The Portland–Purbeck junction (Portlandian–Berriasian) in the Weald, and correlation of latest Jurassic–early Cretaceous rocks in southern England

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Summary. Ammonites and palynology are described at the Portland–Purbeck junction in the Weald. A major disconformity exists between *glaucolithus* Zone Portland Beds and the overlying basal Purbeck facies, the basal Purbeck Beds of the Weald are correlated with the Middle Purbeck strata of Dorset. The Cinder Bed of Dorset and Wiltshire is described as one of several marine incursions entering Wessex from further south in the Anglo-Paris basin, not from the Spilsby basin. The use of Cinder Bed as a convenient Jurassic–Cretaceous (Portlandian–Ryazanian) boundary is critically reviewed, as is the placing of the base of the Berriasian Stage in the type Purbeck section. The rival biostratigrahic schemes based on ostracods and palynology are discussed and the discrepancies between the two schemes in southern England are examined.

1. The boundary between the Portland Beds and Purbeck Beds

1.a. Purbeck Beds in the Weald

The fauna and sedimentology of the Portland and Purbeck Beds of the Weald have received comparatively little attention. Despite numerous records from boreholes (see Taitt & Kent, 1958; Falcon & Kent, 1960, for references) it was not until 1964 that an attempt was made to define the constituent parts of the Purbeck succession, to modernize the older terminology (Topley, 1875) and to make a lithological correlation across the Weald and into the Dorset type area (Howitt, 1964).

Howitt's scheme emphasized the lithological similarities between the Main Gypsiferous Beds and the Cinder Bed with, respectively, the Broken Beds and Caps, and the Cinder Bed of Dorset, as previously had Falcon & Kent (1960) and Arkell (1933). The traditional three-fold division of the Dorset Purbecks was also recognized, and ostracods used to demonstrate the exact synchroneity of the Dorset and Weald Purbeck Beds succession following the work of Anderson (1940, 1947, 1959, 1962, 1971, 1973). The assumption has therefore always been made that a complete Purbeck sequence is present in the Weald (Arkell, 1933; Allen, 1955; Howitt, 1964; Anderson & Bazley, 1971).

Taitt & Kent's (1958) postulation of a sub-Purbeck unconformity, based on incorrect ammonite determinations, has been discussed by one of us (Wimbledon, 1980) and is further examined here.

The palynological studies of Norris (G. Norris, unpubl. thesis, Cambridge Univ., 1963; 1969) demonstrated the diachroneity of similar Purbeck facies betwen the Weald and Dorset, the only evidence running counter to the long-established lithological and ostracod correlation. Norris's tentative and somewhat broad correlations have been ignored by most, and even distorted by some subsequent authors (Anderson & Bazley, 1971; Worssam & Ivimey-Cook, 1971). Later accounts have failed to explore the substantial discrepancy apparent between ostracod and palynological correlation in southern England (e.g. Dörhöfer & Norris, 1977). The wider implications of this mismatch deserve full discussion, because most correlations of Purbeck–Wealden strata in northwest Europe are based, directly or indirectly, on ostracods (see 3.b. below).

1.b. The Brightling section

The section exposed in the Brightling Mine (TQ 677281) is that given by Howitt (1964, p. 82). It extends from 4 m below the top of the Portland sandstone up to the Ice House

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Limestone, within the Rounden Greys; a section *c.* 24 m in thickness. Lithologically it consists of marine, calcareous, quartz sandstones (4 m) with the normal large bivalve fauna, including trigoniids, overlain successively by flaggy sandstones (0.2 m) with no marine shelly fauna, laminated cryptalgal limestones (0.1 m), and the gypsum of No. 4 seam.

1.c. Ammonite faunas in the Weald

In the Brightling Mine ammonites are evenly distributed within a 4 m thickness of Portland sandstone below the lowest-worked gypsum seam, except for one concentration where they are common 0.3 m below the top. All ammonites seen are large individuals assignable to *Glaucolithites glaucolithus* Buckman, and thus correlatable with the fauna of the Parallel Bands etc., of the type Portland Sand (Wimbledon & Cope, 1978). The Brightling section thus resembles boreholes at Henfield and Portsdown (Taitt & Kent, 1958) where *Glaucolithites* occurs just below the Portland–Purbeck junction (Wimbledon, 1980). In the Fairlight borehole at least one other ammonite fauna occurs above that of the *glaucolithus* Zone, but over much of the southern Weald the *okusensis*, *kerberus* and *anguiformis* Zones seem to be cut out beneath the Purbeck facies. At Brightling the upper surface of the Portland sandstone is eroded and infiltrated by Purbeck spores, but otherwise shows little evidence of what is apparently a break in deposition covering several ammonite zones.

Unconformity between the Portland and Purbeck Beds in the Weald was first suggested by Taitt & Kent (1958) who described ammonites near the top of the Portland Beds as a Portland Sand fauna, but quoted as evidence genera typical of the Portland Stone. Nevertheless, from the above account of ammonites and the palynological evidence outlined below there does appear at Brightling to be an unconformity above the highest Portland sandstone.

Why, once this sizeable disconformity had been identified, were the basal Purbeck evaporites in the Weald and Dorset automatically assumed to be coeval? Why was it that deposition was resumed in the Weald at precisely the time when the final Jurassic regression ended marine sedimentation in Wessex, and Purbeck facies came in?

1.d. Palynology in the Weald

1.d.1. Previous work

Little detailed stratigraphic palynology of the marine Portlandian or the Purbeck Beds has been published. Microfloras were recorded from the Purbeck Beds on an exploratory level by Couper (1958) and Lantz (1958). The taxonomy of Portland and Purbeck miospores has been treated in detail by Norris (1969). Norris (1969, 1970, 1973) and Dörhöfer & Norris (1977) presented a coarse miospore zonation of the Purbeck Beds, and showed that the basal Purbeck Bed at the Mountfield Mine in Sussex (TQ 720196) roughly equated with the Middle Purbeck Beds of Dorset.

Miospore assemblages from other parts of Europe were reviewed by Dörhöfer (1979), who proposed a miospore zonation for the Oxfordian–Valanginian sequences of Europe and North America. Comparison of British assemblages with the many published Upper Jurassic–Lower Cretaceous miospore accounts is difficult because of, amongst other considerations, differences of taxonomic approach. The most fruitful comparisons are probably with the Dutch sections of Burger (1966).

Norris (G. Norris, unpubl. thesis, Cambridge Univ. 1963; 1965), Dörhöfer & Norris (1977) and L. A. Riley (unpubl. thesis, Open Univ., 1974) described organic-walled microplankton from the marine Portlandian and from a few horizons in the Purbeck Beds.

Sargeant (1975, 1979) published range-charts for selected Jurassic (including Portlandian) dinoflagellate cysts. Fisher & Riley (1978) and Davey (1979) published range-charts for selected microplankton species in the marine Upper Jurassic and Lower Cretaceous rocks of England and the North Sea, but relating species ranges to an outdated ammonite zonation rather than rock intervals.

1.d.2. Brightling

In this study thirty samples have been collected from the Portland and Purbeck rocks of British Gypsum's Brightling Mine. The lithology of the section, the sampling intervals and the distribution of selected palynomorphs are shown in Figure 1. These distributions may be compared with those of the same species in 55 samples collected at Durlston Bay, Dorset

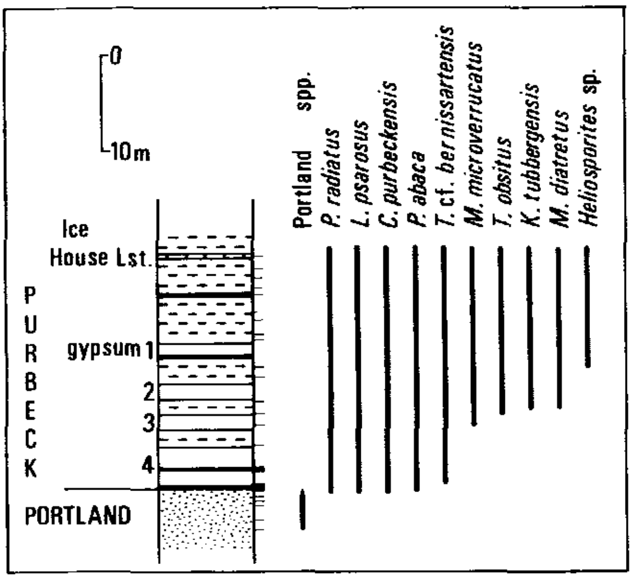

Figure 1. Ranges of selected miospores in the Brightling Mine section.

(Fig. 2). A more complete account of the Durlston section will be published elsewhere. Normal palynological preparation techniques (HCL, HF maceration, sieving through 10 nylon mesh) were used. The residues were mounted in Cellosize and Canada Balsam. The slides are retained in the collection of C.O.H.

The dinoflagellate cyst and acritarch species present in the Portland sandstone are listed below, in alphabetical order. Three new species, as yet unnamed, are omitted.

Dinoflagellate cysts (all references to be found in Stover & Evitt (1978))
Apteodinium nuciforme (Deflandre, 1938), Stover & Evitt, 1978
Cleistosphaeridium ehrenbergi (Deflandre, 1947), Davey *et al.* 1969
Chytroeisphaeridia chytroeioides (Sarjeant, 1962), Davey *et al.* 1969
C. pococki Sarjeant, 1968
Ctenidodinium cumulum (Norris, 1965), Lentin & Williams, 1973
C. panneum (Norris, 1965), Lentin & Williams, 1973
Cryptarchaeodinium calcaretum Deflandre, 1939
Egmontodinium polyphlacorum Gitmez & Sargeant, 1972

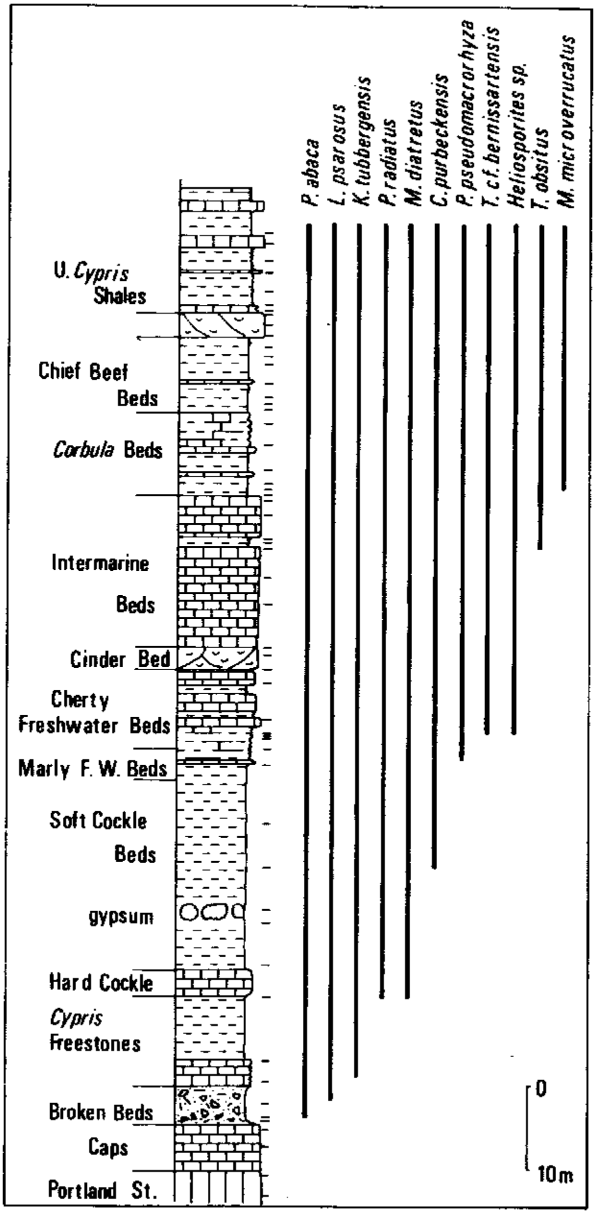

Figure 2. Ranges of selected miospores in the Purbeck Beds of Durlston Bay and St Aldhelms Head, Dorset.

Egmontodinium sp., A. Davey, 1979
Glossodinium dimorphum Ioannides, Stavrinos & Downie, 1977
Gochteodinia villosa (Vozzhennikova, 1967), Norris, 1978
Hystrichodinium ? pulchrum Deflandre, 1935
Heslertonia pellucida Gitmez, 1970
Hystrichosphaerina orbifera (Klement, 1960), Stover & Evitt, 1978
Kleithriasphaeridium sp., A. Davey, 1979

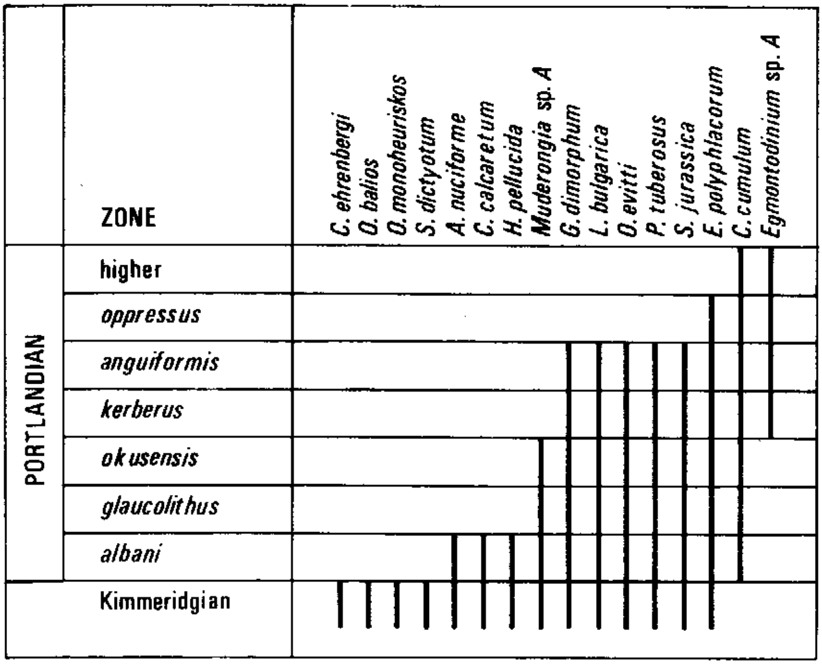

Figure 3. Published ranges for stratigraphically useful dinoflagellate cyst species in the Portlandian.

Lanterna bulgarica Dodekova, 1969
Leptodinium perforans (Cookson & Eisenack, 1958), Stover & Evitt, 1978
L. setcheyensis (Sargeant, 1976), Stover & Evitt, 1978
Mendicodinium groenlandicum (Pocock & Sarjeant, 1972), Davey, 1979
Microdinium opacum Brideaux, 1971
Muderongia sp., A. Davey, 1979
Occisucysta balios Gitmez, 1970
O. evitti (Dodekova, 1969), Gitmez, 1970
O. monoheuriskos Gitmez & Sarjeant, 1972
Pareodinia ceratophora Deflandre, 1947
Parvocavatus tuberosus Gitmez, 1970
Prolixosphaeridium capitatum (Cookson & Eisenack, 1960), Singh, 1971
Scriniodinium dictyotum Cookson & Eisenack, 1960
S. galeritum (Deflandre, 1938), Klement, 1960
Senonisphaera jurassica (Gitmez & Sarjeant, 1972), Lentin & Williams, 1973
Systematophora aureolata Klement, 1960

Acritarchs:
Micrhystridium fragile Deflandre, 1947
M. inconspicuum (Deflandre, 1935), Deflandre, 1937
Pterospermopsis aureolata Cookson & Eisenack, 1958
P. helios Sarjeant, 1959
Tasmanites sp.

The published ranges of selected biostratigraphically useful species are shown in Figure 3. They indicate an early Portlandian age, thus broadly confirming the ammonite evidence.

The stratigraphic ranges of some species must, however, be extended, since the ammonites indicate a *glaucolithus* Zone age.

The palynomorphs in the basal three samples from the Portland sandstone are very well preserved. The four samples above them show progressively more evidence of corrosion – thinning, loss of ornament, fragmentation – until the topmost contains only rare 'ghosts' of the Portland assemblage. In addition the uppermost two samples contain relatively unweathered Purbeck miospores (Fig. 1). This mixture of forms suggests weathering *in situ* of the Portland specimens and infiltration from above of the Purbeck species. This can only have happened during a period of subaerial weathering before the deposition of the Purbeck Beds. The immediately overlying flaggy sandstones contain only 'Purbeck' miospores.

A Portland Beds sample from the Fairlight borehole (TQ 859117) yielded the same microplankton species found at Brightling except the following:

Cleistosphaeridium ehrenbergi
Cryptarchaeodinium calcaretum
Egmontodinium sp. A.
Heslertonia pellucida
Leptodinium perforans
Muderongia sp. A.
Occisucysta balios
O. monoheuriskos

Elsewhere most of these missing forms have ranges with their upper termination either in the Kimmeridgian Stage or the earliest Portlandian *albani* Zone. The Fairlight assemblage is therefore probably younger than that from Brightling. The characteristic short-ranging dinoflagellate cysts and acritarchs of the basal Purbeck Beds of Dorset (C. O. Hunt, unpubl. thesis, Sheffield Univ., 1980) do not occur in the basal units at Brightling or Fairlight; long-ranging species that do occur are not discussed further.

The miospore assemblage from the Portland sandstones at Brightling and Fairlight comprise only long ranging species. They are similar to those reported by Norris (G. Norris, unpubl. thesis, Cambridge Univ., 1963; 1969) from the Portland Sand of Dorset.

In the overlying Purbeck rocks long-ranging species predominate but a number of miospores with restricted ranges are also present. These are:

Cicatricosisporites purbeckensis Norris, 1969
'*Heliosporites*' sp. Norris, 1969
Krauselisporites tubbergensis Burger, 1966 (= *Januasporites tumulosus* Norris, 1969)
Leptolepidites psarosus Norris, 1969
Maculatisporites microverrucatus Döring, 1964
Microreticulatisporites diatretus Norris, 1969
Parvisaccites radiatus Couper, 1958
Plicatella abaca (Burger, 1966), Norris, 1969
P. pseudomacrorhyza (Markova 1961) Dörhöfer 1977
Trilobosporites cf. *bernissartensis* (Delcourt & Sprumont, 1955), Potonié, 1956
Trilobosporites obsitus Norris, 1969

The occurrence of these species at Brightling and Fairlight are tabulated in Figures 1 and 4. For comparison their ranges in the Purbeck Beds of Durlston Bay, Dorset are shown in Figure 2, the discrepancy in their ranges and the correlation of the Durlston and Brightling sections is duscussed below.

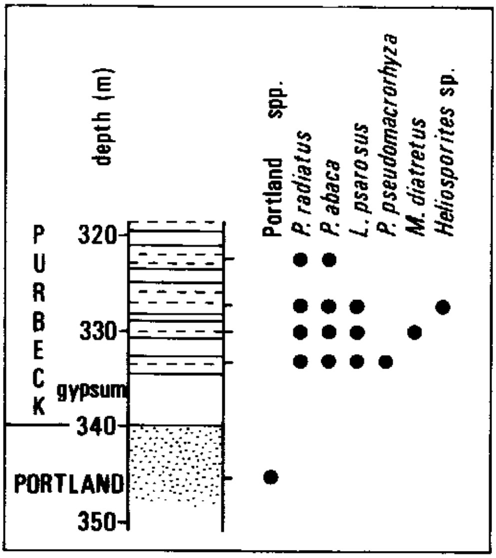

Figure 4. The distribution of selected palynomorphs in five samples from the Fairlight Borehole.

2. The Cinder Bed 'event'

Both the placing and timing of the Portland–Purbeck junction and the position of the Jurassic–Cretaceous boundary present problems for the stratigrapher. The former problem has been dealt with briefly (Wimbledon, 1980) and is further discussed above. The latter problem and the use of the Cinder Bed as a system boundary is discussed below.

In an outline definition of the ammonite biostratigraphy of the Portlandian Stage (Wimbledon, 1980) one of us perpetuated, for reasons of continuity, what has in recent years become an axiomatic (if somewhat approximate) correlation; that between the Cinder Bed of Dorset and Wiltshire and the basal marine Ryazanian beds of the Spilsby–Sandringham basin. This correlation at its inception was no more than a suggestion (Casey, 1962, p. 96) that quasimarine episodes in the Purbeck Beds represented southerly incursions of a Spilsby sea, but later the Cinder Bed was selected as the 'most conspicuous marine bed of all' (Casey, 1963) with which the mid-Spilsby marine incursion could be equated. In the geographically intermediate area, from mid-Wiltshire to Buckinghamshire (and the Boulonnais) Whitchurch Sands deposition was taken to be a coeval product of the same transgression (Casey & Bristow, 1964), as was the Serpulit of north-west Germany (Casey, 1963). There thus appeared to exist a widespread and convenient horizon at which the Jurassic–Cretaceous (i.e. Portlandian–Ryazanian) boundary could be drawn.

Detailed studies of ammonite distributions were however to prove (Casey, 1973, p. 216) that the Mid-Spilsby nodule bed was of Upper Ryazanian age, and that deposits of the basal Ryazanian *runctoni* Zone (within the Mintlyn Beds) only occur in a very limited area of Norfolk. Finally, after its general acceptance, the Cinder Bed 'event' was much more loosely related with four alternative portions of the Spilsby sequence, varying in age between a pre-*runctoni* interval and the *kochi* Zone (Casey, 1973, p. 216).

The Weald Cinder Bed is taken to be the equivalent in age of the Dorset Cinder Bed, but in the Weald the 'Cinder Bed' has usually been recognized more on the presence of specific ostracods than by any distinctive lithology or macrofauna (Anderson & Bazley, 1971, p. 20). Indeed *Liostrea distorta* occurs at several levels in the Weald Purbeck sequence, but not always in the 'Cinder Bed' as defined by ostracods. It is interesting to note that Anderson (*in* Worssam & Ivimey-Cook, 1971) comments that the Weald 'Cinder Bed' as a saline event is less significant in its effect on ostracod faunas than his Scallop or Lulworth S-phases: he adds, rather cryptically, 'there is no evidence that the Cinder Beds are transgressive either in the centre of the basin or marginally'.

2.a. Macrofaunal evidence on the Cinder Bed

There are several worrying aspects of the Cinder Bed thesis. Although there is no reason why the Whitchurch Sands should not be accepted as being of broadly Purbeck age; they contain Portland Beds molluscs, and are at least post-'Lower Purbeck' on the basis of their regional relationships, we know of no strong reasons suggesting that (1) the Whitchurch Sands and Cinder Bed were coeval, or (2) that the marine transgression which supposedly produced the two deposits entered the Wessex basin from the north.

If the sea had encroached into southern England from the Spilsby–Sandringham basin the marine faunas of both the Whitchurch Sands and Cinder Bed (Casey & Bristow, 1964) should have some Spilsby affinities. A recent study of Spilsby–Sandringham bivalve faunas (S. R. A. Kelly, unpubl. thesis, Univ. London, 1977) recorded the presence of 91 bivalve species in those sediments. No species characteristic of the Cinder Bed or the geographically closer (and supposedly lithologically similar) Whitchurch Sands is known in the Spilsby strata. On the contrary the affinities of the Cinder Bed–Whitchurch Sands bivalves, gastropods and echinoid are clearly with the Portland and Purbeck Beds faunas of the Anglo–Paris Basin. They include Portland elements like the ubiquitous *Laevitrigonia gibbosa* (Sow.) (in both deposits), *L. wightensis* (Strand) (Whitchurch Sands?) a form common in the Swindon Roach, and *Hemicidaris purbeckensis* (Forbes), outside the Cinder Bed of Dorset and Wiltshire known only from northern France (notably the Grès des Oies and Assises de Croi of the Boulonnais).

The reported appearance of *Protocardia*, *Corbula*, *neomiodontids*, *Liostrea*, *Chlamys*, *Modiolus* and *Serpula* in the Middle Purbeck Beds of Dorset suggests numerous marine or quasimarine incursions, yet in this interval, as in the rest of the Purbeck Beds and Portland Stone, no distinctive Spilsby bivalve, brachiopod or belemnite species has been recorded. The exclusiveness of the two faunas makes any correlation insecure, despite its 'palaeogeographical neatness' (Hancock, 1972).

Accepting that Dorset was subject to a marine withdrawal during deposition of the Marly and Cherty Freshwater Beds, marine molluscan and echinoderm populations are unlikely to have lingered on even locally. Therefore recolonization of the area during deposition of the Cinder Bed and other 'marine' horizons had to come from a residual Portland/Purbeck sea lying over the Anglo–Paris Basin, or to the southwest, although evidence for a source area in that direction is scanty (Evans, Lott & Warrington, 1981). Palaeogeographically this would seem to fit in with Allen's (1981, fig. 16), primarily Wealden, model of a silted up Tethyan-connected gulf, but his notion of a 'Boreal Sea' connection does not accord with palaeontological evidence, at least in mid-Purbeck times.

Apart from the trigoniids, most of the firmly identified marine bivalve species from the Whitchurch Sands can be found at several levels in the Durlston Bay and other Dorset Purbeck sections, particularly in the Scallop Bed-*Corbula* Beds interval, as indeed can *Serpula coacervata*. The one certain fact is that our knowledge of Purbeck bivalves, their distribution and salinity tolerances is regrettably poor. Until this deficiency is remedied little worthwhile can be said about their correlative value.

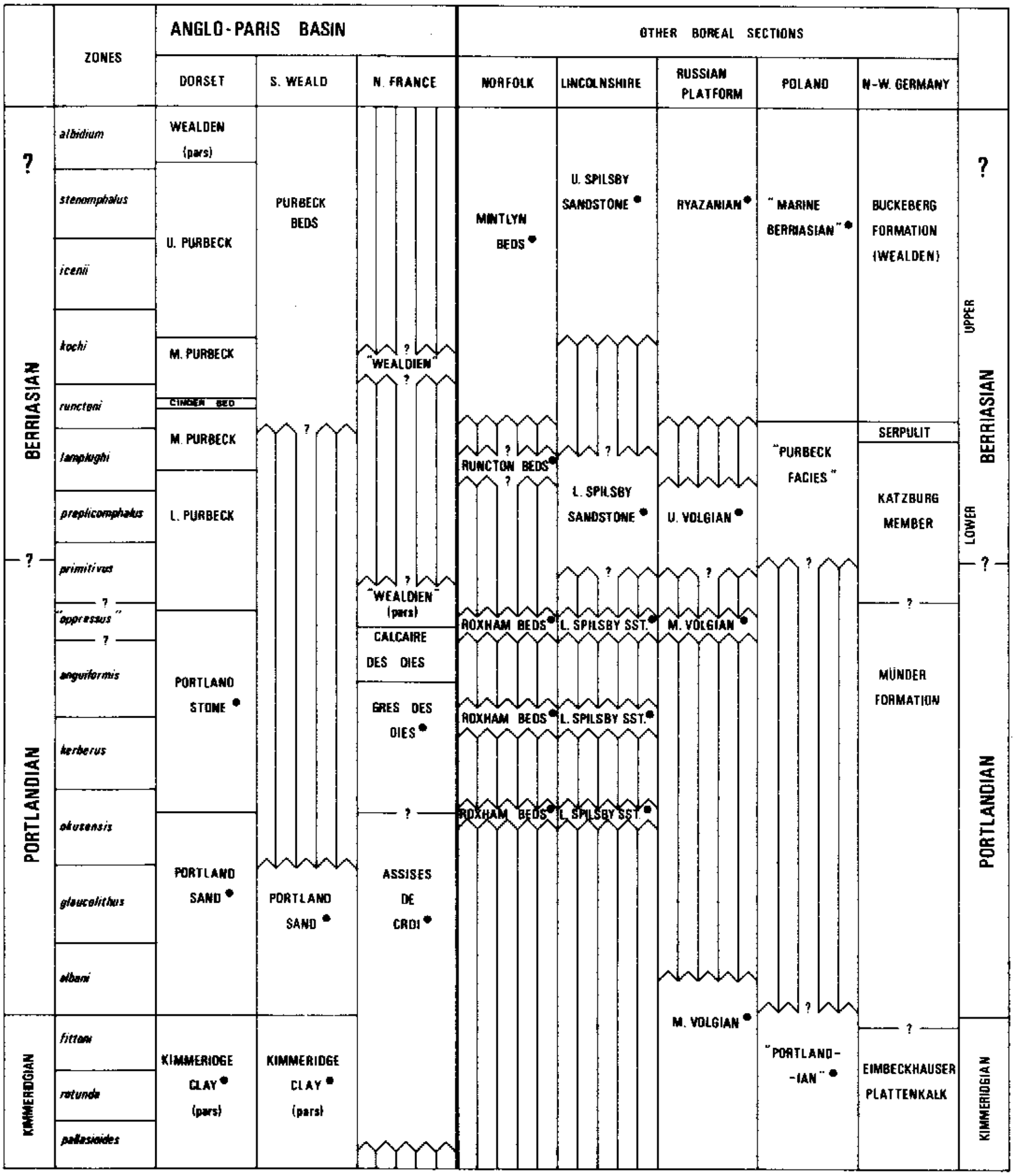

Figure 5. A correlation of late Jurassic–early Cretaceous strata in the Anglo-Paris Basin and other European boreal sections (● = facies with ammonites).

2.b. Ostracod evidence on the Cinder Bed

Recent work on the ostracods also undermines another essential part of the Cinder Bed thesis. The traditional equation of the Serpulit of Saxony with the Middle Purbeck Beds, on the basis of broadly similar ostracods and the presence of *Serpula coacervata* (e.g. Arkell, 1933, 1947 & 1956) was adapted by Casey in his idea of a single northwest European transgression. However, Allen (1955), and Anderson & Hughes (1964) broadly correlated the Serpulit with the lower Middle Purbeck Beds. R. G. Clements (unpubl. thesis, Univ. Hull, 1973) after a study of the type Purbeck sections and their ostracod faunas would maintain this correlation, from the evidence of the distribution of the evolutionary sequence between *Cypridea granulosa granulosa* and *C. granulosa fasciculata*. The former subspecies is characteristic of much of the Serpulit, the latter appears in the highest part of that unit. In Dorset transitional forms between the two subspecies first appear well down in the Cherty Freshwater Beds (4.5 m below the Cinder Bed) and *C. granulosa fasciculata* appears well below the top of those beds. Reinforcing the point is *Cypridea posticalis*, which at Durlston is almost entirely restricted to the lower Cherty Freshwater Beds (Clements, 1973, fig. 46). Anderson (Anderson & Bazley, 1971) stressed the importance of this widespread but vertically limited species, which is found in Division A of the Purbeck facies in Poland (Bielecka & Sztejn, 1966; Anderson, 1973) and in the Serpulit of Germany (Anderson & Bazley, 1971, p. 78), again suggesting a pre-Cinder Bed age for these two deposits (see Fig. 5).

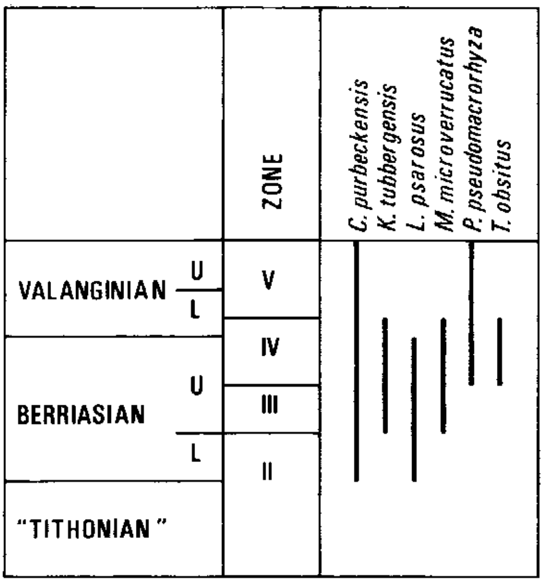

Figure 6. Ranges of selected miospore species in relation to European stages (after Dörhöfer, 1979).

2.c. Palynological evidence on the Cinder Bed

From Figures 1 and 2 it is apparent that none of the miospore species from the Weald basal Purbeck is present in the basal Purbeck Beds at Durlston Bay, and that two species do not make their first appearance until well above the Cinder Bed in the type section.

The occurrence of these Middle Purbeck spores at the base of the Weald section suggests that the basal Purbeck Beds in the Weald are substantially younger than those at Durlston. At the most conservative estimate the Brightling spores may be correlated with those of the Cherty Freshwater Beds, or, more likely, with the Intermarine Beds or Corbula Beds (see Fig. 2).

Comparison of this flora with assemblages elsewhere in Europe is difficult. The presence of *K. tubbergensis* in the middle of the Durlston section, and at Brightling, invites comparison with Burger's (1966) pollen zone V (highest Upper Malm–Wealden 1, probably mid-Berriasian), to which it is restricted in the Dutch sections. However, the range of *K.*

tubbergensis in England is probably longer than it is in Holland. The presence of *C. purbeckensis*, *K. tubbergensis*, *L. psarosus*, *M. microverrucatus*, *P. pseudomacrorhyza*, and *T. obsitus* suggests that the basal Purbeck Bed in the Weald is equivalent in age to Dörhöfer's (1979) zone IV, of uppermost Berriasian–lowest Valanginian age (Fig. 6). Their presence in the middle portion of the Durlston section suggests that the base of the Berriasian stage lies well below the Cinder Bed, and that it is missing in the Weald. More detailed palynological investigations of the type Berriasian and other securely dated sections are needed to allow more accurate correlations.

3. Conclusions

3.a. The Purbeck problem

There clearly exists a discrepancy between the ostracod-based correlation between the Weald and Dorset and that based on palynology. The latter suggests that most of the Purbeck succession in the Weald post-dates much of that at Durlston Bay. This runs counter to correlations based on lithological evidence (Howitt, 1964; West, 1975) and ostracod faunas (summarized in Anderson & Bazley, 1971).

Having on the one hand cast doubt on the value of Anderson's correlation in southern England, Dörhöfer & Norris (1977, p. 81) then proceeded to apply it in Europe. But if the ostracod correlations between Dorset and the Weald are discredited, the Purbeck formation must be diachronous when traced across England, and so too are its contained ostracod faunas. Why, on the evidence of palynology, are the Purbeck Beds of Dorset and Saxony the same age while the Weald succession is believed to be younger? Which is the more reliable biostratigraphic tool, the palynomorph or the ostracod?

The strong facies/salinity control of ostracods and the potential for wide distribution of palynomorphs would seem, to the impartial observer, to make the palynomorph the better choice. Whichever correlation is vindicated, ostracod and palynological correlations between southern England, northwestern Germany, Poland and southern France are still in need of urgent re-examination to find the reasons behind the dramatic mismatch in the correlations afforded by these two groups.

3.b. The Portland–Purbeck problem

In southern England two outstanding correlative problems still exist. Although Portlandian ammonite assemblages in Dorset, and other southern counties, would appear to be the most complete successions in the boreal realm, there are no ammonites later than those of the uppermost Portland Stone common to both the south and east of England. Once Purbeck facies commence in the Wessex basin there are no macro- or micro-faunal or floral elements, common to both the Wessex Basin in southern England and the East Midland Shelf of eastern England, from which one can derive a correlation.

The only way to correlate between southern England and eastern England after this time is by means of Middle Purbeck ostracods in the Polish Purbeck facies, which underlie basal Ryazanian ammonites, which can in turn be approximately equated with the *runctoni* zone of Norfolk (see Fig. 5).

3.c. The Berriasian boundary problem

The precise placing of the base of the Berriasian within the Purbeck Beds of the type area is still unsettled. The ostracods determinations of Donze (1958) gave a correlation between southeastern France and Dorset. This, however, made use of ostracods (*Fabanella boloniensis*, *Theriosynoecum forbesii*, *Mantelliana purbeckensis* and *Cypridea dunkeri*) which have long and overlapping ranges and, if of any use at all, can only afford a broad correlation with (in Dorset terms) a late Portland Beds–Cinder Bed fauna.

3.d. The Cinder Bed problem

The possibility that the Cinder Bed (of Wessex) is the same age as the Mid-Spilsby nodule bed or the basal Mintlyn Beds still exists but this should not be regarded as proven, nor should the correlation of the Cinder Bed with the Serpulit. There is at present no concrete evidence that any marine connection existed between the Spilsby province and the Anglo-Paris basin after late Portland Stone times (*anguiformis* Zone, Wimbledon, 1980). Clearly the name Cinder Bed should be reserved solely for the appropriate strata in Wessex, and not applied to *Liostrea*-bearing sediments in the Weald; also the terms 'Lulworth' and 'Durlston Beds' should be set aside in favour of Purbeck (Beds) Formation and its traditional lithostratigraphic subdivisions where these are applicable.

4. Postscript

Marine macrofossils and foraminifera, although comparatively infrequent, do occur in the Purbeck Beds together with the more common marine dinoflagellates and ostracods, indicating repeated connections with a marine source area. They should collectively enable the establishment of an acceptable boundary between the Berriasian and the Portlandian stages in the Purbeck type section. Lacking an accessible, continuous and wholly marine type section for the Jurassic–Cretaceous boundary in northwest Europe the Portland–Purbeck sections of southern England merit serious consideration.

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