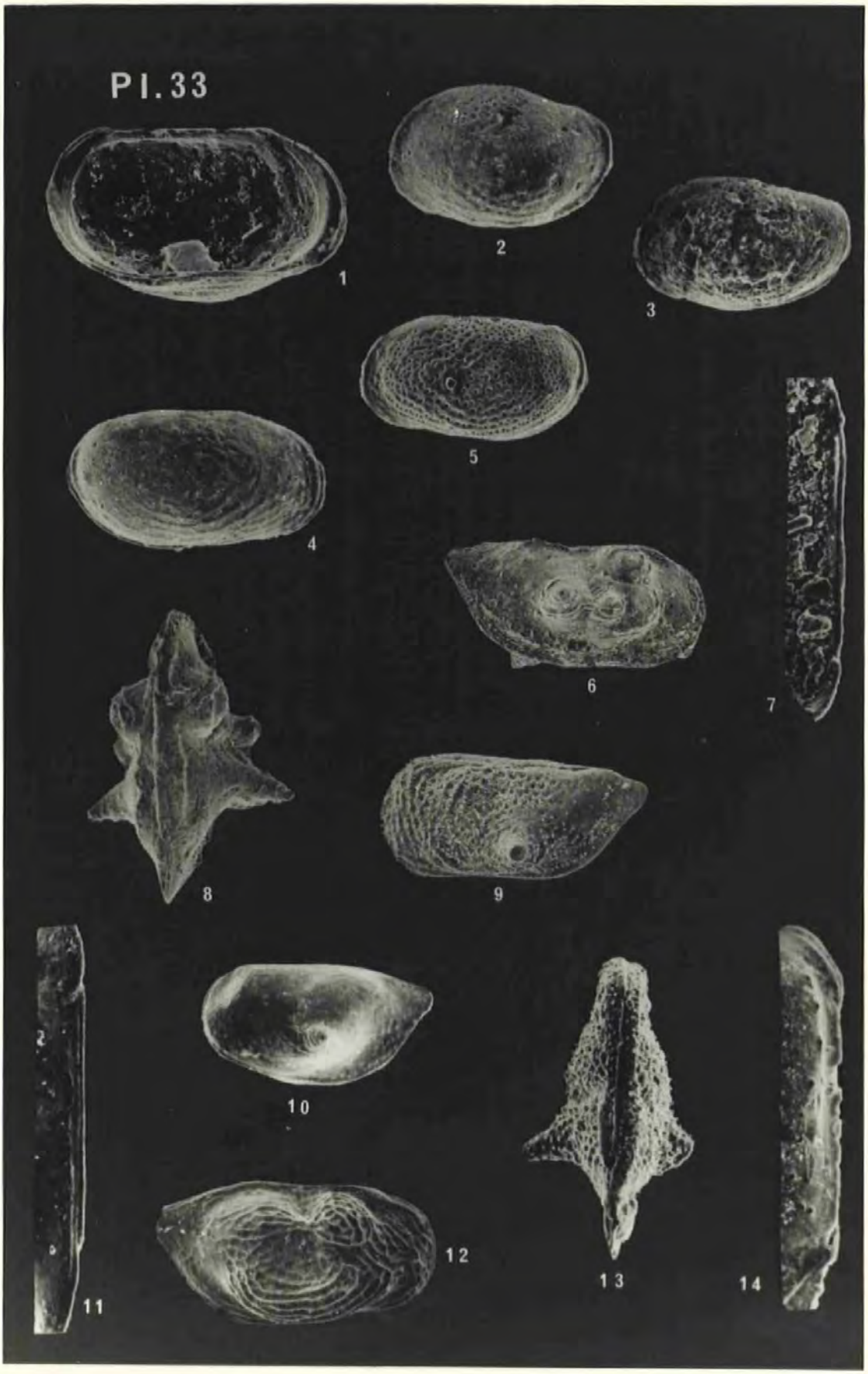
Fig. 10. Monoceratina sp.cf.M.longispina (Bosquet) ; Left valve, female (x55) ; number 444 ; Glyndebourne 128-128.5 m.

Fig. 11. Monoceratina sp.A. sp.nov. ; Right valve, hinge (x140) ; number 448 ; Glyndebourne 106.5-107 m.

Fig. 12. Monoceratina sp.A. sp.nov. ; Right valve, female (x72) ; number 448 ; Glyndebourne 106.5-107 m.

Fig. 13. Monoceratina umbonata (Williamson) ; Dorsal, carapace, female (x55) ; number 447 ; Glyndebourne 109.5-110 m.

Fig. 14. Monoceratina umbonata (Williamson) ; Right valve, hinge (x110) ; number 446 ; Glyndebourne 109.5-110 m.


Pl. 33
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