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# The ammonite faunas of the English Portland Beds and the zones of the Portlandian Stage

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SUMMARY: On the basis of new and large collections of ammonites, a succession of ammonite faunas is described from the Portland Beds of southern England and a revised scheme of Standard Zones (=chronozones) proposed.

The faunas of the Portland Freestone of Dorset are shown to consist largely of hitherto undescribed species; *Titanites anguiformis* sp. nov. is described and figured therefrom. Correlations are proposed with other areas where the Portland Beds occur, and the scheme is integrated with the zonal scheme proposed by Casey (1974) for the younger Portlandian faunas. *Glaucolithites glaucolithus* Buckman and *Titanites giganteus* (Sowerby) are redefined with the aid of new material.

'Portlandian' is preferred as stage name for the terminal Jurassic stage.

The first scheme of zones for the Portlandian Stage of the Upper Jurassic was proposed by Salfeld (1913) but has suffered because some of the index species used were of dubious interpretation, and it was based on sections in the S Midlands now known to be incomplete. Salfeld's zonal table was succeeded by Buckman's hemeral scheme. Buckman was the first person to attempt any really detailed stratigraphical work on the Portland Beds, and he obtained, from quarries in the Thame district ammonites which were described half a century ago in 'Type Ammonites' under a multiplicity of new generic and specific names. Although Buckman's hemeral scheme has long since been abandoned, his work is a very useful record of the faunal succession in an area where there are now few exposures. Comparison with sections further south has shown that his records are essentially correct as far as recording of horizons is concerned. Where his work failed, and also that of subsequent workers, was in the correlation of the south Midland successions with those of the Dorset coast. This was due to the persistent acceptance of certain widespread misconceptions concerning the ammonites and their stratigraphic relationships, a lack of systematic collecting, and a consequent inability to establish the ranges of the faunal assemblages.

Recent work on the Portland Beds throughout their outcrop by the authors, but with emphasis on the presumed complete successions in Dorset, has shown how wrong some of the former correlations were, and although work has not yet reached completion (when a joint monographic work is contemplated) sufficient is now known to set up a revised zonal scheme.

The work on the faunas of the Portland Stone, the subjacent rocks north of Dorset, and the systematic palaeontology, is by Wimbledon. This has been integrated with Cope's work on the Portland Sand in Dorset.

## The faunal succession

A succession of distinctive ammonite faunas has been recognised throughout the Portland Beds (Fig. 1). In ascending stratigraphical order these are:

### Fauna 1: *Progalbanites–Epivirgatites* fauna

The genus *Progalbanites* Spath 1933 appears to be quite distinct from the earlier Volgian genus *Zaraiskites* with which it has long been confused (see Casey 1967, p. 132). The type species of the genus, *P. albani*, is frequently common, and is associated with hitherto undescribed species of the genus. The remainder of the ammonite fauna includes species of *Epivirgatites* including *E. nikitini* (Mich.), *E. vulgaris* (Spath) and others. There are also undescribed species of *Pavlovia*. Amongst the pavloviids are occasional fragments of forms apparently close to the subgenus *Epipallasiceras* Spath (see Buckman 1926, pl. 693).

### Fauna 2: *Glaucolithites* fauna

This fauna consists predominantly of evolute, round-whorled ammonites, with sharp, rectiradiate, biplicate ribs interspersed with frequent simple ribs and constrictions. These ammonites are clearly closely related to *Pavlovia* of the beds beneath, and may prove ultimately to be only sub-generically separable from it. In the past, these forms have been described under a variety of generic names, of which the most senior available is *Glaucolithites* (type species *G. glaucolithus* Buckman 1922, pl. 306). Unfortunately, the poor figure of the holotype has led to endless confusion over the genus. In order to try to remedy this position, we figure two specimens which agree closely with the holotype but which illustrate better the inner whorls and the whorl section respectively.

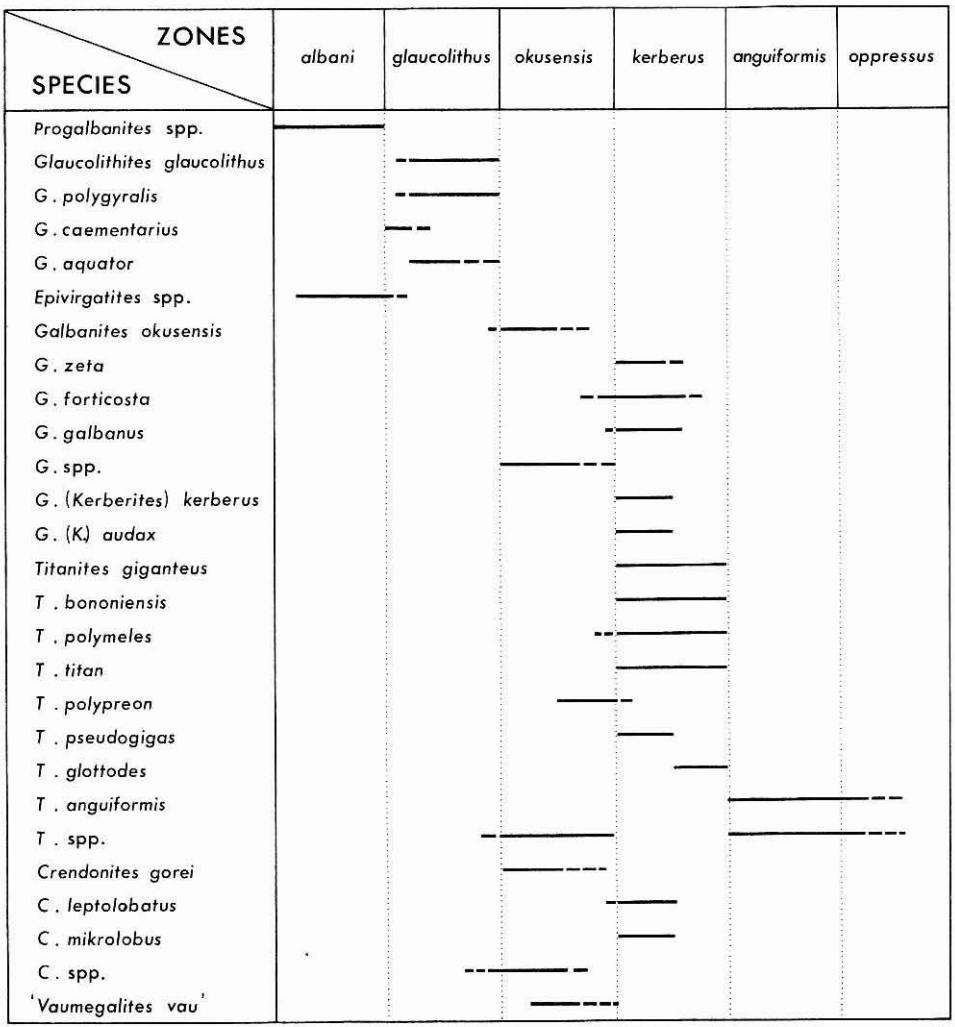


FIG. 1. Ranges of ammonite species within the English Portland Beds.

Other forms belonging to Fauna 2, which Buckman later described under a variety of other generic names, clearly belong to this genus. These include *G. lapideus* (Buckman 1922, pl. 342), *G. lyditicus* (1922, pl. 353A (only)), *G. aquator* (1924, pl. 534), *G. polygyralis* (1925, pl. 620) and *G. caementarius* (1926, pl. 677). Some other species of the genus have also been found during the present work and remain to be described; these include possible microconch equivalents of the larger species. Rare specimens of *Titanites* also occur.

Fauna 3: *Galbanites okusensis* fauna

This is an assemblage dominated by *Galbanites okusensis* (Salfeld) and related forms, and the inflated round-whorled *Titanites* (*Polymegalites*) *polypreon* (Buck.). The genus *Crendonites* (Buckman 1923) continues the line of sharply-ribbed evolute pavloviids, and specimens referable to *C. gorei* (Salfeld) are often common. A single specimen close to *C. leptolobatus* Buck. is known from one locality. Other forms include '*Vaumegalites vau*' Buck., and a number of new species of *Titanites*, in addition to *Titanites transitorius* (Spath).

Fauna 4: *Kerberites–Titanites* fauna

The genus *Galbanites* which first occurs in Fauna 3 is abundantly represented in this fauna. Its described species include: *Galbanites* (*Galbanites*) *galbanus*

Buck., *G.* (*G.*) *zeta* (Buck.), *G.* (*G.*) *forticosta* (Buck.), *G.* (*Kerberites*) *kerberus* (Buck.)—sometimes abundant, and *G.* (*K.*) *audax* (Buck.). There is also an abundance of species of *Titanites* in this fauna; previously described forms include *T. titan* Buck., *T. pseudogigas* (Blake) (see Buckman 1923, pl. 385), *T. bononiensis* (de Loriol), *T. polymeles* (Buck.), and *T. giganteus* (Sow.). *T. glottodes* apparently occurs at higher horizons than some other members of the assemblage, together with undescribed titanitids.

*Crendonites leptolobatus* is also particularly characteristic of Fauna 4 (one specimen only having so far been found with Fauna 3) and is frequently abundant. *C. mikrolobus* (Buck.) occurs rarely.

Fauna 5: *Titanites anguiformis* fauna

This fauna consists entirely of hitherto undescribed species of the genus *Titanites*. In the past it has always been erroneously referred to as the *giganteus* fauna. These titanitids are characteristically more densely ribbed species of the genus than those which occur in Fauna 4. *T. anguiformis* sp. nov. is described below; other species will be described at a future date. Records of *Kerberites* amongst this fauna (e.g. Casey 1974, p. 208) probably refer entirely to specimens of inner whorls of *Titanites*.

## The occurrence of the ammonite faunas

The Portland Beds have been described in Dorset primarily by Fitton (1836), Blake (1880) and Arkell (1935, 1947*a*). A sedimentological study was made by Townson (1975). Further north accounts of the Portland Beds have been given by a large number of authors, including Blake (1880), Buckman (1921–1930) and Arkell (1933, 1947*b*).

In this account the lithological units used by Arkell form the basis of the divisions used (Fig. 2). We believe that confusion would follow the introduction of new members throughout, in the manner of Townson (1975).

Fauna 1 is known as an indigenous fauna only in Dorset. In Portland it occurs in the Black Nore Sandstone, the Upper Black Nore Beds, the Exogyra Bed and in the basal part of the West Weare Sandstones (Arkell 1947*a*, p. 120). In Purbeck the fauna characterises the Massive Bed and the Emmit Hill Marls. At inland outcrops the assemblage is unknown except as derived material in the Upper Lydite Bed of Buckinghamshire. Its presence in the thicker sequences of the Vale of Wardour has not yet been proved.

Fauna 2 occurs in the middle part of the West Weare Sandstones on Portland, and in Purbeck appears in the White Cementstone, and then persists through the overlying St. Alban's Head Marls, Parallel Bands, and the lowest Black Sandstones. In the Vale of Wardour elements of the fauna are to be found abundantly in the lower half of the Main Building Stones (now renamed the Tisbury Glauconitic Member (Wimbledon 1976)) and in the underlying Chicksgrove Limestones. At Swindon, and in Oxfordshire and Buckinghamshire, the Glauconitic Beds (Arkell 1947*b*) yield this assemblage and in these areas the Upper Lydite Bed includes indigenous elements of Fauna 2 together with a remanié fauna.

Fauna 3 occurs in Dorset in the upper part of the West Weare Sandstones and Portland Clay of Portland. In Purbeck the equivalent Black Sandstones and the overlying Lower Cherty Beds (Beds B-H, Arkell 1935) contain the same ammonite assemblage. In the Vale of Wardour the upper part of the Tisbury Glauconitic Member yields the fauna, and it is seen again in the Swindon area in the upper part of the Glauconitic Beds and the composite unit known as the Cockly Bed, this being the most prolific occurrence of this faunal assemblage. It should, however, be noted that in the Swindon area the boundary between the Glauconitic Beds and the Cockly Bed is probably diachronous, for the base of the Cockly Bed at Okus (SU 147837) is older than at Coate Water (SU 177821). The upper part of the Glauconitic Beds and the lower part of the Aylesbury Limestone yield Fauna 3 in Oxfordshire and Buckinghamshire.

Fauna 4 is found abundantly in the Basal Shell Bed of Dorset. Well known from Portland and the area to the north of Weymouth, this bed is now recognised as Arkell's units J and J$^1$ in Purbeck (Arkell 1935). The same forms persist through into the overlying Cherty Beds of Portland and the Upper Cherty Beds of Purbeck. Further north Fauna 4 occurs in the Vale of Wardour in the Ragstones and Chalky 'Series' (Arkell 1933, p. 502), now combined in the Wockley Micritic Member (Wimbledon 1976). The upper part of the Cockly Bed at Swindon and the overlying Swindon Sand and Stone also yield this ammonite assemblage. This same fauna is also characteristic of the Creamy Limestones and the upper part of the Aylesbury Limestones of the Oxfordshire/Buckinghamshire area, where it is as common as in the Dorset occurrences (see many figures in Buckman 1921–1930).

Fauna 5 has been identified in the topmost 3 m of the Cherty Beds of Portland and there persists through to the top of the Portland Beds. In Purbeck the fauna characterises most of the Portland Freestone and is particularly abundant in the ooid sands which Arkell named the *Titanites* Bed, and in the lower half of the overlying Shrimp Bed. The fauna has only been recognised, north of Dorset, in the Vale of Wardour, where one specimen of *Titanites* close to forms characteristic of this fauna in Dorset was obtained (Wimbledon 1976, p. 7). The higher members of the purely marine Portlandian succession in the Swindon region, where

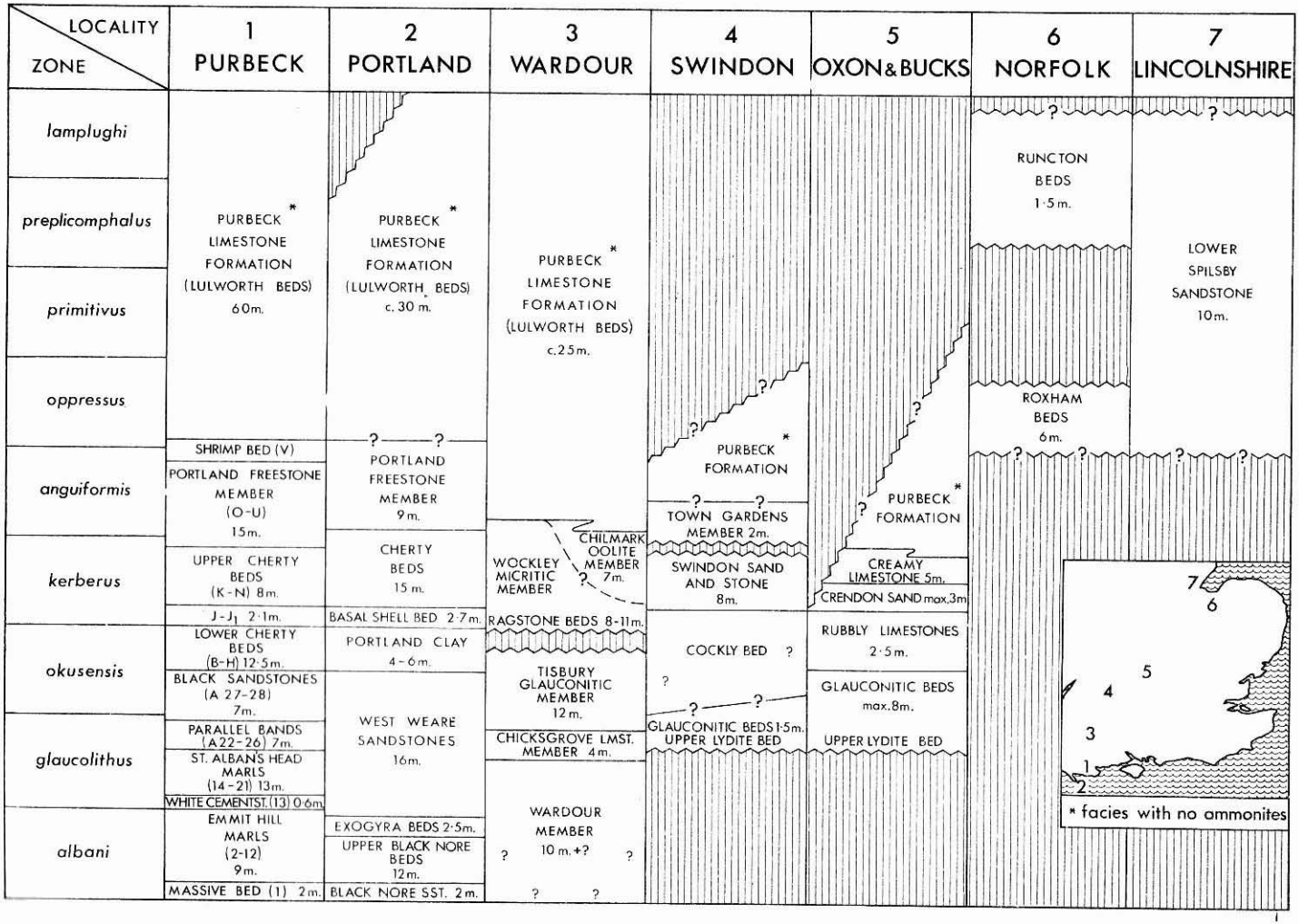


FIG. 2. Correlation of the rocks of the Portlandian Stage.

this fauna might be expected, have hitherto yielded no ammonites.

## The Standard Zones

The faunal assemblages described above are readily separable and recognisable, and as such are considered to form a sound basis for the foundation of a series of Standard Zones (=chronozones) for the major part of the Portlandian Stage (Figs. 1,2). From each fauna we have selected a characteristic species as index for that Zone. The Zones are defined by their bases only, so that the base of the succeeding Zone automatically fixes the top of the preceding Zone. A reference section for the base of each Zone has been selected. Where possible the reference section chosen is on the Dorset coast, where the succession is thicker and presumed to be complete.

### Progalbanites albani *Zone*

Index species: *Progalbanites albani* Arkell 1935

The base of the Zone is defined on the first occurrence of the genus *Progalbanites*. The type section chosen is at Hounstout Cliff, in the Isle of Purbeck, where this genus was first discovered by Buckman (1926, pl. 675). The Massive Bed in this section is the lowest horizon yet to yield *Progalbanites* (Arkell 1947*a*, p. 103) and the base of this unit becomes the base of the Zone at that point. The fauna of the Zone is Fauna 1.

### Glaucolithites glaucolithus *Zone*

Index species: *Glaucolithites glaucolithus* Buckman 1923

The base of the Zone is defined as the first appearance of species of the genus *Glaucolithites* (which compose Fauna 2). The type section for the Zone is also Hounstout Cliff, Purbeck, where the White Cementstone (Arkell 1935, p. 310) with *G. caementarius* fixes the base of the Zone.

### Galbanites okusensis *Zone*

Index species: *Galbanites okusensis* (Salfeld)

Although the fauna of this Zone (Fauna 3) is now well known in Dorset, it is not easy to fix a reference section there for the base of the Zone. Throughout Dorset the base of the Zone falls within the dolomitic upper members of the Portland Sand, in which fossils are inevitably hard to extract, poorly preserved and often not readily identifiable. For this reason the base of the Zone is defined in the Swindon region as the base of unit 4 of the Coate Water Section (Wimbledon 1976, p. 8) within the Glauconitic Beds (Arkell 1947*b*, p. 116). This section was first described by Blake (1880, p. 209).

*Titanites* (*Polymegalites*) *polypreon* appears to be associated with the zonal index in the reference section, but in Dorset appears (so far) to be restricted to the upper part of the Zone, where *G. okusensis* has yet to be found.

This Zone was introduced by Salfeld (1913), with *T. pseudogigas* as joint index, for the Cherty Beds of Dorset and the Cockly Bed of Swindon, and is equivalent to his *gorei* Zone. We have discontinued the use of the latter species as a zonal index, however, as the specific identity of British specimens referred to *C. gorei* is not entirely certain. The French lectotype of the species, chosen by Salfeld, was from a figure by de Loriol & Pellat (1874–5, pl. 2, fig. 1). The specimen has not yet been traced and it is felt better to remove any possible ambiguity which could arise from not having the type specimen of a zonal index species available. The horizon of the specimen, also, was not accurately recorded.

### Galbanites (Kerberites) kerberus *Zone*

Index species: *Galbanites* (*Kerberites*) *kerberus* (Buckman)

The base of the Zone is fixed by the first occurrence of the index species, which is fairly common in most localities and frequently abundant. It may be noted that the white biomicrite matrix of the holotype of this species suggests very strongly that it came from the 'Ragstones' (Wockley Micritic Member) and not, as supposed by Buckman, from the underlying beds.

The reference section has been selected on the Isle of Portland, where there are several fine sections where the entire Zone may be examined. The chosen section is at the northern side of Freshwater Bay (SY 692703), where the bottom of the basal unit of the Basal Shell Bed is taken as the base of the Zone.

The fauna of this Zone (Fauna 4) extends upwards on Portland Isle almost to the top of the Cherty Beds where the earliest members of Fauna 5 appear.

### Titanites anguiformis *Zone*

Index species: *Titanites anguiformis* sp. nov.

The fauna of this Zone is Fauna 5. The Zone includes the Portland Freestone Member of Dorset, and its base is drawn on the first appearance of the index species. This Zone was previously named the *giganteus* Zone following Salfeld (1913), Arkell (1933, 1935, 1946, 1947*a*, 1956), Casey (1963, 1974) and others, though House (1958) suggested that the *titan* Zone was a more appropriate name. It is now conclusively shown that the fauna with *T. titan* and *T. giganteus* is the fauna of the underlying *kerberus* Zone (Fauna 4) and that neither of these fossils therefore occurs in its nominal zone in Dorset. For these beds in Dorset, therefore, the species *Titanites anguiformis* is proposed as zonal index. The reference

section for the base of the Zone is here chosen on the south side of Freshwater Bay, Portland, (SY 691700) at a point 3.0 m below the top of the Cherty Beds.

*Higher Zones*

Casey (1974) proposed a further four Upper Jurassic Zones, younger in age than the *anguiformis* Zone. These zones are based on work in East Anglia and for the most part are clearly marine equivalents of the Purbeck facies to the south. The exception here is the *Paracraspedites oppressus* Zone. The type locality for the Zone is presumably the Roxham Beds south of King's Lynn (Casey 1974, p. 208). The index species, however, is based on a Shrimp Bed holotype, with paratypes from erratic blocks of Spilsby Sandstone, the Roxham Beds, and the Volga at Gorodishche. We are not firmly convinced of the specific identity of the Dorset holotype with the East Anglian paratype, but if one assumes that *Paracraspedites oppressus* as defined by the holotype does occur in its nominal zone, as defined by the type locality, there is no difficulty in fixing an *anguiformis–oppressus* zonal boundary. The *anguiformis* Zone rises to the base of the *oppressus* Zone in the Dorset succession, presumably thus excluding the top of the Shrimp Bed from the *anguiformis* Zone.

Casey (1974, p. 208) also mentioned the presence of large *Paracraspedites* 'indistinguishable from the well-known Portland giants' in erratics. Specimens of these have been examined by W. A. W. who has concluded that whilst these specimens include titanitids, there are none which can be matched with any certainty with species of the *anguiformis* Zone to the south, and that they may include *Titanites* from the *kerberus* Zone. The basement beds of the Spilsby Sandstone certainly contain smaller *kerberus* Zone elements such as *Crendonites* and *Kerberites*.

## Palaeontological notes

Collections of ammonites made by the authors are to be deposited in the National Museum of Wales, Cardiff. These are prefaced by the letters NMW in the text below. Specimens in the musem of the Institute of Geological Sciences are prefaced by GSM and those of the British Museum (Natural History) by BM.

*Glaucolithites glaucolithus* Buckman

The holotype of this species was figured by Buckman in 1922 (pl. 306), but because of the poor figure, the species has been subject to repeated misinterpretation. Few people seem to have examined the wholly phragmoconic type specimen which, although defective on several counts, does show certain well-defined characteristics of the species.

Arkell believed many of the Portland Sand ammonites to be congeneric and placed virtually all of them into *Glaucolithites,* as that was the most senior name available for forms occurring in the Portland Sand. Included amongst the ammonites which Arkell and others erroneously placed with this genus were species of *Crendonites.* The result was that the generic name *Glaucolithites* came to be associated with any Portland Sand ammonite (other than *Progalbanites*).

In the belief that this previous misinterpretation of the species is based solely on the fact that neither the holotype nor any other adequate material of *G. glaucolithus* has ever been properly figured, we figure two larger specimens from the Chicksgrove Limestone and Tisbury Glauconitic Members of the Vale of Wardour (pl. 1). The well-defined characters of the genus and species—the typical pavloviid rib style of sharp biplicate ribs, the common simple ribs, the constrictions, and the round to sub-quadrate whorl-section—typify a readily recognisable Portlandian species of zonal value.

*Titanites giganteus* (Sowerby)

1818 *Ammonites giganteus* Sowerby, pp. 55–59, pl. 126.
1921 *Gigantites giganteus* (Sowerby) Buckman, pls. 256*a,b*.
1925 *Galbanites cretarius* Buckman, pl. 621.
1933 *Titanites giganteus* (Sowerby) Arkell, p. 481.

*Emended Diagnosis.* Large, to 600 mm or more, in diameter; evolute (umbilicus 47–52 per cent of diameter), whorl section rounded, whorl height 18–22 per cent, whorl thickness 23–28 per cent of diameter. Ribbing prorsiradiate throughout; inner whorls with biplicate ribs and some intercalatories. At umbilical diameter of 80 mm, approximately 21 ribs; at 110, 24; 140, 27–31; 170, 29–36; 200, 36–41; 230, 38–40. Outer whorl chiefly biplicate but with common simple ribs; about 60 primary ribs on outer whorl at maturity, ribs sometimes crowded. Body-chamber three-quarters to almost one whorl long at maturity.

*Material.* 7 specimens.

*Horizons.* Buckman's chorotype (GSM 32057) from 'Lime Bed' (Creamy Limestone), Barrel Hill, Long Crendon, Bucks.

GSM 47825 (*Galbanites cretarius* of Buckman) from Wockley Micritic Member, Chilmark, Wilts.

NMW 77. 30G. 3, Basal Shell Bed, Broadcroft Quarry, Portland (See Pl. 2).

NMW 77. 30G. 4 & 5, Basal Shell Bed, Chalbury, Preston, Dorset.

NMW 77. 30G. 6, Basal Shell Bed, cliff west of Southwell, Portland.

NMW 77. 30G, 7, Basal Shell Bed, Nicodemus Knob, Portland.

*Stratigraphical range.* *kerberus* Zone.

*Description and Remarks.* Sowerby based his species on several specimens from the Vale of Wardour and

FIG. 1. *Glaucolithites glaucolithus* Buckman. NMW 77.30G.1, ×0·3. Chicksgrove Limestone Member. Chicksgrove Quarry. Tisbury. Wilts.

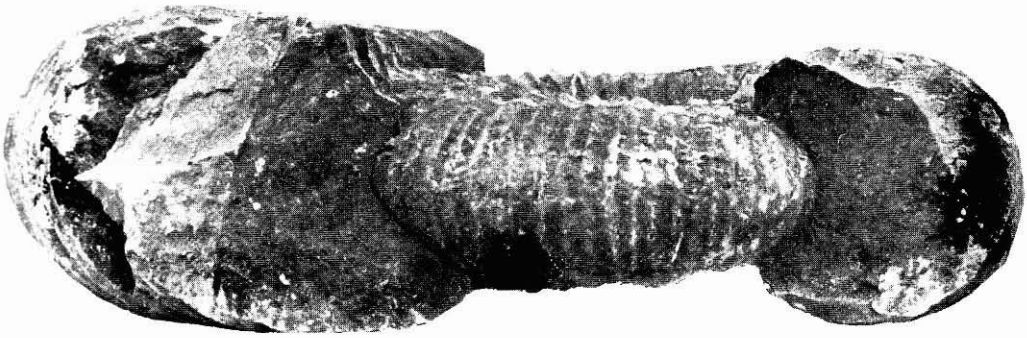

FIG. 2. *Glaucolithites glaucolithus* Buckman. NMW 77.30G.2, ×0·3. Tisbury Glauconite Member, Chicksgrove Quarry, Tisbury, Wilts.

PLATE 1.

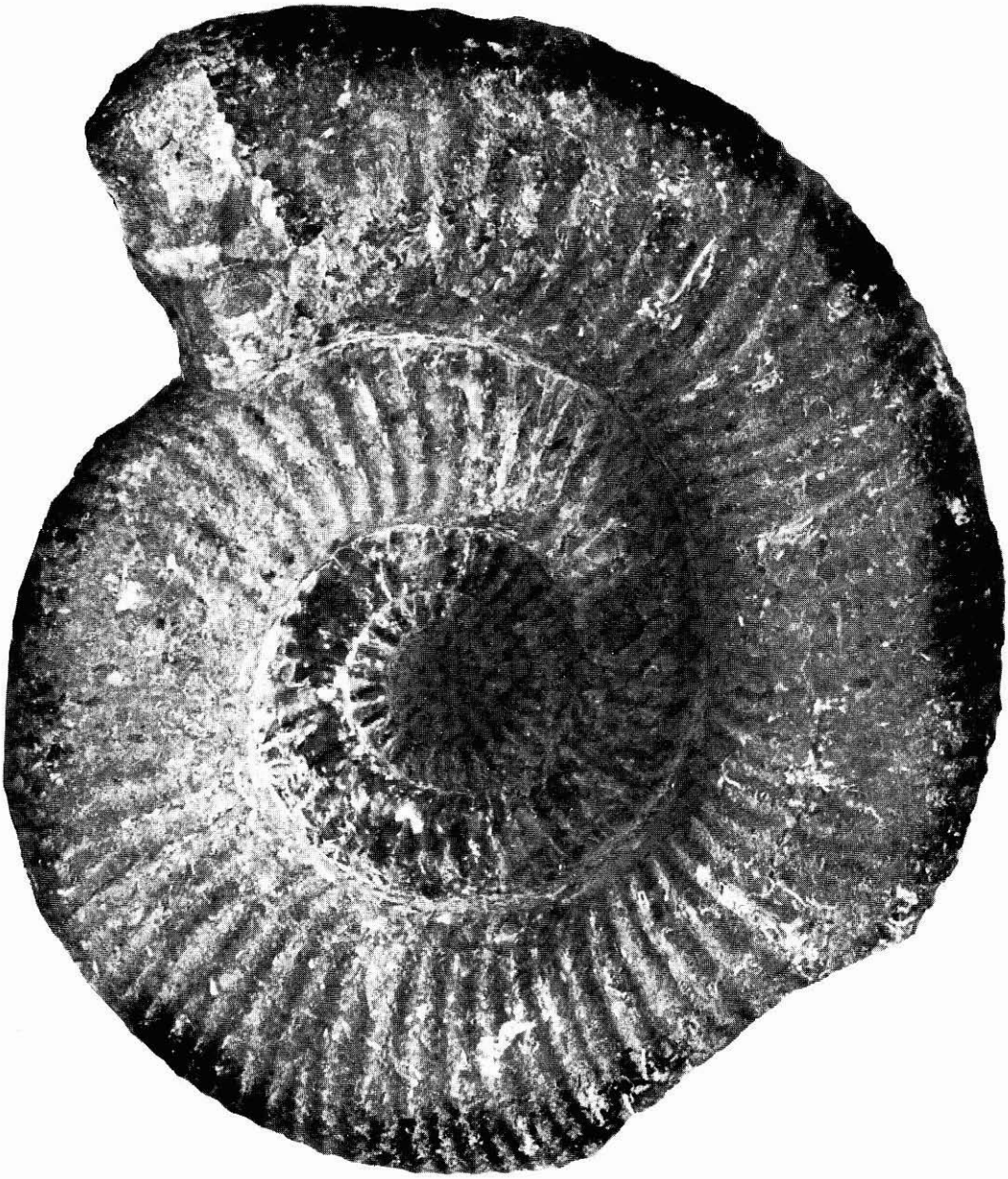

PLATE 2.
*Titanites giganteus* (Sowerby). NMW 77. 30G. 3, × 0·375. Basal Shell Bed, Portland Stone, Broadcroft Quarry, Portland.

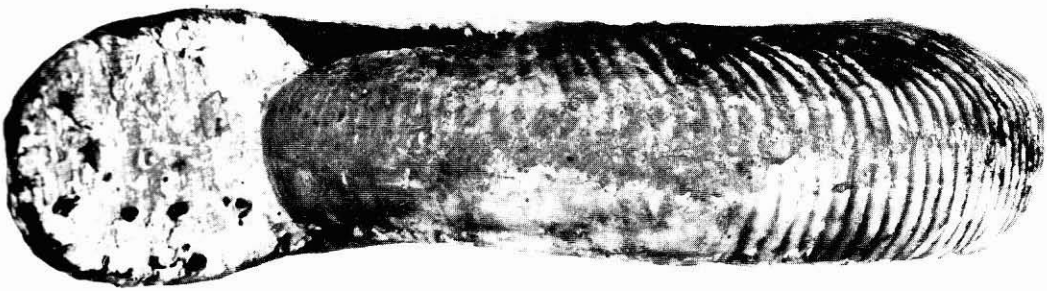

PLATE 3.
FIGS. 1, 2. *Titanites anguiformis* sp. nov. Holotype, BM C2956, ×0·21. Roach (top unit of Portland Freestone Member), Portland.

one from Dorset. His figure is, unfortunately, uninterpretable and only one of the syntypes is apparently now in existence. This surviving specimen consists of the internal part of a mineralised phragmocone and is completely devoid of any distinguishing character.

In an attempt to define the species more satisfactorily Buckman figured a specimen from the Creamy Limestones of Buckinghamshire (1921, pls. 256A, 256B). This specimen has a well-preserved outer whorl, but no detail of the inner whorls is visible, and the specimen is therefore not suitable for detailed comparative study. During examination of the collections from various localities, comprising Fauna 4 recognised in the present study, it became clear that amongst the species of *Titanites* was a species group with characters identical to those preserved on the defective specimen figured by Buckman.

We figure a specimen from Portland Isle (pl. 2) to which future workers may refer. It is not possible to designate this specimen as a neotype, since a syntype of Sowerby's still exists.

Specimens of this species reach a diameter of about 600 mm, are evolute (the umbilical diameter being around 50 per cent of the total diameter) and have a rounded whorl section. The ribbing is biplicate with common simple ribs occurring on the outer whorl, although the number of the latter is highly variable. The ribs on the outer whorl sometimes appear quite crowded and the ribs themselves are comparatively fine, with high rib densities in comparison to other *kerberus* Zone *Titanites* (see under 'Diagnosis' above). Most specimens have *c.* 60 ribs on the outer whorl.

Buckman's specimen of this species which he named *Galbanites cretarius* shows the typical middle whorl development of the species with very frequent simple ribs visible.

*Titanites anguiformis* sp. nov. (Plate 3)

*Diagnosis.* Very large, up to 900 mm diameter, evolute, round-whorled. Umbilical diameter 48–58 per cent, whorl height 19–26 per cent, and whorl thickness 21–30 per cent of total diameter. At umbilical diameter 120, 36 ribs; at 140, 34–44; 170, 38–49; 200, 40–56; 230, 43–56; 260, 44–63; 290, 47–62; 320, 50–65; 350, 52–71; 380, 53–74. Outer whorl with 70 to over 90 ribs, frequent simple ribs with tendency to fading of ribs on body-chamber. Growth lines frequently the only ornament towards aperture. Body-chamber 340–360°.

*Holotype.* BMC 2956.

*Material.* 14 specimens.

*Horizons.* Holotype from Roach, top of Portland Stone, Portland (probably from Kingbarrow Quarry complex).
BM C2927, C2928, C10810; GSM 74321, 85804 from Portland Freestone, unrecorded horizon, Portland Isle.
NMW 77. 30G. 8 & 9, 'Base Bed Roach', Portland Stone, Portland.
NMW 77. 30G. 10, *Titanites* Bed, Portland Stone, St. Aldhelm's Head, Purbeck.
NMW 77. 30G. 11 & 12, *Titanites* Bed, Portland Stone, Swanworth Quarry, Worth Matravers, Purbeck.
NMW 77. 30G. 13, 14 & 15, base of Shrimp Bed, Swanworth Quarry, Worth Matravers, Purbeck.
Other specimens seen *in situ* but not collected.

*Stratigraphical range.* *anguiformis* Zone.

*Description.* Very large evolute form with dense strong ribbing. The holotype is 665 mm in diameter, has a whorl height of 155 mm, whorl thickness of 170 mm and an umbilical diameter of 340 mm. It has 85 primary ribs on the last whorl, and an inner whorl rib density as follows: at 140 mm there are 38 ribs; 170, 44; 200, 49; 230, 54; 260, 58; 290, 61; 320, 65; 340, 68. The holotype shows predominantly bifurcate normal ribs to the brown-coloured plain peristome. Paratype C 2927, on the other hand, shows a marked fading of the ribs at maturity with well-developed growth lines.

*Remarks.* Since this species of *Titanites* is much more finely-ribbed than other species of the genus, it is readily recognisable in the field. Thus field identifications tend to be more reliable than with some other species or genera. Many specimens of the species have been seen *in situ*, but have proved impossible to extract.

## The terminal Jurassic stage

The authors support the continued usage of Portlandian as the name for the terminal Jurassic stage. The base of the Portlandian is well-defined in a continuous succession. Unlike the Volgian, a rival contender for acceptance as the international stage for the uppermost Jurassic, the type successions are based on thick sequences with no demonstrable break. The upper parts of the Portlandian succession described by Casey (1974) from East Anglia continue the story of marine deposition to the base of the Cretaceous, albeit with some apparent condensation.

There can be no doubt that the Portlandian rocks of Britain are thicker and more complete than the type Volgian. Casey (1967) demonstrated the incompleteness of major parts of the Volgian succession, and seriously questioned the suitability of the Volgian stage as a basis for international correlation. In this we support him.

It seems inevitable that for the time being, however, the usage of Tithonian for the uppermost Jurassic of the Tethyan realm is continued and that the two stage names Portlandian and Tithonian should exist alongside each other. Correlations between the Tethyan and

Boreal provinces remain a major problem in Upper Jurassic stratigraphy. The time when one stage name will serve as the international standard has yet to come.

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